Corporate Venture Capital Investment Lifecycle, Organization and Differences to Corporate Accelerator

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List of abbreviations

AI ..... Artificial intelligence
APM ..... Arbitrage pricing model
BA ..... Business angel
bn ..... Billion
CA ..... Corporate accelerator
CAPM ..... Capital asset pricing model
CEO ..... Chief executive officer
CF ..... Cash-flow
CFO ..... Chief financial officer
CI ..... Corporate incubator
CRE ..... Core from random endowments
CTO ..... Chief technology officer
CV ..... Corporate venturing
CVC ..... Corporate venture capital
DCF ..... Discounted cash-flow
DMP model ..... Diamond-Mortensen-Pissarides model
e.g. ..... exempli gratia
EBIT ..... Earnings before interest and taxes
EIS ..... Enterprise investment scheme
et al. ..... et alia/ et alii/ et aliae
FDA ..... Food and drug administration
GM ..... General Motors
GNI ..... Gross national income
GVC ..... Governmental venture capital
HTGF ..... High-Tech Gründerfonds
i.e. ..... id est
ICO ..... Initial coin offering
ICT ..... Information and communication technology
Inc. ..... Incorporated
IoT ..... Internet-of-Things
IP ..... Intellectual property
IPO ..... Initial public offering
IT ..... Information technology
IVC ..... Independent venture capital
JV ..... Joint venture
k ..... Thousands
LBO ..... Leverage buy-out
LOI ..... Letter of intent
M&A ..... Merger and acquisition
MBO ..... Management buy-out
mn ..... Million
MPT ..... Modern portfolio theory
Nbreg ..... Negative binomial regression
OECD ..... Organisation for Economic Co-operation and Development
OLS ..... Ordinary-least square
p ..... page
p.c. ..... per capita
PE ..... Private equity
PhD ..... Doctor of philosophy

pp ..... pages
PRT ..... Property-rights theory
PSM ..... Propensity score matching
QR code ..... Quick response code
R&D ..... Research and development
RFS ..... Risk-factor summation method
ROI ..... Return on investment
RSD ..... Random serial dictatorship
SEIS ..... Seed enterprise investment scheme
TTC ..... Top trading cycle
TTCC ..... Top trading cycles and chains
UK ..... United Kingdom
US ..... United States of America
VC ..... Venture capital
VIF ..... Variance inflation factor
vs. ..... versus
WACC ..... Weighted average cost of capital
YRMH-IGYT ..... You request my house – I get your turn

I. Introduction

"If I have seen further than others, it is by standing upon the shoulders of giants." Isaac Newton, 1675

In the current fast-paced world with constant change and far reaching trends – such as digitization, shifting economic powers, sustainability and the aim for personal fulfillment – entrepreneurship and the founding of small innovative start-ups is gaining increased attention. Currently, new enterprise creations are above pre-financial crisis levels in most countries (OECD, 2017), resulting in more than 300mn start-ups globally (InnMind, 2016)[1]. These start-ups face some unique challenges regarding the availability of funding, resources, capabilities and networks. Moreover, the accelerated pace of change and requirements for constant innovation threaten corporations, as can be seen from the significant reduction in average lifespan of a company in the S&P 500 index. In 1958, the average tenure was 61 years, which was reduced to only 18 years in 2010 and is forecasted to stay below 20 years (Foster, 2012). To stay ahead of competition, corporations need to find new ways of stimulating innovation, for example through opening up to external sources and players.

As hinted at by Sir Isaac Newton, start-ups might benefit from collaborating with corporate giants and corporations might benefit from start-up's innovativeness. Over time, different forms of corporate start-up engagement evolved. One specific broadly accepted and widely spread form is corporate venture capital (CVC). In 2018, 773 CVC funds were active globally, with the number of new CVCs increasing by a compound annual growth rate of over 30% since 2013 to 264 newly set up CVCs in 2018 (CBInsights, 2019). The global CVC

[1] More recent reliable numbers are not available on a global scale; however, it is reasonable to assume that the number further increased substantially

deal volume increased in a similar extent, leading to 53bn$ investment volume and 2,740 deals globally (CBInsights, 2019).

CVC is not only of interest for practitioners, but also has a remarkable track record in academia, with several landmark contributions. As one of the first scholars, Hardymon, DeNino and Salter (1983) published a practical discussion about CVC in the Harvard Business Review, whereas Sykes (1986) conducted one of the first case studies with Exxon, finding that different intrinsic and extrinsic factors influence the success of a CVC investment. Subsequently, Siegel, Siegel and MacMillan published an influential questionnaire-based study on CVC performance and elaborated "which approach to corporate venture capital is most likely to produce successful results" (1988, p. 233). Gompers and Lerner (1998) published one of the first and most cited empirical studies on CVC success, including a definition of CVC that is still widely used today. Other important steps in CVC literature are the separation in a financial and strategic perspective (Chesbrough, 2002) along with a discussion of the downsides of CVC investments (especially Katila, Rosenberger, & Eisenhardt, 2008). One of the most distinguished scholars in CVC research, Gary Dushnitsky, heavily contributed to CVC research through studies on innovative outputs, influencing factors of personnel, an embedding of CVC in a broader corporate strategy or a differentiation with other investment practices (Drover et al., 2017; Dushnitsky, 2011, 2012; Dushnitsky & Lavie, 2010; Dushnitsky & Lenox, 2005, 2006; Dushnitsky & Shapira, 2010; Dushnitsky & Shaver, 2009).

Building on this existing literature, the aim of this thesis is to further extend the understanding of CVC in general and the organizational dimension and its performance implications, along with a distinction to corporate accelerator (CA). Readers will not only

get an introduction to how CVC investments work, but obtain empirical insights based on a novel hand-collected dataset. It will become clear what should be performance enhancing theoretically and what actually is performance enhancing empirically. Thereby, this work strives to not only be beneficial for researchers gaining an understanding of CVC, the current stage of literature and avenues for future research, but also to be helpful for corporate and start-up practitioners that cope with CVC investments or set up CVC funds.

Being aware that CVC is not a novel phenomenon and that a large array of literature already exists, the research topic of this dissertation is identified through a structured comparison of overarching economic theories and their applications in the CVC context, amended by existing requests for future research from well-established researchers. As a result, multiple research gaps are identified of which three are elaborated on in more detail.

First, and due to the nature of peer-reviewed journal articles, the majority of work on CVC focuses on specific topics and analyzes respective research questions on a detailed level. Therefore, there is a gap in literature regarding a broader and more comprehensive understanding of CVC investments, a connection between the different streams and a challenging of existing economic wisdom. For example, neither scholars nor practitioners will understand the contracting and collaboration between corporations or CVCs on the one hand and start-ups on the other without understanding principal-agent theory or the effect of equity ownership on control rights. This thesis aims at better explaining CVC through taking into consideration all stages of a CVC investment lifecycle.

The second research gap refers to the underdeveloped literature on the organization of CVC. Literature finds that a CVC is a mediator between a corporation and a start-up (Dushnitsky & Lenox, 2006; Ernst, Witt, & Brachtendorf, 2005), however, the question of

how exactly a CVC should be designed to satisfactorily fulfill this role and balance the needs of all involved parties remains open and requires more research (e.g. Anokhin, Wincent, & Oghazi, 2016; Asel, Park, & Velamuri, 2015; Drover et al., 2017). Therefore, this work asks what strategic direction and organizational design of a CVC supports a start-up's performance.

When dealing with CVC literature, it occurs that several papers compare CVC to similar forms of start-up support or corporate venturing, like independent venture capital (IVC), governmental venture capital (GVC), business angels, alliances or joint ventures (e.g. Bengtsson & Wang, 2010; Bjørgum & Sørheim, 2015; Colombo & Murtinu, 2017; Pahnke, Katila, & Eisenhardt, 2015; Schildt, Maula, & Keil, 2005; Van De Vrande, Vanhaverbeke, & Duysters, 2011). However, no such differentiation and empirical comparison exists for the most recent form of corporate start-up support, namely corporate accelerator, but is requested by scholars (Colombo, Rossi-Lamastra, & Wright, 2018; Drover et al., 2017). Therefore, the third research question refers to differences between CVC and CA and an empirical comparison of the two forms including their start-ups under management.

Through elaborating on these three research questions, this thesis modestly contributes to entrepreneurship, strategic management and innovation literature. The understanding of CVC investments is increased through covering all major topics along the investment lifecycle in more detail and by comparing existing economic theories with their application in the CVC context. Thereby, this work allows readers to better understand the underlying rationale, mechanisms and tensions that heavily influence collaborations between corporations and start-ups and helps to increase awareness that CVC investments are a manifold and complex endeavor. The empirical work creates insights on the organization,

set-up and staffing of a CVC, the balancing of the benefits and risks of such investments and effects on start-up performance. In addition, it increases the understanding of different forms of corporate venturing through differentiating performance effects of CVC with those of CA. Therefore, this work is one of the first studies to present empirical evidence on the new phenomenon of CA. Being based on a novel hand-collected dataset from Germany, this thesis contributes to literature through offering insights on a country with previously underdeveloped CVC literature.

In order to achieve the objectives of this dissertation, the work is structured as follows:

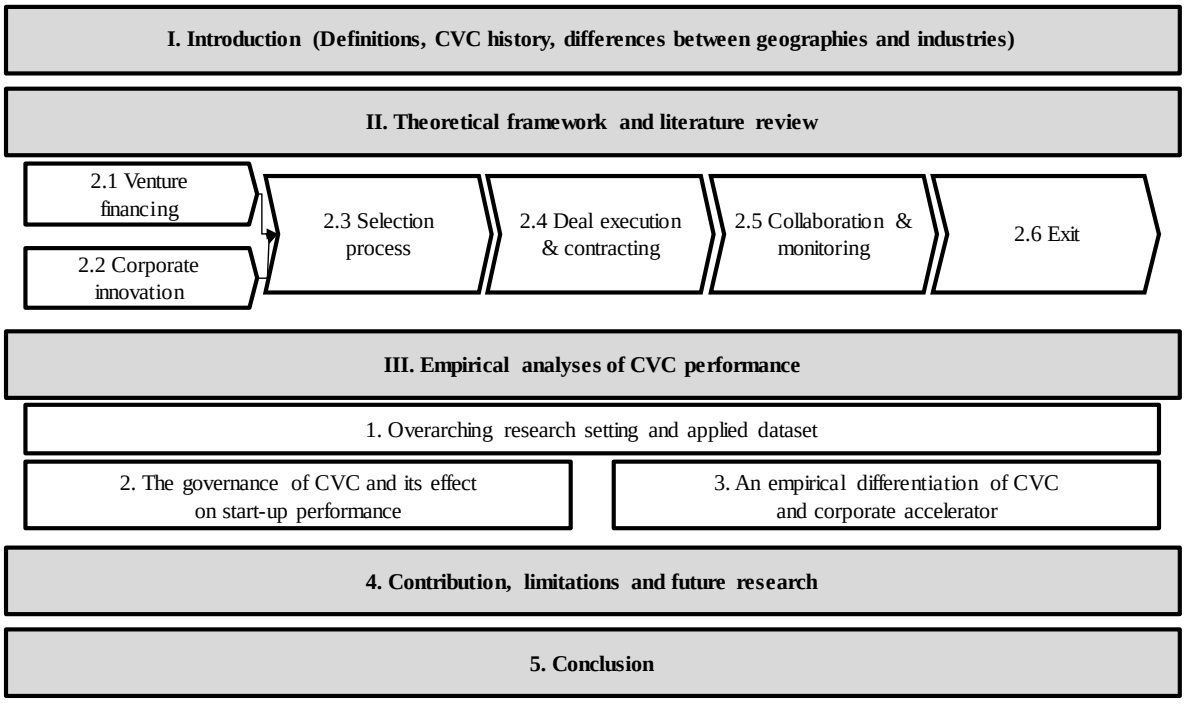

Figure 1: Structure of the dissertation (author's approach)

First, a general introduction to CVC – including key definitions, CVC history as well as differences between geographies and industries – initiates this work. Chapter II describes the theoretical framework and serves as general literature review. Taking a lifecycle

perspective, different steps of a CVC-start-up collaboration are reviewed. In this section, all sub-chapters follow the same structure as they first elaborate on respective economic theories and subsequently review the application of those theories in a CVC context. Chapter III entails multiple empirical analyses on the performance of CVC investments including specific existing literature. First, the underlying dataset is described and subsequently used variables are explained. In section III.2 empirical evidence on the effect of a CVC's strategic direction and organizational design on start-up performance is presented. Next, CVC is differentiated with the more recent phenomenon of CA in section III.3. Chapter IV summarizes the contribution of this dissertation, reflects on its limitations and derives future research needs. Finally, the last chapter concludes the entire work.

I.1 Definitions

Corporate venture capital (CVC) is a form of open innovation (Anokhin, Peck, & Wincent, 2016) and, as a subset of corporate venturing (CV), part of the large field of (corporate) entrepreneurship (Röhm, 2018). Moreover, CVC is a special manifestation of venture capital (VC). Although a handful of definitions for CVC exists, most scholars follow Gompers and Lerner (1998) that refer to CVC as minority equity investments by established firms in private entrepreneurial ventures (e.g. Benson & Ziedonis, 2009; Dushnitsky, 2012; Dushnitsky & Lenox, 2005, 2006; Dushnitsky & Shapira, 2010; Pahnke et al., 2015; H. D. Park & Steensma, 2012; J. H. Park & Bae, 2018; S. W. Smith & Shah, 2013; Souitaris & Zerbinati, 2014; Wadhwa & Kotha, 2006; Wadhwa, Phelps, & Kotha, 2016; Yang, Narayanan, & De Carolis, 2014). Other scholars amend this definition, for example through highlighting that CVC is an "external endeavor" (Alvarez-Garrido & Dushnitsky, 2016, p. 819) or that a CVC is owned by a "non-financial company" (Colombo & Murtinu, 2017, p.

38). However, the basic definition of Gompers and Lerner (1998) is universally accepted, such that newer publications even omit to specifically define CVC (e.g. Anokhin, Wincent, et al., 2016; Belderbos, Jacob, & Lokshin, 2018). Going forward, this work will apply the broadly accepted definition rooted in Gompers and Lerner (1998). Despite a universal definition, different structures and governance modes of CVC units are possible (Schildt et al., 2005). For example, Souitaris, Zerbinati and Liu (2012), split CVCs in external and internal units with external CVCs being more oriented towards the industry-side, whereas internal CVCs are more focused towards the corporate parent, while Soutaris and Zerbinati (2014) differentiate between integrated and arm's length investments.

A CVC investment occurs in a triad between a corporation, a CVC unit and a start-up (Dushnitsky and Lenox, 2006; Röhm, 2018), where the CVC unit acts as intermediary between the other two (Ernst et al., 2005). Some scholars stress specific characteristics of start-ups under CVC management, stating that start-ups are "legally independent of the investor" (Allen & Hevert, 2007, p. 264), "early-stage start-up companies" (S. U. Lee & Kang, 2015, p. 350), "young firms" (Pahnke et al., 2015, p. 596), "innovative ventures" (Alvarez-Garrido & Dushnitsky, 2016, p. 821), "high technology small ventures" (Röhm, 2018, p. 2) or "relatively new, not-publicly-traded companies that are seeking capital to continue operation" (Dushnitsky & Lenox, 2006, p. 615; Gompers & Lerner, 1998). Often, however, start-ups are not specifically defined in CVC literature (e.g. Allen & Hevert, 2007; Alvarez-Garrido & Dushnitsky, 2016; Belderbos et al., 2018; Benson & Ziedonis, 2009; Keil, Maula, Schildt, & Zahra, 2008; S. M. Lee, Kim, & Jang, 2015; S. U. Lee & Kang, 2015; H. D. Park & Steensma, 2012; S. W. Smith & Shah, 2013). Start-ups under CVC-management

can be diverse, including small teams in young ventures, but also even unicorns[2]. Generally, start-ups lack resources but have "promising ideas, organizational agility, the willingness to take risk, and aspirations of rapid growth" (Weiblen & Chesbrough, 2015, p. 67) and are therefore also referred to as "entrepreneurial enterprise" (e.g. Audretsch & Link, 2012) or "ventures" (e.g. Tirole, 2005). Literature offers multiple definitions of an entrepreneur, making one all-embracing definition of entrepreneurship challenging (Audretsch & Link, 2012; Hebert & Link, 2009). However, new combinations (Schumpeter, 1934) and innovative change (Audretsch, 2003; Schumpeter, 1943) are key aspects. Practitioners also define start-ups differently. For example, Steve Blank, a Silicon Valley based entrepreneur and Stanford adjunct professor of entrepreneurship, defines a start-up as "a temporary organization used to search for a repeatable and scalable business model", whereas Eric Ries, an American entrepreneur and author, describes a start-up as "a human institution designed to deliver a new product or service under conditions of extreme uncertainty" (Sanwal, 2015, p. 8). As a final definition of start-ups is challenging, start-ups are in the CVC context often defined as portfolio firms of a CVC (e.g. Colombo & Murtinu, 2017; Ernst et al., 2005; Yang et al., 2014). Going forward, this thesis will use the terms 'start-up', 'entrepreneurial enterprise' or 'venture' to refer to CVC portfolio companies or companies with the potential to be a portfolio firm[3].

[2] Unicorns are start-ups with a valuation of above $1bn, intriguingly 51% of all US-based unicorns are CVC-backed (Sanwal, 2015)

[3] For example, a firm that has the opportunity to be under CVC-management but fails to succeed in a due-diligence will also be termed start-up

I.2 History of CVC

The following section summarizes the historical development of CVC[4]. Although CVC investments became broadly observable from the 1960s onwards (Chesbrough, 2000; Dushnitsky, 2011) when also the term 'Corporate Venture Capital' was phrased (Bielesch, Brigl, Khanna, Roos, & Schmieg, 2012), the 1914 investment of DuPont in the six year old automotive start-up General Motors (GM) is considered the first CVC investment ever. DuPont regarded GM a promising investment and expected to increase its own sales, especially from artificial leather products and painting (CBInsights, 2017c). The investment proved successful financially and strategically, increasing its value seven times during World War I. Other companies that adopted CVC early on were Alcoa and 3M (CBInsights, 2017c).

Historically, four waves of CVC investments are observed, namely from 1960 to 1977, from 1978 to 1994, from 1995 to 2001 and since 2002 (Bielesch et al., 2012; CBInsights, 2017c; Chesbrough, 2000; Dushnitsky, 2011). Although the waves differ with regards to motivation, objectives[5], strategic direction and lifetime[6] of CVC funds, they are all driven by technological enhancements and economic developments. Moreover, the CVC market is lagging behind the VC market. Reduction in CVC investments occur due to exogeneous shocks, like stock market crashes or reduction of IPOs (Gompers & Lerner, 2000).

The first wave of CVC was initiated after the US recession in 1960, when large corporations invested in start-ups in order to diversify without fearing antitrust litigations.

[4] For a more extensive and practical discussion of CVC history, see CBInsights (2017c), which served as primary source for this section
[5] Whereas 83% of CVCs pursued only strategic goals in 1996, only 42% did so beginning of this century (Weber & Weber, 2002)
[6] Over the years, the lifetime of CVC increased from around 2.5 to more than 4 years (Dushnitsky, 2011)

The high availability of cash and success stories from VCs investing in early tech start-ups further accelerated the market development. During that time, Exxon had one of the largest and most prestigious CVC programs[7]. As CVCs were mainly active in the US, the introduction of a capital gains tax and the stock market crash in 1973 impeded CVC investments, ending the first wave of CVC in 1977 (CBInsights, 2017c).

The second wave from 1978 to 1994 is often referred to as 'Silicon Valley wave' as it was fueled by the emergence of personal computers out of the Silicon Valley (CBInsights, 2017c). Entrepreneurship gained publicity through media coverage, research interest and study programs. This development pressured corporations to also engage in entrepreneurial investments. During that time, up to 40% of all VC investments involved corporate investors, often through indirect investments in VC funds (CBInsights, 2017c). Although corporations learned from the first wave and invested more strategically, their focus was on their own goals, often failing to take start-up objectives in consideration. Therefore, several collaborations did not yield the expected results. During the second wave, the internationalization of CVC started, especially in countries like Japan (CBInsights, 2017c). Again, the wave came to an end due to exogeneous market shocks, initiated by the stock market crash in 1987.

The third wave is often described as the most irrational wave, fueled by the Dotcom bubble (CBInsights, 2017c). As the initial public offering (IPO) of Netscape Communications in 1995 yielded immense returns in the first few days, companies felt an urge to participate in the booming internet market. US CVCs started investing in non-US start-ups making CVC more international. In addition, CVCs focused on strategic objectives,

[7] Nonetheless, the Exxon CVC fund ceased existence in 1984 with an accumulated 2bn$ losses (CBInsights, 2017c)

using investments in start-ups as second source of innovation besides in-house R&D departments and aiming at detecting start-ups that are adjacent to their core business. Thereby, the quality of CVC investments increased, making corporations attractive syndicate partners for other VCs. After the Dotcom bubble burst, large write-downs of CVC investments occurred, e.g. 5.7bn$ for Microsoft in 2001 (CBInsights, 2017c).

Although the fourth wave started in 2002, the uptick in CVC investments only occurred from 2011 and especially from 2014 onwards. By that time, the VC market fully recovered from the crash in 2000 and digital and mobile solutions started swamping every industry. A key turning point happened in 2009 when the CVC market was growing although the overall economy was on a decline. According to Radcliffe and Lehot (2018), this signals the increased strategic importance of corporate venturing. Moreover, low interest rates and high cash availability after the financial crisis supported the CVC market development (CBInsights, 2017c). The current wave differs from the third wave, regarding the maturity of investors and start-up ideas. According to Lorenz Hartung, previous CEO of TechFounders, both the technologies and business models of start-ups are nowadays more professional than those of Dotcom start-ups and the entrepreneurial ecosystem is more developed (VentureCapital Magazin, 2017). Michael Brandkamp, managing director of the German High-Tech Gründerfonds adds that the Dotcom era was fueled by expectations, whereas the current digitization is based on tangible and feasible business models (VentureCapital Magazin, 2017). Moreover, CVC investments are driven by the need for external innovation, globalization and digital technologies with cross-industry impact, like data analytics (Bielesch et al., 2012).

Three observations can be made from the long history of CVC investments. First, neither corporations nor start-ups would engage in CVC investments for decades for only altruistic reasons, i.e. if no value would result out of the collaboration. Second, the long history of CVC investments gave all involved parties enough time to sharpen these collaborations such that they should be performance enhancing nowadays. Third, when talking about the history of corporate venturing and venture capital investments, the US is the leading market (Christofidis & Debande, 2001).

History of CVC research

As expected, the scientific literature is lagging behind the CVC investment waves. In a literature review, Röhm (2018) detects that most CVC studies were published from 2006 onwards:

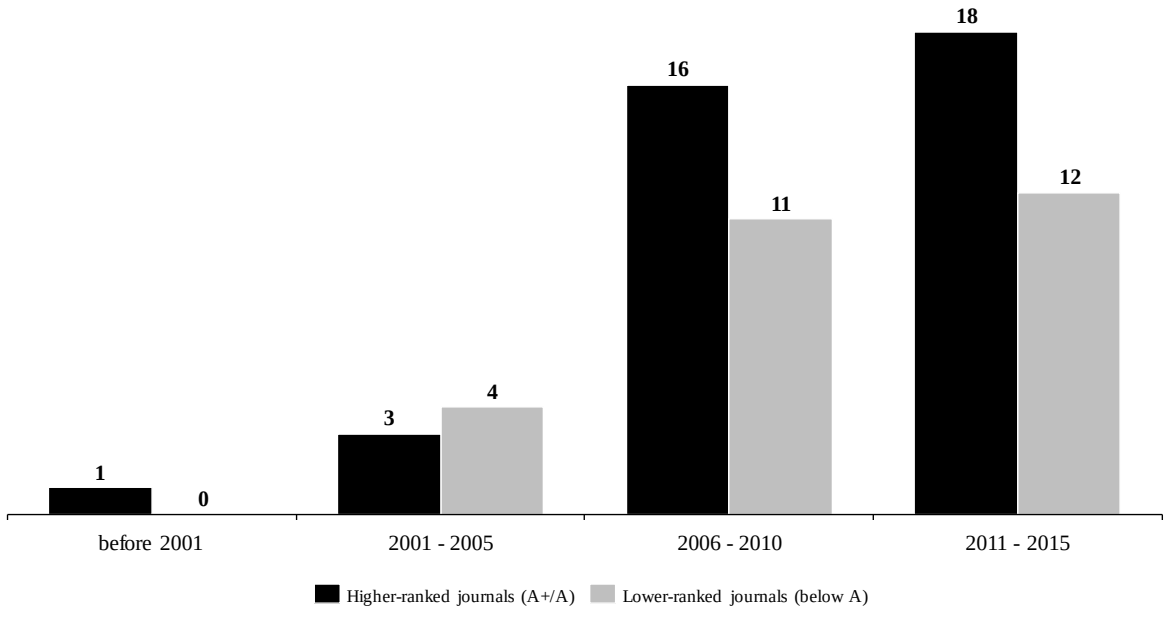

Figure 2: Development of CVC-related articles in higher- and lower-ranked journals (Röhm, 2018)

According to his literature review, the oldest CVC study is Gupta and Sapienza (1992). Early work on CVC was, however, non-empirical and published in e.g. the Harvard

Business Review (Hardymon et al., 1983) or based on questionnaires to describe the phenomenon of CVC better (Siegel et al., 1988). The first empirical paper on CVC is from Gompers and Lerner (1998). In accordance with the finding of Röhm (2018), CVC research accelerated from mid-2000 onwards, when the influential papers of Dushnitsky and Lenox (2005, 2006) were published. Since then, a steady number of CVC-related articles is published ongoingly.

I.3 Differences between geographies and industries

Differences in the frequency of CVC funds, the number of deals and the size of investments between geographies and industries exist. On a geographic level, CVC activity differs by continent, country, region within a country or even cities. Globally, countries in Africa, Middle East and Russia see low growth rates for CVC, whereas the North American and European as well as Chinese and Indian market grow considerably (Radcliffe & Lehot, 2018). Therefore, global CVC spend share shifts more and more to Asia from 19% in 2013 to almost 40% in 2018:

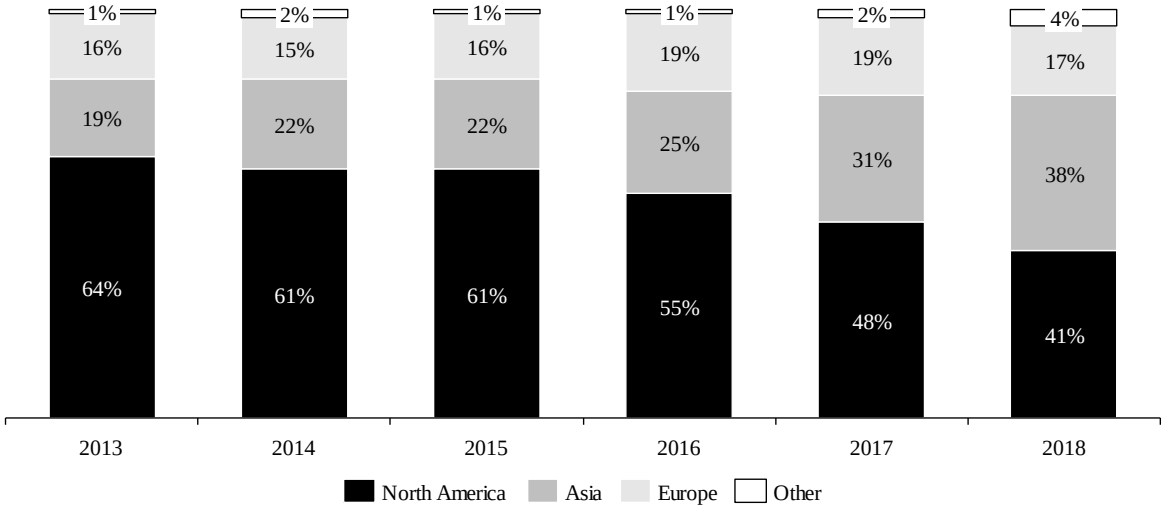

Figure 3: Annual global CVC deal share (CBInsights, 2019)

For the first time ever, the Asian deal share was larger than the US share in Q3 2018 (PwC & CBInsights, 2019). Nonetheless, the US is still seen as the leading CVC market. As an example, the US market can be divided in four regions where VC activity is large, namely the Bay area (including San Francisco and the Silicon Valley), the New York area, New England (especially Boston) and the Midwest (PwC & CBInsights, 2019). Differences are based on the occurrence of start-ups, as well as the availability of ecosystems[8] and investors (Bengtsson & Ravid, 2009). Although start-ups concentrate in cities like San Francisco, Tel Aviv or Berlin[9], CVCs are mostly based at the location of the corporate headquarters.

Industries and sectors also differ with regards to the usage of CVC. The following Figure 4 shows the share of CVC investments by US industry sector:

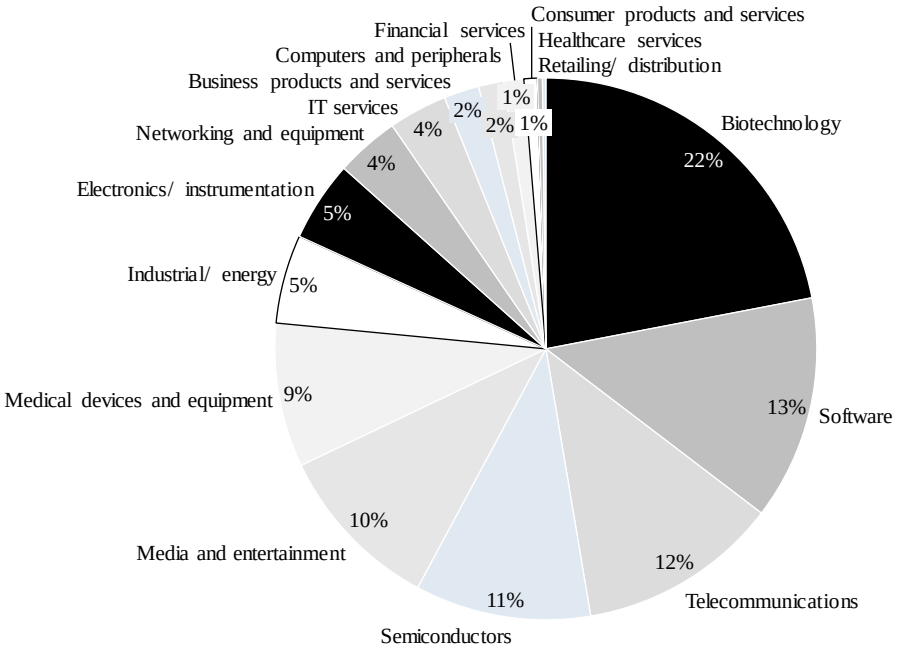

Figure 4: CVC investment received by US industry sector in 2006 (MacMillan, Roberts, Livada, & Wang, 2008)

[8]See Colombo, Dagnino, Lehmann and Salmador (2019) and Audretsch, Cunningham, Kuratko, Lehmann and Menter (2019) for a discussion of entrepreneurial ecosystems

[9]Cities with a high concentration of start-ups and respective ecosystems are often referred to as 'start-up hubs'

The investments of CVCs in start-up industries shift over time, focusing on fast-paced high-technology environments. Starting from the 1980s, the focus shifted from energy companies to computer hardware to software to internet companies (Zider, 1998). More recently especially mobile, internet, AI, digital healthcare and cybersecurity investments are prevalent (CBInsights, 2019). Bertoni, Colombo, Quas and Tenca (2019) find that CVC investments are well balanced around industries, although a tendency towards software investments and a hesitation to invest in R&D, manufacturing and engineering can be detected.

Similar to the investment amount received, the availability of CVC funds differs by industry, as exemplary shown for the German market:

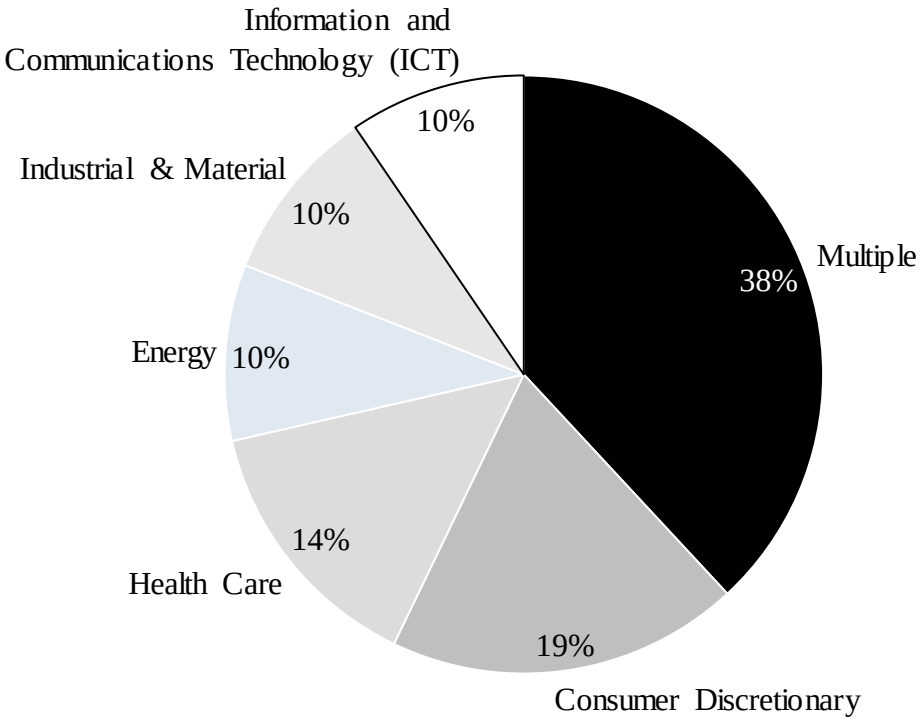

Figure 5: Split of German CVC units by industry (author's dataset)

Traditional industries, like automotive, engage less in CVC, whereas tech and highly innovative companies, for example in health care, more frequently use corporate venturing (Alvarez-Garrido & Dushnitsky, 2016; Flamand & Frigant, 2017). Several industry-specifics, like the structure, competitiveness, innovation need or regulatory environment offer explanations for such differences. Market competition, market information and industry collaboration play a role in make-or-buy decisions (He & Nickerson, 2006) and thereby a corporation's decision to either focus on internal innovation (e.g. from R&D departments) or to open up to external sources (e.g. start-up engagement). Such open innovation is found to be more impactful in consumer-oriented industries, like sporting equipment (Shah, 2000) or banking (van der Boor, Oliveira, & Veloso, 2014). Moreover, not all industries are suitable for start-ups. For example, industries with a high capital intensity are difficult for start-ups to enter. In addition, start-ups in some industries benefit more from corporate support than start-ups in other industries. In biotech, for example, start-ups benefit from corporate experience regarding Food and drug administration (FDA) approvals and patent applications (Alvarez-Garrido & Dushnitsky, 2016).

More recently, topics like data analytics, artificial intelligence or other digital solutions impact every industry, thereby leveling out the historically observed industry differences to some degree.

Application of geography and industry differences in (empirical) research

In research, especially in empirical studies, different ways of coping with geographic and industry differences emerge. Either datasets cover selected geographies or industries only, or differences are controlled for in empirical models. Some of the studies only focus on single countries, like the US (Alvarez-Garrido & Dushnitsky, 2016; Chemmanur, Loutskina,

& Tian, 2014), Germany (e.g. Ernst et al., 2005; Weber & Weber, 2002) or Taiwan (S. J. Lin & Lee, 2011). Most studies use US data as the CVC activity is frequent enough to build a sufficiently large dataset (J. S. Harrison & Fitza, 2014). In contrast, most of the European market is poorly covered in major VC databases (Colombo & Murtinu, 2017). Several studies use cross-country datasets and control for geography in empirical model (Belderbos et al., 2018).

Similarly, several researchers focus on specific industries only. Wadwha and Kotha (2006) review knowledge creation through CVC and venture involvement by using alliances formed and board seats taken as their independent variables for the telecommunication equipment manufacturing industry. More industry-specific research exists for biotech (Alvarez-Garrido & Dushnitsky, 2016), automotive (Flamand & Frigant, 2017), telecommunication equipment manufacturers (Wadhwa et al., 2016), medical devices (Howard, Pahnke, & Garg, 2017; Pahnke et al., 2015), semiconductors (e.g. Corredoira & Di Lorenzo, 2016) or software companies (Dushnitsky & Lavie, 2010). Moreover, case studies of individual companies, like banks exist (Maxin, 2018). Studies that use cross-industry datasets and control for industry effects include, for example, Anokhin et al. (2016) or Sahaym, Steensma and Barden (2010). Based on these observations, the empirical work of this dissertation is based on a German dataset

II. Theoretical framework and literature review for CVC

II.1 Introduction

After a general introduction to CVC, the following part discusses how overarching economic theories are applied within the context of CVC investments. Well-known theories are compared to CVC-specific literature and applications. Thereby, this work contributes to a better understanding of CVC and identifies research white spots. In essence, one needs to understand what a CVC is, why it functions the way it does, what advantages and drawbacks it has as a financing and innovation vehicle and how the collaboration with start-ups is initiated, executed and terminated. Therefore, this section covers the whole lifecycle of a CVC investment from initial considerations for entering such a relationship, to the exit from such a collaboration[10]. By applying a lifecycle perspective, it is ensured that (i) the individual perspective of the entrepreneurial enterprise, (ii) the individual objectives of the corporation and (iii) the combination of the two are considered. Using a lifecycle perspective also helps scholars to challenge their own work and identify areas for improvement and further research.

Other authors use a similar structure, especially for the discussion of VC funds (Bygrave & Timmons, 1992; Isaksson, 2006)[11] finding its origin in Tirole's (2005) extensive work about the theory of corporate finance[12]. His work is used for multiple reasons. First, it

[10] To the author's best knowledge, no detailed discussion of CVC along the investment lifecycle exists yet
[11] Although the focus lies on the specifics of corporate VCs, this work will – from time to time – swing out to independent VCs, as similarities and overlaps between the two exist and as a larger range of literature is available on VCs
[12] Tirole's (2005) work serves as basis for the theoretical understanding and is recommended as primary source for further deep-dives on most of the following theoretical discussions

provides a good overview of the existing theory, paired with a review of empirical literature. Second, the theory is not oversimplified, but represents the inherent complexity adequately.

The following figure illustrates the different steps of the CVC investment lifecycle perspective:

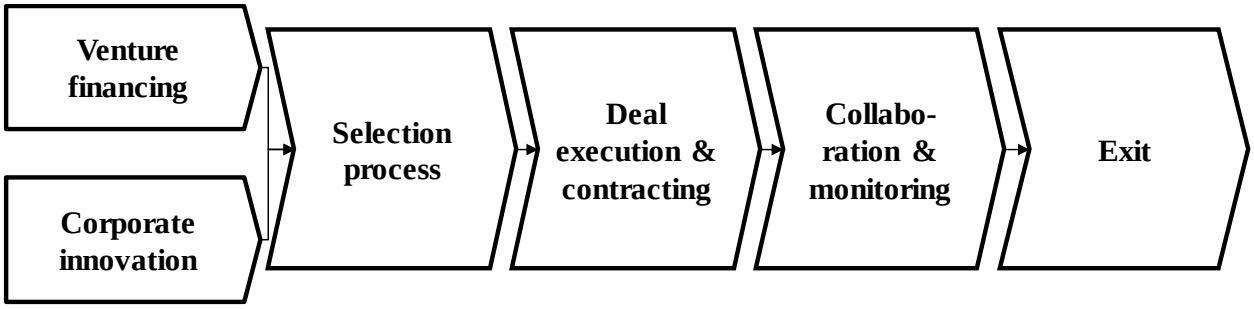

Figure 6: CVC-venture lifecycle perspective (derived from Tirole, 2005)

First, a venture needs to decide on its preferred financing, for example debt vs. equity or different equity investors. Similarly, a corporation has to determine its innovation sources, being both internally and externally. Once both parties consider CVC as source of financing and innovation, a mutual selection process occurs, resulting in a matching. Next, the deal is executed, contracts signed and money transferred. The collaboration and monitoring phase has the longest duration, where both parties work together. Finally, at some point the relationship comes to a formal end and the venture exits the collaboration, e.g. through an initial public offering (IPO).

Key assumptions

Several key assumptions, especially regarding (i) information asymmetry, (ii) adverse selection and (iii) moral hazard are broadly used in economics and are fundamental in the CVC context.

'Information asymmetry' describes a situation where two players have different information about a topic (Leland & Pyle, 1977). Originally, it was derived from agency theory, more precisely the separation of control over and management of a firm and proves to hold empirically (Eisenhardt, 1989). It is assumed that both the investor in and the initial owner of a start-up, in many cases the founder[13], have imperfect information. This assumption is reasonable in both directions. Potential investors might know the market, competitors or regulatory hurdles much better. The founder of a start-up knows about the capabilities of the firm and the skills of the team and she is informed about the real stage of a development. Consequently, both parties have different information about a potential future success of the start-up (Holmström, 1989). Moreover, information asymmetry exists among investors. A strategic investor that operates in a given market for multiple years will have a better view on future industry trends that a financial investor without any market intelligence. This assumption comes especially into effect when comparing CVC to other forms of start-up funding (see e.g. Benson & Ziedonis, 2009; Gompers & Lerner, 1998; Hamm, Jung, & Min, 2018). In the course of this work, several occasions of information asymmetry will become obvious and ways and tools to manage it are discussed.

[13] To reduce misunderstandings, the incumbent owner pre-CVC investment is referred to as the 'founder', although other pre-CVC investment owners might also exist in reality

The asymmetry in information available to different parties leads to ‘adverse selection’. The term describes a situation where one party is afraid of having inferior information to another party and consequently decides to change its behavior (Akerlof, 1970; Holmström, 1989), which might also result in changes in the behavior of the second party. Adverse selection is prominently described in a seminal paper by Akerlof (1970) where he discusses the impact of asymmetric information about the quality of used cars in the second-hand market and concludes that the market will end up consisting only of ‘lemons’, i.e. cars with inferior quality. In severe cases, adverse selection might lead to cross-subsidization (Tirole, 2005, p. 237) or even complete market failure (Akerlof, 1970). The phenomenon is observable in many markets, e.g. insurances (where the term originally stems from), all-you-can-eat restaurants, financial markets or entrepreneurial ventures. Following Amit et al. (1998), Drover et al. (2017) and Wright and Robbie (1996), this thesis assumes that adverse selection will be present, e.g. if “the form of finance offered by an investor attracts the worst possible type of firm for that form of finance” (Akerlof, 1970; Cumming, 2006, p. 157).

Moreover, the asymmetry in information will lead to a second phenomenon, called ‘moral hazard’ (Hart & Holmström, 1986; Holmström, 1979). The term describes a situation where an action taken by or information available to one party is hidden from the other party (Tirole, 2005, p. 15). The action is performed or the information available after some transaction occurs, e.g. a contract is signed. Moral hazard often has a negative connotation, e.g. when referring to circumstances in which one party takes a risk or misbehaves at the disadvantage of another party, like tax payers (Krugman, 2009, p. 64). Moral hazard can appear in multiple forms, e.g. in the context of risk management, incentivization, monitoring or advising. In several cases, a so-called ‘double-sided moral hazard’ can be detected (Bhattacharyya & Lafontaine, 1995; R. Cooper & Ross, 1985; Coricelli & Luini, 1999; Lal,

1990; Reid, 1977; Romano, 1994). It is reasonable to assume moral hazard in the specific case of CVC-venture relationships. Both parties involved have some incentive to deviate from their contracted behavior. For the founder this might be an action where she enriches herself at the cost of the corporation, whereas for the corporation this might be a situation where the corporate management pursues its own agenda, which might even deteriorate the ventures success.

Moreover, as common practice in economics, this work assumes a profit maximizing homo economicus. Throughout this work, all these assumptions hold, unless explicitly stated otherwise, even if they are not stressed every time in particular. Other more specific assumptions might be made from time to time and will be specifically stated.

The remainder of this chapter II is structured along the lifecycle discussed above. In section II.2, economic theory and CVC application are reviewed and compared for all six steps, building the core of the theoretical discussion. In addition, real-life examples are discussed occasionally. Section II.3 discusses the contributions and the identified avenues for future research. Lastly, the main findings of this theoretical work are summarized in section II.4.

II.2 Lifecycle perspective on CVC

II.2.1 Venture financing

The number of US start-ups that were younger than one year diminished from 17% in 1977 to only 8% by 2011 (Ryan, 2014). According to the authors, the biggest hurdle is the access to adequate financing. Similarly, a 2015 Gallup poll reports that 68% of US Americans do not start their own business because they lack sufficient funds, especially own savings (Badal & Ott, 2015). In Germany – where financing is also seen as the most important resource for founding a venture – the 'Gründungsquote'[14] was at an all-time low of only 1.3% in 2016 (Metzger, 2017). Once founded, start-ups take a long time until they generate their own revenue or even profits, with experienced market participants quoting timeframes of at least three years to make start-ups profitable (Marks, 2013) and four to seven years to make it truly successful as initially pictured by the founder (Schroter, 2017). For example, Tesla Inc. was created in 2003 and disrupted the car manufacturing market delivering more than 100,000 cars in 2017 (Statista, 2017). Still, the company did not manage to generate a positive net income for any full year since then (Morningstar, 2017b), requiring external financing.

A bouquet of financing options exists through different types of securities from various lenders. These financing options have different requirements from and implications on the borrowing firm. Due to their distinct characteristics, like missing historical prove of performance, often no final products or services or no stable cash-flows, start-ups face difficulties in receiving funding. Therefore, the following section discusses forms of financing suitable to a venture from both a theoretical and practical perspective.

[14] Gründungsquote = Start-up founding rate in percent

II.2.1.1 The theory of financing

All firms need funding to run their business. Therefore, a broad theory on corporate funding exists, called 'corporate finance theory'. Going forward, Tirole (2005) is used as major source to elaborate on this financing theory. In its most simple way, two distinct forms of financing exist namely (i) debt and (ii) equity, which are differentiated by the prerequisites necessary to obtain them and especially by the implications they have on the parties involved. Both investors and borrowers will have different demands and preferences, e.g. regarding taxes or liquidity. Moreover, the extend of monitoring and the strength of control rights vary (Aghion & Bolton, 1992). Being aware that firms are often financed by a mix of available securities, conflicts of interest arise among different types of investors.

In its most basic form, debt is a claim of the investor on future cash-flows in exchange of providing funds to a firm in the beginning (Tirole, 2005, p. 238). The initial payment from the investor to the firm is called 'principal' whereas the regular re-payments of the firm to the investor normally constitute both interest and principal payments[15]. Debt holders normally do not acquire any control rights of the firm as long it is in a normal state of operations. As soon as ex-ante agreed so-called covenants are violated, debt holders obtain a right on the firm's immediate income until their claims are satisfied. Accordingly, when plotting the debt holders return versus the firm's income, a concave graph results (see Figure 7). This also induces that all remaining cash-flows above the agreed upon interest and principal payments reside within the firm or are distributed to equity holders.

Covenants are legal statutes of the debt agreements. Once they are violated, control rights are handed over from the debtor management to investors. Thereby, investors get a

[15] Exemptions exist, e.g. zero-coupon bonds that do not pay any interest, but are sold at a discount of the face value of the principal (Cornell & Shapiro, 1988)

chance to ensure that sufficient cash-flows are generated to secure the repayment of their investment. Covenants can be either affirmative (i.e. requiring the borrower to perform some activity) or negative (i.e. prohibiting the borrower to perform some activity). Often covenants are linked to some financial indicators, like firm leverage. Through covenants, debt has a disciplining effect on the management of the borrowing firm. Management needs to ensure to fulfill the agreed upon performance indicators, to generate enough cash-flows and not to misuse the cash on hand.

Moreover, debt is often linked to collaterals, e.g. valuable assets the investor receives ownership of once covenants are violated, i.e. if repayment of the investment becomes more and more unlikely. Once debt is protected by collaterals, it is referred to as secured debt. Both covenants and collaterals are used to manage information asymmetries.

Theory describes different types of debt lenders and borrowers. Lenders are often split in sophisticated large lenders that are normally well informed and concentrated (e.g. banks and institutional investors) and dispersed lenders (e.g. public bondholders or trade creditors). Borrowers are often split by firm characteristics, like cash-flow quality, riskiness, capitalization and size, information availability and rating. These lenders and borrowers might come together in both public or private markets.

A breakdown of debt is possible along the timing of the investment, i.e. a split in short-term and long-term bonds, or by its seniority. Seniority refers to the order of reimbursement, which becomes especially relevant in the case of a breach of covenants. Senior debt is reimbursed before more junior debt is repaid. Therefore, the risk of senior debt is lower which is reflected in lower interest rates. In addition, convertible debt is available which is debt that can be transferred into equity. As one might notice, different forms of debt

bear different types of risk and therefore require different levels of risk-compensation, i.e. interest rates[16]. An even higher risk is inherent in equity which will be discussed next.

Equity describes a type of security with which the holder receives a right on the (residual) income of the firm and control rights (Tirole, 2005, p. 404)[17]. The control rights can take different forms and depend on the share of the equity stake[18]. Often shareholders can make decisions about the management board or the distribution of dividends. Equity holders only have a right on the residual income of the firm that remains after the claims of debt holders and other stakeholders are satisfied. Consequently, the equity holder's income versus the firm's income is of convex shape (see Figure 7). As noted above, providers of debt assume control over the firm once covenants are violated. Therefore, the equity holder has control rights only if the firm runs smoothly. Moreover, equity does not necessarily pay any type of regular interest. Instead, it is on the management and the shareholders to decide whether residual earnings should be retained within the firm, e.g. for investment projects, or whether they should be distributed to the equity holders in the form of dividends.

Equity can be broken down in various parts. First, it can be owned by insiders (e.g. founders, managers) or outsiders (e.g. financial institutions, private shareholder). Outside ownership can be further split by its concentration (e.g. in the hand of few large corporations versus free floating equity with thousands of shareholders), the type of equity providers, and both the involvement and turnover of shareholders. Some shareholders only hold equity for short times and only trade for financial reasons, whereas others might pursue a strategic long-term interest. Shareholders that own shares for an extended period and interfere with the

[16] Through the interest payments, debt also has a tax impact (Cornell & Shapiro, 1988)
[17] Specific forms of equities without control rights but entitlement on predetermined repayments also exist
[18] See below for a more detailed discussion of control rights

management of the firm are so-called ‘active investors’. Moreover, outside shares can be either hold privately or traded on public markets (e.g. the well-known stock exchanges in New York or Frankfurt).

As with junior and senior debt, equity can be divided based on its priority. Preferred stock is somewhat like debt in that it is senior to common stock and is entitled to predetermined payments. If the payments to holders of preferred stock are not made, though, the firm does not fail for bankruptcy. However, dividends on common stock may only be distributed once all holders of preferred stock received their agreed upon payment. To balance the lower priority of common stock versus preferred shares, preferred stockholders often lose their voting rights, whereas common stock holders in most cases have voting rights.

Figure 7 shows the return for debt and equity holders based on the firm’s income, respectively. A connection between debt and equity exists through the level of (arbitrary) debt reimbursement D. Moreover, the debt-equity ratio determines the risk of bankruptcy and consequently serves as incentivizing measure for managers to perform well (Grossman & Hart, 1983b).

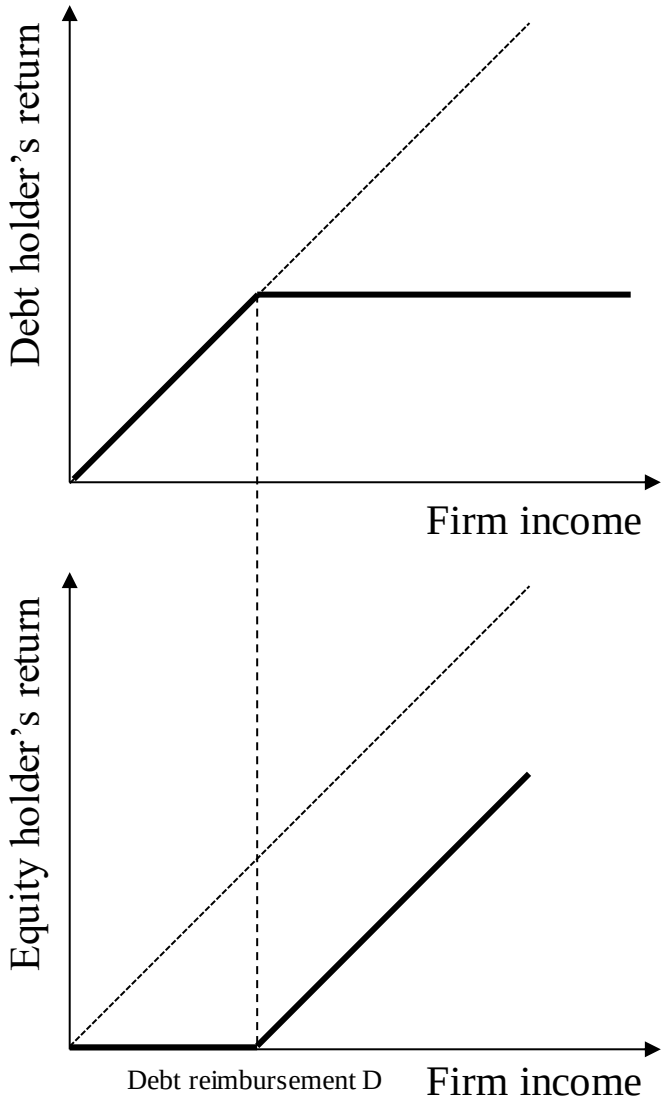

Figure 7: Debt and equity holders' return based on firm income (adapted from Tirole, 2005, p. 75)

The underlying hierarchy and different priorities among the different forms of securities was first discussed by Donaldson (1961) who identified this so-called 'pecking order'. Later the theory was formalized by Myers and Majluf (1984) and gained increased popularity. In the years after the development of the theory, a discussion about its robustness and empirical relevance developed. Many researchers concluded that the pecking order hypothesis is not the primary rationale behind a firm's capital structure (Cornell & Shapiro,

1988). However, there is empirical evidence that firms directionally follow the theory (e.g. Fama & French, 2002), making it necessary to understand its underlying rationale.

When in need of funding, firms will start with low cost (and high benefit) securities first. Once the issuance cost of one form of security is higher than the costs of the second form of securities, the latter security will be chosen (Myers & Majluf, 1984). The relevant costs include transaction costs, costs of collecting information and riskiness[19]. Starting with low risk, low information-intense securities, the following order evolves:

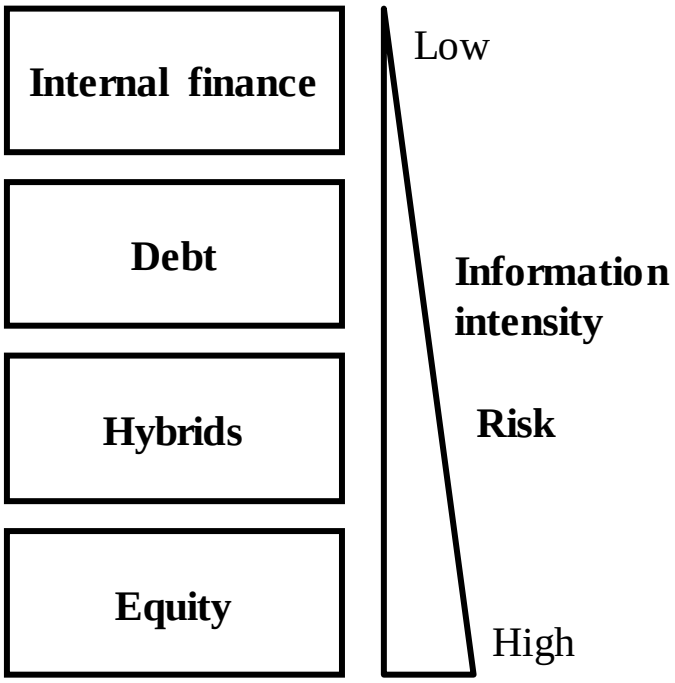

Figure 8: Pecking order (adapted from Tirole, 2005, p. 238)

Internal finance is fully endogenous and has therefore no information asymmetry. It includes initial equity provided, e.g. by the founder of the firm, and retained earnings. Note that the providers of the initial equity usually also require some form of dividend. Normally initial internal equity is limited. Moreover, a time-gap between an initial investment (e.g.

[19] Note that the assumptions introduced earlier – especially information asymmetry and adverse selection – play a crucial role here

paying a salary to your staff or developing a technology) and the return of this investment (i.e. profits leading to retained earnings) exists. Therefore, in almost all cases, external sources of capital are required. The information asymmetry for debt and hybrids is not too large as the claim acquired by the investor can be precisely valued (Tirole, 2005, p. 248). For equity, it is much harder to determine the value a shareholder will receive. One must stress, that this order might not always hold. The general idea of the pecking order hypothesis is that low information claims are used first.

There might be instances where hybrids or equity will be used before debt. This is the case if signaling or insurances change the information asymmetry accordingly (Tirole, 2005, p. 249). Moreover, limited cash-flow by the firm or favorably conditions for the equity market might reverse the order. Especially if one needs to invest some effort to obtain information, the security chosen should reward for it.

Other forms of financing not discussed here exist, e.g. through R&D alliances or through (not to be repaid) grants and subsidies. Moreover, further financial instruments can be derived from the securities discussed above, e.g. securitized bonds or equity options like stock warrants or stock appreciation rights. Summing up, it becomes obvious that the different forms of securities bear different prerequisites and implications. Reviewing empirical evidence, the next section discusses which security proves most suitable for the financing of start-ups.

II.2.1.2 Financing of start-ups

The theory of corporate finance discussed above is rather general in its form and was initially derived from studying larger corporations. Financing start-ups and entrepreneurial enterprises, however, was for a long time seen as separate research stream (Denis, 2004) and

differs in many regards from financing large established corporations (R. L. Smith & Smith, 2004, p. 4). The main difference of corporate finance and entrepreneurial finance is the extent to which agency problems and information asymmetries exist (Denis, 2004), with a specific relevance of agency problems in the context of strategic entrepreneurship (Audretsch, Lehmann, & Plummer, 2009). Entrepreneurship as research field discusses the necessities of creating future goods and services (Venkataraman, 1997). Start-ups have specific needs, with financing being the most pressing one (Dushnitsky & Lenox, 2005; Radcliffe & Lehot, 2018)[20]. Start-ups have specific – and in the case of financing rather disadvantageous (Solvang & Berg-Utby, 2009) – characteristics. First, there is a high degree of information asymmetry. Few people have a deep understanding of a venture, especially if an idea still resides in the founder's mind and no product prototype or proof-of-concept exists. Often, founders have no interest in making their idea public early on, as this could deteriorate the value (Cornell & Shapiro, 1988). Moreover, no predictable and stable cash-flows exist. Start-ups are young firms, so no historic data is available that can be used as approximation for future performance. Even knowledgeable observers often underestimate the potential of an idea, especially for a product or service without any existing market. In 1943, Thomas Watson, then president of IBM, said "I think there is a world market for maybe five computers" and in 1977 Ken Olsen, founder of Digital Equipment Corporation[21], was quoted saying "there is no reason anyone would want a computer in their home" (Strohmeyer, 2008, p. 1). Moreover, few market participants make the effort to analyze the financial or operational performance of a start-up, whereas large corporations are regularly screened and evaluated, e.g. from rating agencies. As start-ups are small in size, they often are not capable

[20] Other needs include access to markets, facilities and talent, as well as technical and business expertise
[21] Digital Equipment Corporation was later acquired by Compaq, who then merged with HP in 2002

of reporting any financials. Even if they do, they might comply with broadly accepted accounting principles, which makes it hard to make sense of the numbers. Moreover, there is evidence that the majority of start-ups fails at some point (Freeman, Carroll, & Hannan, 1983; Solvang & Berg-Utby, 2009). In the US, only half of the ventures survive for more than 5 years (Badal & Ott, 2015). For the German market, 30% of start-ups cease existence after 3 years, mainly for personal reasons (Metzger, 2017). Knowing that the majority of start-ups fails, investors are even more hesitant to contribute funds. Therefore, different financing options need to be evaluated and their suitability for start-ups tested. Figure 9 presents an overview of potential financing options:

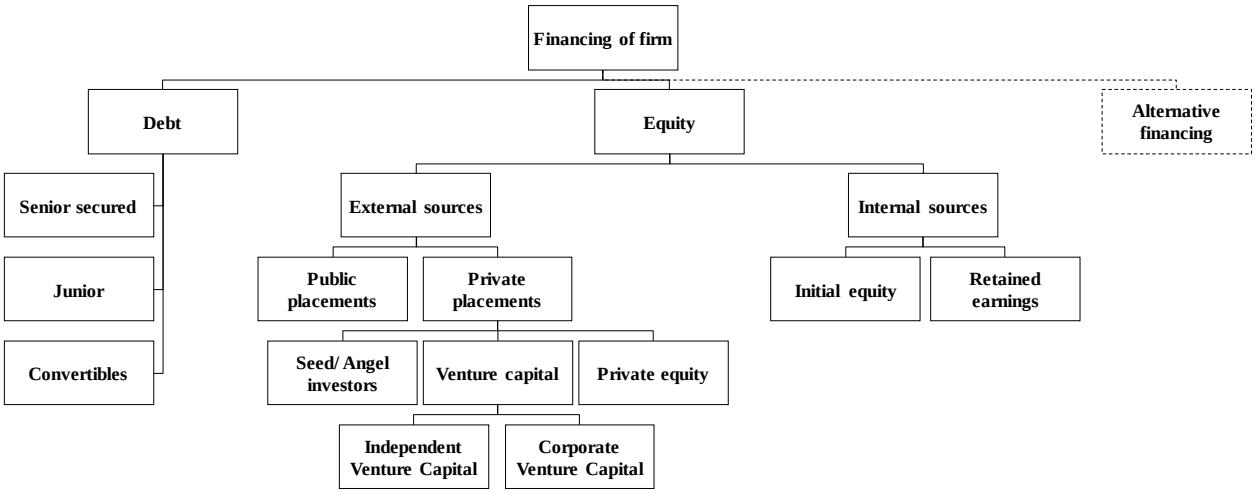

Figure 9: Financing options (authors compilation)

Theoretically, start-ups can be financed through debt, equity or alternative financing forms. Debt financing from banks is often not obtainable for innovative small start-ups (Audretsch & Lehmann, 2004) as the most essential prerequisite for debt financing is enough liquidity. The debt holder must be assured that the start-up generates sufficient cash-flows to pay back the principal including interest. Start-ups often have no or limited liquidity and need their liquidity somewhere else, e.g. as investment in R&D activities or market development. Therefore, start-ups are not willing to assume an additional burden of bankruptcy risk.

Additionally, investors are hesitant to invest debt into start-ups, as start-ups can normally not offer sufficient hard assets as collaterals (Zider, 1998). Moreover, it might be difficult for the two parties to agree on reasonable covenants.

In a start-up context, many things are still fluctuating a lot. Therefore, many decisions cannot be predetermined but must be made whenever they arise and are highly significant for young enterprises and will shape the start-up's long-term success (Solvang & Berg-Utby, 2009). After investing, a debt holder has no chance to influence any decision until the firm fails for bankruptcy. Lenders often do not trust start-ups enough to accept this tremendous loss of control, especially as the objectives of the two parties may conflict (Aghion & Bolton, 1992). As there is no way around in the context of debt lending, this hinders investors from investing debt in start-ups. As start-ups often do not earn any profit, debt even fails to generate an immediate tax advantage. Summing up, not having enough liquidity on the start-up's side and missing control rights on the lender's side are the main reasons why start-ups fail to obtain debt financing.

Equity is a more suitable form of start-up financing as equity investors obtain control rights and equity has less pressure on the start-up's liquidity. As discussed in the theory part, equity can be split in internal and external sources. Internal sources are most desirable – according to the pecking order hypothesis – and include initial equity and retained earnings. Initial equity is funding that is brought in during the very early stage of a start-up. It normally comes from the founder itself or the 'three Fs', namely family, friends and fools (Financial Times, 2018). Besides being a source of funding, the fact that the founder, owner or manager of a start-up also owns some part of the firm matters. The manager than has an incentive to maximize the value of the firm (Cornell & Shapiro, 1988), which will be of advantage to

other shareholders as well. In addition, the three Fs function as signal to the market. If even the founder's own mother does not believe in her daughter's idea and entrepreneurial skills, why should the financial market?

Clearly, internal equity plays an important role, yet cannot satisfy all funding needs, especially as start-ups grow and require more financial resources. In Germany, almost 40% of entrepreneurs are self-funded and another 30% are physical resource founders, whereas almost 25% of entrepreneurial enterprises use third party borrowings[22] (Metzger, 2017). In the US, the funds of the founder also play a crucial role as evident by the effect a declining personal savings rate has on the business start-up rate (Ryan, 2014). However, most of the start-up founders have limited funds they can attribute to their venture (Aghion & Bolton, 1992). Initial equity of the founder is essential for start-ups early on, but sooner or later it is not sufficient anymore. Therefore, additional sources of equity need to be tapped into.

Retained earnings are the residual money from operations after anything else is paid for. To obtain retained earnings, start-ups would need to generate enough revenue to pay for e.g. the salaries, utilities, asset depreciation, resources and material, office rent, payments to debt holders and taxes. Everything that remains afterwards can be used as retained earnings. It becomes obvious that start-ups, which often do not generate revenues, let alone profits for many years, are not capable of accruing retained earnings as source of funding. Summing up, internal equity might be available to some degree to start-ups, however, not sufficiently to grow and expand the venture. Therefore, external equity is required.

External equity can be split into public and private placements (Isaksson, 2006). Public equity placements are equity investments in stock-listed public firms, i.e. firms that

[22] The remaining are zero-resource founders

already went through their IPO. Historically, only companies with sales above 15mn$, repeating profit and assets worth more than 10mn$ could enter the public equity market in the US (Zider, 1998). For the NASDAQ one of three standards need to be met to fulfil the listing requirements, for example annual revenues of more than 90mn$ (Nasdaq, 2017), which is rarely the case for start-ups. Moreover, access to public equity is normally quite costly, due to underwriting fees, reporting requirements and legal support (Cornell & Shapiro, 1988). Therefore, new enterprises need to look at private equity placements for external funding.

Private equity placements describe a situation where the start-up is not publicly listed at an exchange but still receives equity investments from external investors (Christofidis & Debande, 2001). This type of equity is also referred to as risk capital, as investing in a start-up remains a dangerous endeavor as outlined above, especially as only 20% of investments actually meet the initial expectations and targets (Christofidis & Debande, 2001). Due to the high risk, a superior return of 25 – 35% annually is required for successful investments (Zider, 1998). Consequently, financial success, i.e. capital gains, is the primary, but not only as shown later, objective of investors in private equity placements. As start-ups are initially worthless units, the investor realizes most of its gains when it exits the start-up after several years (National Venture Capital Association, 2015). Investors normally acquire a significant share of equity, also giving them sufficient control rights. Through control rights and the possibility of interfering with the management of the start-up, investors are more comfortable in providing funds to a start-up with an uncertain future (Tirole, 2005, p. 389). Moreover, the information asymmetry between the investor and the start-up is reduced.

Different players are active in the private placement market and are mainly differentiated by the maturity of an entrepreneurial enterprise they invest in. Various definitions of start-up stages exist, for example from the US National Venture Capital Association (National Venture Capital Association, 2015). During the 'seed' or 'start-up phase' the concept is derived and a product or service developed although the firm is not operational yet. Next, the 'early stage' is used to develop pilots and test the product or service. As first commercial deals might be available, some revenue might be generated already. However, many firms earn revenues only later. Once the start-up is fully operational, it enters the 'expansion stage'. Products and services are commercially available, resulting in a growing revenue. Still the companies often do not generate profits, especially as investments are very high in this phase (Dushnitsky & Lenox, 2005). Lastly, companies reach the 'later stage'. Often, companies earn stable revenues and first profits. After the later stage, previous start-ups become more mature players and can perform IPOs and receive debt funding. One has to be aware that this is a generalized description. There are, for example, firms that fail to generate profits and still perform IPOs (Christofidis & Debande, 2001), e.g. Snapchat. Moreover, the terms 'round A', 'round B', 'round C' and so on are also used regularly. Round A starts when VC funds enter a start-up, with B, C and all the others following subsequently. Start-ups are often not funded at once, but in various funding rounds, to limit the down-side risk for investors and keep up pressure on start-up to perform (Cornell & Shapiro, 1988; Denis, 2004). With the development over time, the risk profile decreases and the funding need increases. All in all, the following structure of market players evolves:

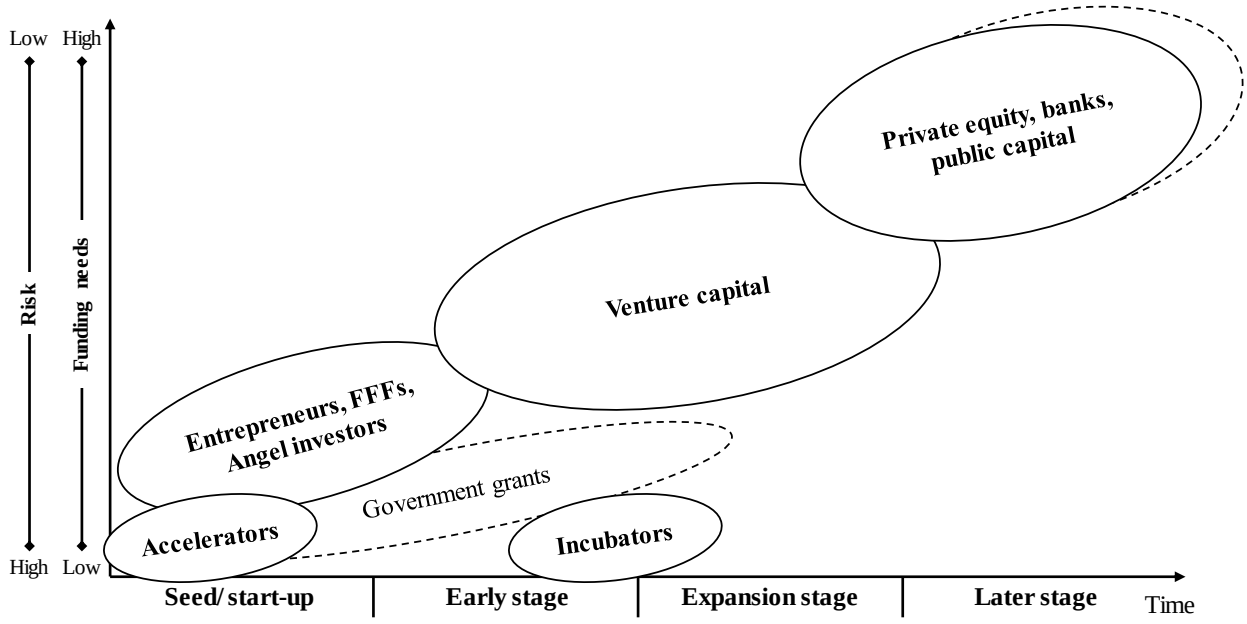

Figure 10: Mapping of private equity providers to start-up stages (adapted from Christofidis & Debande, 2001; Isaksson, 2006)

As discussed above, the initial funding comes from the founder herself and from family, friends and fools. In addition, 'angel investors' or 'business angels' invest in smaller young start-ups (Wong, Bhatia, & Freeman, 2009). They are wealthy individuals, that differentiate themselves from VCs through investing their own funds, instead of that other investors (Denis, 2004). Often, they earned the money from successful own firms and now want to help more inexperienced start-up founders (van Osnabrugge, 2000). For example Elon Musk used the proceeds from the sale of his company Zip2 Corporation to Compaq and X.com which later merged with PayPal, to invest in the IT company Everdream Corporation (Calderone, 2016). As the uncertainty is specifically high for young enterprises, angel investors tend to be heavily involved in shaping the start-ups future (Isaksson, 2006). They use both their financial resources and management capabilities to support the entrepreneurial activities (R. T. Harrison & Mason, 1999; Wetzel, 1983). The amount of funding provided through angels is normally clearly below 1mn€ and thereby smaller than most VC

investments (Christofidis & Debande, 2001)[23]. Business angels play a critical role in bridging the financing gap between the founders own equity and VC investments (R. T. Harrison & Mason, 1999).

'Venture capital funds' perform investments in promising companies in the early and expansion stage. Often the start-ups are still entrepreneur-led and characterize themselves by a high innovativeness. As VCs help small start-ups from an idea to a (most of the times) profitable business (Zider, 1998), their relationship is often characterized by a hands-on approach (Solvang & Berg-Utby, 2009) and regular interactions, e.g. through taking board seats (National Venture Capital Association, 2015). VC can be further split in independent IVC, CVC, GVC or finance captives (Christofidis & Debande, 2001). All of them are similar with regards to the provision of funding, however, differences exist especially for the fund objectives and type of collaboration with the start-up. Although start-up financing through VCs is promising, one must keep in mind that it is not an easy undertaking for start-ups. As a rule-of-thumb, only 10 out of 100 business plans are seriously evaluated by VCs and only 1 out of 100 start-ups ends up getting funding (National Venture Capital Association, 2015).

'Private equity' (PE) funds invest in later stage more mature and established companies (European Private Equity & Venture Capital Association, 2016, p. 4) that are not public (yet). Often, these firms are in need of a bridge financing (Christofidis & Debande, 2001) or are in distress (Isaksson, 2006). Moreover, succession in family-owned companies, leveraged buy-outs (LBOs) and management buy-outs (MBOs) are often supported by PE funds (Christofidis & Debande, 2001). PEs are normally less involved in the operations and

[23] See van Osnabrugge (2000) for a more detailed differentiation of business angels and VCs

interfere less with management (Fried, Bruton, & Hisrich, 1998)[24]. Figure 10 shows the most likely source of funds, where overlaps of investor types exist. It might be plausible that both the founder, a VC fund and a PE fund hold some share of a start-up. From a start-up perspective, funding through a business angel, any form of VC or a PE fund is possible and depends mainly on the stage of the start-up.

Completing the discussion on Figure 9, alternative funding sources are available and could be used by some start-ups. These sources include e.g. government grants or subsidies that often do not hold any control rights and might or might not be paid back. In addition, crowdfunding or R&D alliances could – depending on the start-up – be successful. For start-ups, using these sources could be a reasonable possibility. However, their availability is limited and decision-making of investors often follows different rationale (see e.g. Hoegen, Steininger, & Veit, 2017). In addition, start-ups need to be aware that investors might also have negative effects (see e.g. Steininger, Wermann, & Veit, 2018) and that, new companies face, besides the finance gap, also a competence gap. VC in general and CVC in specific, play an important role in filling this gap (Chemmanur et al., 2014; Solvang & Berg-Utby, 2009). Working with corporations brings access to e.g. complementary assets (Alvarez-Garrido & Dushnitsky, 2016; Gans & Stern, 2003; H. D. Park & Steensma, 2012), knowledge and expertise (Delmar & Shane, 2006; Zahra, Ireland, & Hitt, 2000) and sends a positive signal to the market (Stuart, Hoang, & Hybels, 1999).

In summary, start-ups require productive assets, need to set up infrastructure, develop new prototypes and enter new markets, all requiring financing. Nonetheless, obtaining funds is one of the largest challenge young start-ups face. According to theory, debt, equity and

[24] See for instance Bygrave and Timmons (1992) and Wright and Robbie (1996) for a more detailed differentiation of VCs and PEs

some intermediate hybrid forms are the major sources of financing. Start-ups can rarely provide the interest payments, control rights and collaterals required by debt holders. Therefore, debt financing is often not obtainable by start-ups. Equity is further down the line in the pecking order and riskier for both involved parties. Nonetheless, it offers control rights for investors, while reducing liquidity requirements for investees. Different forms of VC, including CVC, seem suitable for successfully coping with characteristics specific to start-ups and therefore present one of the best sources of start-up funding.

II.2.1.3 Example: Funding of Snapchat

In real-life, endless examples of start-up funding exist. In the following, one prominent example, namely Snap Inc., better known by its original name and the name of its major product Snapchat, will be discussed. The photo-sharing social media app was developed in spring and summer 2011 by three Stanford students. After initial difficulties, the user base started growing strongly in 2012 (Crook & Escher, 2015). In the beginning, it could be considered as just another social media app, with strong competition from Facebook, Twitter or Instagram. The clue was the disappearance of pictures and messages shared, a feature that was latter copied by both Facebook and Instagram. An app that allows – mainly teenage – users to share pictures which disappear later, has difficulties generating reliable cash in-flows. Therefore, at some point the company was in needed of a significant amount of funding, especially for hosting their webservers (Crook & Escher, 2015). As neither cash-flows, nor any collaterals were available, debt funding was ruled out. Moreover, the company was in a stage full of risk and uncertainty. The app was often referred to as sexting app, private user data of 4.6mn users was exposed to the public and one of the three owners sued the other two for stealing his idea. Such a situation describes a textbook funding opportunity for VCs. In 2012, Lightspeed Ventures invested 485k$ as first VC fund in the start-up. From

May 2012 till May 2016, eight primary market funding rounds took place. Most of them were syndications, including the investment from well-known corporations like Yahoo, Alibaba and Tencent. During these rounds, the company was valued at 4.25mn$ in May 2012 and already at 800mn$ in June 2013 (Crunchbase, 2018). The example of Snapchat clearly shows the difficulties a start-up phases regarding financials, competitive threats, internal disagreements or bad image. Snapchat was able to attract enough investors and achieve tremendous valuations. Obviously, this is not the case for many start-ups that struggle to get any funding at all.

II.2.2 Corporate innovation

The following part leaves the perspective of the start-up and focuses on large mature corporations. Corporations act in a more and more rapidly changing environment. For example, the pace of adaptation, measured as the time needed to reach 50mn users has changed tremendously in recent years. Whereas the telephone needed 75 years to reach 50mn users, the internet needed only 4 years and Angry Birds, a famous video game for mobile devices required only 35 days (C. B. Frey & Osborne, 2015).

For firms one of the most successful ways of generating profits and staying ahead of competition is innovation (Schumpeter, 1934, p. 133). Therefore, companies need to constantly question themselves and ask what it takes to be and especially stay successful. Being an innovative company generates a sustainable competitive advantage. Innovative firms show a three-year (ten-year) premium over their peers of 6.7% (2.9%) in Americas and even 14% (6.9%) in Asia (Brigl, Roos, Schmieg, & Watten, 2014).

But what does it mean to be innovative? Following OECD definition, "an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2005, p. 46). Companies need to accept that innovation is necessary to survive and stay ahead of competition. Therefore, companies must find ways to constantly innovate. A large field of theoretical considerations of innovation including discussions of different definitions and forms, sources and ideal conditions and prerequisites is available. Therefore, the following part elaborates on innovation-related theories with a specific focus on reviewing the sources of innovation in a make-or-buy context. In addition, the impact of a firm's culture and its organizational structural on its innovativeness are discussed.

II.2.2.1 Theory of innovation

The concept of innovation has a long and controversial history, having its origin in ancient Greece. Historically, innovation was a negatively connotated description of change (Godin, 2008) without any formal underlying theory (Godin, 2015, p. 3). In the 16th century, innovation was even forbidden in England and Wales by King Charles I. Beginning in the 19th century and especially from World War II onwards, innovation became a neutral word and often even a positive praise (Godin, 2015, p. 16). From then on, innovation was coined towards technological progress leading to economic growth. Schumpeter's (1934, 1943) economic work is often seen as the most focal contribution to modern innovation theory (Godin, 2015, p. 6; Śledzik, 2013). Especially in his earlier work, Schumpeter highlights the importance of entrepreneurs for innovation and the need to innovate for every firm to generate profits. Later, he argues that "creative destruction" is at the core of economic activity (Schumpeter, 1943, p. 83). This is, however, not merely achieved through having a

new idea, but more importantly by bringing this idea to life and implementing it. Consequently, the term innovation developed from referring to an unintended change to describing a planned process of change (Godin, 2015, p. 20). Currently, innovation is positively connotated and seen as the key concept for solving a variety of problems (Godin, 2008). Further broadly accepted thoughts on innovation come from the well-known management theorist Peter Drucker (2002). He argues that talent, knowledge and capabilities serve as a mere basis for a systematic approach to innovation, but that hard work, motivation and persistence truly differentiate between successful and unsuccessful innovation. Moreover, he notes that innovations are rarely revolutionizing mega ideas from the beginning but start as small improvements and develop over time.

Although the need for innovation becomes inevitably clear, companies' investments in innovation are limited. During times of growth companies neglect the need to invest largely in innovation and during more bearish times available funding for investments is limited (Christensen, Johnson, & Rigby, 2002) although even good and previously successful companies are prone to fail if they miss to innovate (Christensen, 2002, p. 7).

According to Drucker (2002), the impulse for innovation can come from within a firm – from unexpected occurrences, incongruities, process needs or industry and market changes – or from the broader social environment, more precisely from demographic change, changes in perception and new knowledge. Innovation can come from firm internal or firm external bases. Therefore, a typical make-or-buy decision problem arises. Therefore, the motion of innovation as make-or-buy decision was already included in the first and most formal discussion of innovation sources in von Hippel's seminal book 'The Sources of Innovation' (1988). Focusing on products and neglecting services or process innovations, he

acknowledges that innovation will not only stem from a manufacturer internally, but that multiple external sources exist. He differentiates between (i) manufacturer innovation, (ii) user innovation and (iii) supplier innovation. A review of the theory on make-or-buy decisions will therefore help to understand the fundamentals of innovation sources and the implications of deciding for internal versus external sources.

Innovation as make-or-buy decision

Make-or-buy is used in the context of innovation (see also Love & Roper, 2002; Rijnsoever, Kempkes, & Chappin, 2017), referring to whether an activity is performed internally by the corporation or whether external third parties are the source of innovation. Firms decide on make-or-buy in a rationale manner, aiming at achieving long-term success for the company. Nonetheless, one should not underestimate the fact that individual human beings, not firms, make decisions that are sensitive to biases (Mantel, Tatikonda, & Liao, 2006).

The theory on make-or-buy finds its origin in the discussion whether production takes place internally or through a market (Coase, 1937) and was formalized in Williamson's (1975, 1985) idea of 'transaction cost economics'. In the beginning of the industrial age, make-or-buy decisions were about 'owning' the labor versus outsourcing it to independent subcontracts (Ford & Farmer, 1986). Nowadays, a majority of scholars differentiates between internal production and external sourcing of components or products as part of a manufacturing and supply chain process (e.g. Brem & Elsner, 2018; Mantel et al., 2006; Meng, Yao, Nie, & Zhao, 2018; Parmigiani, 2007; Walker & Weber, 1984). Besides manufacturing, services, like IT services, can be outsourced (e.g. Bertschek, Erdsiek, & Trenz, 2017). In this context, 'make' describes as a situation in which the firm owns and

controls the facilities and assets needed to produce a respective product (Balakrishnan, 1994; Tadelis, 2002). Moreover, more precise definitions exist. Monteverde and Teece (1982) define ‘make’ as producing equal to or more than 80% of the requirements in-house, with ‘buy’ describing everything else. Others differentiate between captive offshoring and offshore outsourcing (Pongelli, Calabrò, & Basco, 2018). Moreover, the theory of make-or-buy is the basis for the related discussion of vertical integration or outsourcing (Tadelis, 2002; Walker & Weber, 1984). In addition, industry-specific applications are common, e.g. internal or external drivers in the trucking industry (He & Nickerson, 2006) or functional applications like the build or buy of a software (Shahzad, Abdullatif, Ikram, & Member, 2017).

Over time, literature developed a broad set of criteria and prerequisites to be considered when making a make-or-buy decision, with different positive and negative implications resulting from deciding for one option or the other. A firm’s strategy, knowledge and capabilities, availability of specialized unique resources, cost structure and efficiencies build the basis for make-or-buy considerations. Moreover, the firm’s preferences regarding intellectual property (IP) protection and ownership as well as speed to market will impact the decision. Finally, market competition, market risk and external offerings play a role. All these areas of interested mentioned will be shortly discussed in the following paragraphs.

Following a resource-based view of the firm, not only the context of an individual decision but also a firm’s broader strategy impacts the choice between ‘make’ or ‘buy’ (Argyres, 1996; Barney, 1999; Ford & Farmer, 1986; Leiblein, Reuer, & Dalsace, 2002; Mantel et al., 2006; Quinn & Hilmer, 1994). The magnitude of vertical integration is often a strategic decision. Buying externally saves management attention which can be redirected to more strategic tasks (Ford & Farmer, 1986). This is especially the case in normal times with

smooth operations. During the search and set-up phase of outsourcing and especially when problems arise, intense senior management involvement is required. Moreover, outsourcing has the advantage that a firm can focus on a limited set of activities it has high proficiency in (Mantel et al., 2006) and pool demand from multiple partners to achieve economies of scale (Liebeskind, Oliver, Zucker, & Brewer, 1996).

Further, a firm's capabilities, skills and knowledge of their employees need to be taken into consideration. Firms will perform activities internally if they have differentiating capabilities that no other competitor has. If highly specialized assets are required, firms perform the more custom activities internally to protect themselves against competition (Williamson, 1975, 1985). Thereby, employees will be further trained and a coordination benefit realized, resulting in superior internal information exchange (Leiblein et al., 2002). In contrast, buying from an external resource gives access to critical capabilities that are not available within the firm, like capabilities needed to solve independent technical problems (Leiblein et al., 2002). In this case, two consequences are possible. Either the firm completely relies on its external sources, loses internal capabilities and fails to renew existing and develop new skills (Bettis, Bradley, & Hamel, 1992; Leiblein et al., 2002; Quinn & Hilmer, 1994), or a knowledge spill-over effect takes place through which internal employees learn from the third party and new skills and capabilities are developed in-house.

Costs are a key determinant in deciding for vertical integration, especially the cost for in-house production (He & Nickerson, 2006), transaction cost (Coase, 1937; M. K. Perry, 1989) or contracting an external party (Williamson, 1975, 1985). Production costs include the inputs required to produce a product or perform an activity and include e.g. labor, material and utilities (Walker & Weber, 1984) and are normally straightforward to determine for both

internal and external sourcing. Under a make scenario, money is needed to provide assets, to pay employees and to ensure required capabilities are available (Parmigiani, 2007). Simply buying externally is often more efficient than developing internally (Rijnsoever et al., 2017). Transaction costs of external sourcing come in the form of identifying, selecting and managing external partners (Parmigiani, 2007) and are more difficult to assess. Moreover, the performance of a supplier needs to be consistently evaluated (Walker & Weber, 1984), for which a firm also requires internal knowledgeable resources and capacity.

Firms are concerned about the protection of their intellectual property. They are hesitant to share differentiating IP with other market players and therefore keep their activity internally instead. Full ownership of a result of a performed activity can only be achieved if all the work is done internally (B. Lin & Wu, 2010; Rijnsoever et al., 2017). This tendency is even stronger in the context of non-patentable know-how (Monteverde & Teece, 1982). Accordingly, simple and non-differentiating products or 'safe' activities, like cleaning, printing and catering were among the firsts to be sourced through a market (Ford & Farmer, 1986; Tadelis, 2002). However, in the course of time, more important functions of a firm started to be sourced externally, including manufacturing or R&D activities (Brem & Elsner, 2017; Greco, 1997; Leiblein et al., 2002). Consequently, the concept of acquiring external innovation, like through open innovation, is widely accepted nowadays.

A further differentiator is the speed with which the required output can be produced. Buying is often faster than developing internally (Leiblein et al., 2002; Rijnsoever et al., 2017). In contrast, make options often lead to first-mover advantages (Kessler, Bierly, & Gopalakrishnan, 2000; Lieberman & Montgomery, 1988). Sourcing externally helps to create something new for the firm, which is, however, not completely new to the market (Rijnsoever

et al., 2017). Nonetheless, an external party might develop a breakthrough invention which is bought by another firm to incorporate it in a marketable product.

Market competition, market information and industry collaboration play a role in make-or-buy decisions (He & Nickerson, 2006). The option to buy is applied if specific know-how or skills are centered in one particular external firm (Monteverde & Teece, 1982), making it too costly to produce such a product internally, or if the external firm offers significant price advantages for other reasons (Ford & Farmer, 1986). Information available regarding alternative external suppliers also impacts the decision whether to make or buy (Mantel et al., 2006). Price advantages from buying externally are specifically high if supplier market competition exists (Walker & Weber, 1984). A proven track-record and experience of a supplier lowers the risk of subcontracting and therefore makes outsourcing more common (Ford & Farmer, 1986; Walker & Weber, 1984). When firms chose to buy from external suppliers, they can decide on the intensity of collaboration with the external party (Fey & Birkinshaw, 2005; Rijnsoever et al., 2017; Teirlinck & Spithoven, 2013). This is especially relevant as partners play a crucial role in contributing to a competitive advantage (Eisenhardt & Schoonhoven, 1996; Lavie, 2006; Z. J. Lin, Yang, & Arya, 2009; Mention, 2011).

Lastly, uncertainty regarding both environmental changes and the behavior of (potential) sourcing partners influences the decision. In an uncertain environment, firms tend to produce internally to reduce the dependency on other players (Williamson, 1985). This proposition needs to be challenged in the case of innovation, as the example of electric vehicles elucidates. As long as no industry standard for batteries emerges, large automotive OEMs[25] will hesitate to invest large amounts in production plants. Instead, external sourcing

[25] OEM = Original equipment manufacturer, e.g. Daimler, Volkswagen or General Motors

is used to maintain flexibility and circumvent tremendous initial investments. Concluding, a multitude of considerations regarding strategy, capabilities, cost structure, intellectual property and risks, influence a make-or-buy decision.

Historically, most of the theory considers make-or-buy decisions a dichotomous choice. More recently, however, multiple studies present evidence of a complementarity of external knowledge acquisition and internal R&D (Cassiman & Veugelers, 2006), even leading to improved innovation outcomes. Therefore, a mixture of the two forms is observed, often referred to as 'make-and-buy' or 'ally' (e.g. Du, Lu, Reardon, & Zilberman, 2016; K. S. Lee & Lim, 2001). It describes e.g. franchising, alliances, joint ventures or supply chain networks (Hodgson, 2002). According to Parmigiani (2007), the mixture is a third option which does not lie within the make-or-buy continuum. Firms concurrently make and buy in order to smoothen fluctuations (Adelman, 1949) i.e. better utilize their capacity while using external sources as buffer for additional demand. Moreover, they increase their in-house knowledge (Harris & Wiens, 1980; He & Nickerson, 2006; Lafontaine & Shaw, 2005) or achieve synergies in an uncertain environment (Harrigan, 1986). Further research finds that performance uncertainty, market heterogeneity and information asymmetry (Dutta, Bergen, Heide, & John, 1995; Heide, 2003) lead to a mixture of the two options, even for the most innovative corporations (Cassiman & Veugelers, 2006). There is good rationale to combine the two. Based on the rigidity of corporations, creating disruptive innovations from inside a large firm is challenging (Christensen, Raynor, & McDonald, 2015). Therefore, internal sources are expected to have a stronger dominance in exploitative innovation, whereas external sources, especially start-ups, often support explorative and more disruptive innovations (Acs & Audretsch, 1988; Laursen & Salter, 2006; Weiblen & Chesbrough, 2015).

Open innovation

To use external sources of innovation, firms need to open up to third parties. The topic of open innovation is well researched in literature (e.g. Chesbrough, 2003), stating that the assets for creating and commercializing an innovation are not necessarily owned by the same party (Chesbrough, 2006, p. 2). The theory of open innovation stresses a collaborative nature across the boundaries of a firm and is contrary to the traditional linear theory of innovation (Gallouj & Djellal, 2018, p. 4). Different organizations or individuals can serve as counterpart for open innovation, e.g. suppliers, clients, competitors, consultants, universities, commercial laboratories or research institutes. Interestingly, using a sample of Portuguese firms, Simao and Franco (2018) find that research institutes, competitors, universities and state institutions are not significantly relevant for sourcing external knowledge. Whereas external open innovations can be observed almost everywhere, the impact is specifically noteworthy in industries like automotive (Cabigiosu, Zirpoli, & Camuffo, 2013), sporting equipment (Shah, 2000) or banking (van der Boor et al., 2014). Open innovation can be distinguished in both outside-in and coupled types (West & Bogers, 2014). Out-side in innovation describes a situation where a firm absorbs innovation from the outside (Chesbrough & Crowther, 2006). In contrast, coupled open innovation refers to a two-way interaction (Enkel, Gassmann, & Chesbrough, 2009). Open innovation requires more interaction with external sources. Therefore, the innovation process is often augmented by adding a final step, namely a structured interaction between the firm and the third party providers of innovation (West & Bogers, 2014). Open innovation, in specific, is not only applicable for product and service innovation, but also process enhancements (von Krogh, Netland, & Wörter, 2018). Moreover, external innovation sources are not only relevant for high-technology companies or industries, but also for low- and medium-technology

corporations (Santamaría, Nieto, & Barge-Gil, 2009). External knowledge and capabilities used for innovations can be detected using different search approaches. Innovation in goods proves more successful when using a broad knowledge search, whereas a deep search is more successful for supporting service innovations (Segarra-Ciprés & Bou-Llusar, 2018).

Besides the importance of using the right sources, a firm's handling of innovation – independently of whether it is sourced internally or externally – is strongly influenced by its corporate culture and organizational structure.

Innovation culture

Most discussions on culture have its origin in Hofstede (1980, 1994, 2001) and Shane (1992, 1993) and their studies on (national) cultural differences. In literature, multiple definitions of culture exist (e.g. Tian, Deng, Zhang, & Salmador, 2018). Often it is described as a common set of parameters that shapes behavior and thinking of people and thereby differentiates them from members of another cultural group (G. J. Hofstede, Hofstede, & Minkov, 2010, p. 4; House, Javidan, Hanges, & Dorfman, 2002). Culture serves as common denominator for implicit and explicit rules, thereby serving as guidance for individuals (Herbig & Dunphy, 1998). This common denominator is crucial in creating solidarity and team spirit. Culture is observable on multiple levels and can be distinctive to nations, corporations or small teams. It is strongly influenced by a nation's or group's history and the behavior, symbols, rituals and practices of a leader or founder (R. G. Cooper, 2011; G. Hofstede, 1994; Kenny & Reedy, 2006). Firm culture is also influenced by the culture of the nation where the firm operates in (G. Hofstede, 2001, p. 373). In a country where, for example, innovation and entrepreneurship are highly valued and success stories aired in

media, firms and individuals are more encouraged to innovate themselves (Turró, Urbano, & Peris-Ortiz, 2014).

Besides broader national traits, the manifestation of a firm-specific culture has a strong impact on the innovation capacity of a firm, as discussed in multiple papers (e.g. Ahmed, 1998; Brettel & Cleven, 2011; Büschgens, Bausch, & Balkin, 2013; R. G. Cooper, 2011; Efrat, 2014; Hurley & Hult, 1998; Martins & Terblanche, 2003; Rohlfer, Zhang, Rohlfer, & Zhang, 2016). From early on, researchers highlighted the relevance of cultural values regarding right and wrong, creativity, a group's social structure, risk taking, authority, learning ability, importance of formal education and technical skills, acceptance of new ideas and change, individual freedom and independent thinking, shared responsibility, or long-term and future market orientation (Barnett, 1953; Brettel & Cleven, 2011; Habisch & Zhu, 2017; Kenny & Reedy, 2006; Markman, 2018; Nassar & Sori, 2017; Rothwell & Wissema, 1986; Shapero & Sokol, 1982; Škerlavaj, Hoon, & Lee, 2010; H. Wang, Begley, Hui, & Lee, 2012).

Especially in the context of open innovation, organizational culture with regards to openness towards external partners and ideas plays a crucial role (West & Bogers, 2014). External innovation bears a large cultural aspect and many firms still need to change and adapt (Kratzer, Meissner, & Roud, 2017), especially as firms often face a 'not invented here' rejection from its own employees (Chesbrough, 2003, p. 30; Laursen & Salter, 2006; West & Gallagher, 2006). Culture is also impacted by firm size, with larger firms facing more behavioral issues or the development of subcultures (Connell, 2001). For further detail, Herbig and Dunphy (1998) and Tian et al. (2018) present a much broader discussion of literature on culture, especially in the context of enterprises and innovation.

Organizational structure

Although culture and organizational structure are closely linked and often develop jointly over time, the set-up of a firm can be a strong catalyst for a firm's innovation performance (M. Smith, Busi, Ball, & van der Meer, 2008). The interplay of teams and functions, the split of responsibilities and the degree of bureaucracy and formality impact employees in their daily job (M. Smith et al., 2008). More formalized structures increase the efficiency of multiple process, but harm innovation (Koberg, Uhlenbruck, & Sarason, 1996). Truly disruptive innovation can only be achieved if the unit that develops the new technology is fully independent from the remaining company organization (Christensen et al., 2015). Some sociologists argue that not only division of labor, but the complexity of the division of labor are crucial for promoting innovations (Hage, 1999). Meadows (1980) finds that the degree of sharing tasks within a small team of three to five people is a relevant indicator for the team's innovativeness. Besides the organizational structure, the process organization of developing innovations differs from firm to firm. Cummings and O'Connell (1978) describe a five-step process including identification of a problem, generation, evaluation and selection of alternatives and initiation, acceptance and routinization of the selected alternative. Merx-Chermin and Nijhof (2005) argue that innovation is achieved in a repetitive spiral-process of knowledge creation, innovation and learning to learn. Following demographic developments, more recent work focuses on how the organization and processes of a firm need to be set up to support employee motivation for innovations (Amar, 2011). Most of the processes focus on good practices in a relatively stable environment. Bessant et al. (2005) rightly criticize this fact and discuss routines that are more suitable for 'discontinuous innovations'. In addition, large and small firms are different with regards to its prerequisites for innovation (Acs & Audretsch, 1988; Koberg et al., 1996). Whereas a loose structure may help a small

entrepreneurial team to creatively come up with new ideas, it may reduce a large firm's innovativeness as it overstrains its employees with multiple possibilities of action. Moreover, centralization of power increases a start-ups innovativeness, whereas it proves contra-productive for more mature firms. Nonetheless, entrepreneurial and innovative behavior and success are not limited to early stages of young enterprises but can also be achieved by large and mature organizations (Zhao, 2005).

Disruptive innovation

Lastly, a specific contribution to innovation theory is the concept of disruptive innovation. Bower and Christensen (1995) argue that companies that want to innovate can do so by marketing new technologies that initially only satisfy the needs of a small customer niche. As the authors of the initial idea recently noticed themselves, the concept of disruptive innovation is often misunderstood and used more broadly then initially intended (Christensen et al., 2015). Therefore, a short discussion of the main ideas is required. Disruption describes a situation, where a large incumbent firm is successfully challenged by a much smaller, less well-known company with fewer resources available (Bower & Christensen, 1995). One key reason is that the established firm focuses more on improving its existing products and thereby often neglects the needs of smaller customer segments with lower priority. Disruptive small firms tackle the needs of a niche and gradually push into the core market of the established firm until mainstream customers adopt the entrants offering (Christensen et al., 2015). The niche that is penetrated by the disruptive firm in the beginning is often a low-end, e.g. low cost, low quality market or the small firm even establishes a new, previously non-existing market, e.g. through serving new customer groups (Christensen et al., 2015). In the course of time, the disrupting firm improves its offering – often the quality of it – and

consequently becomes attractive to mainstream customers. The contrary of disruptive innovation is labeled ‘sustaining innovation’ and refers to the improvement of an existing product or service. The theory was tested empirically, finding that incumbents outperform sustaining, but not disrupting innovators (Christensen et al., 2015) and finding that very few truly disruptive companies exist which, however, showed great success (Christensen et al., 2002). The distinction between disrupting and sustaining innovation is related to the study of exploration and exploitation in adaptive processes (March, 1991).

In summary, firms need to be innovative to sustainably survive in the current fast-changing environment. Considerations on where to obtain innovations constitute a make-or-buy decision problem. In addition to finding a suitable source, cultural and organizational aspects need to be considered. Keeping all that in mind, the following section specifically discusses the use of CVC as source of innovation in more detail.

II.2.2.2 CVC as innovation vehicle

Innovation can be seen in the context of a corporate make-or-buy decision. Innovations can come from firm internal sources, like R&D departments, or external sources, like start-ups or consumer innovation. Examples of innovative young enterprises having a successful cooperation with corporations suggest that start-ups are a sound external source for innovation, especially as Zhao (2005) finds an empirical link between entrepreneurship and innovation, which is supported by the fact that start-ups and small businesses play a crucial role for innovation through having a significant share of economic power, especially in emerging markets (Price, 2018). Multiple sources for corporate innovation and corporate entrepreneurship exist, as shown by Figure 11:

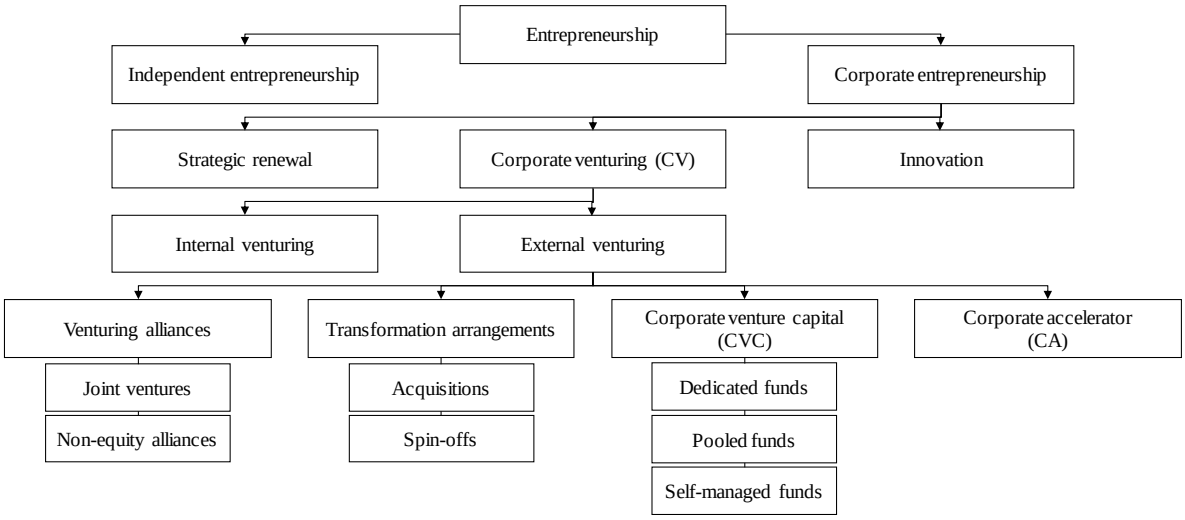

Figure 11: Corporate entrepreneurship (Keil, 2000; Röhm, 2018)

CVC-specific innovation

The following section focuses on CVC exclusively. CVCs are often differentiated by either following short-term financials or long-term strategic objectives (Chesbrough, 2002). In one of the first studies on CVC performance, Siegel et al. (1988) conclude that financial considerations should be the leading objective. Complementary strategic goals are acceptable only, as long as they do not harm the financial results of a deal. Consequently, pursuing deals for purely strategic reasons will not prove successful. In contrast, Dushnitsky and Lenox (2006) argue that – due to structural reasons – financial success of CVC programs might be limited. Additional firm value, however, is created from using CVC as a window on new technology, i.e. pursuing strategic goals. Using a US panel dataset, they successfully confirm their hypothesis and conclude that the innovation performance of a CVC fund is dependent on its key objectives. One advantage of this study is that it does not limit itself to selected sectors. The findings are therefore universally applicable with specifically strong evidence in the semiconductor, devices and computer industry. A drawback of the study is that

innovativeness is only indirectly measured through looking at the overall firm value. Using a German dataset, Ernst et al. (2005) even find that a financial orientation of a CVC harms the occurrence of strategic innovation benefits. Going a step further they identify that many CVC funds are rather managed following short-term financial objectives. The opposite result for the German CVC market is available in Weber and Weber (2002), which find that CVCs pursuing financial goals are sometimes strategically even more successful. They attribute this to more experience in deal transactions, which will lead to better both financial and strategic results. More deal experience lets CVCs rather turn towards financial goals and weaken the strategic orientation.

Multiple studies investigate how CVC can foster both corporate and start-up innovation. One prerequisite – which is assumed to be true for innovation through CVC – is that both the corporation and the start-up have some initial innovation power ex-ante the collaboration. Researchers either take the perspective of the corporation, i.e. evaluate how collaborating with start-ups increases the innovativeness of the corporation itself (e.g. Dushnitsky & Lenox, 2005; Siegel et al., 1988; S. W. Smith & Shah, 2013; Wadhwa & Kotha, 2006), or look at the start-up, i.e. review how working together with a large institution helps the start-up to become more innovative (Alvarez-Garrido & Dushnitsky, 2016; Chemmanur et al., 2014; Howard et al., 2017; Paik & Woo, 2017). Generally, a positive synergistic effect on the innovation capacity of both the corporation and the venture is expected. This positive effect on both sides can come from mutual support and learning, as well as increased competition. However, an evaluation of whether the positive effect on innovation performance is relatively larger for the corporation or the start-up is an intriguing, yet difficult to measure, issue.

In general, culture plays a crucial role in supporting a firm's innovation performance. However, research on the influence of corporate and start-up cultures and their conjunction is limited due to the fact that cultural differences are often hard to measure from an external perspective and therefore mainly come from anecdotal evidence or specifically designed questionnaires. Most large corporations with a proud history have a strong culture, often praising themselves over others. In such circumstances, open innovation with external sources becomes challenging. Especially R&D departments are delighted by their successes and suffer from an "not invented here' rejection of external innovations (Cassiman & Veugelers, 2006). The speed of bureaucratic processes in a large corporation differs from unstructured and loose working-styles of start-ups. Opposite expectations and working styles make a close alignment of corporations and start-ups hard to achieve (Siegel et al., 1988). Therefore, CVC plays a crucial role as mediator and bridge builder between a corporation and its business units on the one hand and more agile, risk-taking and fast start-ups on the other hand. CVC should not only aim at translating between the two parties but ensure that positive cultural attitudes are adapted from each other. Fenwick and Vermeulen (2016) especially stress that large firms should learn from start-ups to prevent a hierarchical, bureaucratic and overly conservative corporate attitude.

Moreover, the management practices of CVC programs matter. Often, such practices are derived from the parent company or the established incentive system for CVC managers (Benson & Ziedonis, 2009; Dushnitsky & Shapira, 2010; Hill & Birkinshaw, 2008). The study of Siegel et al. (1988) finds that the ideal CVC should be fully independent from the mother corporation, having their own pool of funds they can dispose individually. This is necessary as corporate leadership often lacks a clear mission, financial commitment and appreciation of inherent risks of CVC. The authors themselves discuss that deal experience

and mutual learning might mitigate many of the hurdles identified. Given the time the paper was written and the juniority of CVC at this stage, the study presents some groundbreaking findings, although focus and rationale of CVC investments change over time.

Backing of and support for the CVC team from senior executives is essential. This can be achieved through locating CVCs in the direct reporting line of senior executives, especially the CEO. Moreover, specific reporting arrangements and a CVC investment board with representatives from all business units can be used. Anokhin et al. (2016) find that the governance structure of a corporation plays a crucial, yet often overlooked, role for the performance of a CVC fund. 2/3rd of CVCs report to top management (e.g. CEO, CFO, CTO, Head of Corporate Strategy/ Finance/ R&D) and only 1/5th reports to business units. Accordingly, investment boards mainly consist of CVC and senior corporate personnel with a background in start-ups or finance (MacMillan et al., 2008, p. 13). Thereby it is ensured that CVC investments are in line with the long-term corporate strategy and within the financial boundaries of the corporation. In the daily operations, however, business units play a crucial role in the collaboration with the start-up and thereby the innovation performance. Consequently, buy-in from business unit management and key personnel is inevitable and should be achieved early on. As this is rarely done through representation on the CVC investment boards, other forms of involvement during the screening and selection process are needed. Therefore, 3/5th of the CVCs consider it important to have either R&D or business unit representatives involved (MacMillan et al., 2008, p. 12). It becomes obvious that most CVCs are organized centrally, close to the corporate level.

Souitaris et al. (2012) extend this view and argue that the structure also depends on the mission of the CVC program. It can either have an endoisomorph orientation, i.e. have

its focus internally towards the parent, or be exoisomorph, i.e. geared towards the external industry. Although the authors contribute to CVC theory, especially to the description of how CVCs are organized, and provide empirical evidence on how the orientation influences the program structure, they fail to discuss implications on the performance, be it financially or especially strategically. The concept of endo-/ exoisomorphism has rarely be picked up in CVC literature, mainly because CVCs' goal is to provide a window on technology, which requires the external orientation.

Management of CVCs should mainly be staffed by experienced VC veterans from the start-up or venture community. Few corporate executives should be added to the team to support intra-corporation collaboration (Siegel et al., 1988). MacMillan et al. (2008, p. 23) find that, in reality, the majority of CVC management personnel comes from either outside hires having a link to the venture community or (temporary) secondments of business unit personnel to foster internal collaboration. Thereby, the best from both worlds is brought together and mutual understanding ensured. Following Hofstede's (2001, p. 373) finding that corporate culture is influenced by national culture, CVC teams are often comprised of multinational members. In addition, they are not necessarily (only) located at the corporations headquarter but are also situated in global start-up hotspots. For example, BMW's iVentures is headquartered in Silicon Valley. Additionally, it has an office at BMW's headquarters in Munich which is directly located in the BMW Forschungs- und Technologiehaus[26] to foster close collaboration with other research and technology-driven units within the larger corporation. Siemens' Next47 has offices in Munich, Palo Alto, Boston, London and Beijing to underpin its global presence.

[26] BMWs Research and Technology House

Besides staffing of CVCs, Dushnitsky and Shapira (2010) specifically analyze the effect of compensation of CVC management on the fund's performance and find that CVCs behave more similar to IVCs if the CVC management compensation is performance-based. CVC performance is superior to IVCs performance if the incentives for CVC management are dependent on performance. Therefore, Siegel et al. (1988) agree that CVC personnel should be rewarded in line with compensation schemes observable in IVCs, i.e. with a large variable performance-based share, as a performance-based incentive system seems to have a positive effect on the performance of CVC funds.

Clearly, the intensity of collaboration between the CVC and the venture will influence the innovation outcome. Paik and Woo (2017) find that CVC ownership, founder incumbency and a close CVC-venture interaction have a positive impact on a start-ups innovation capability, measured as R&D intensity. This proves especially strong if the founder keeps an active role in the management of the start-up and if CVC investors assume a seat on the venture board to support knowledge spillover and to closely align goals. Similarly, Howard et al. (2017) confirm the finding that a higher number of CVC managers on venture boards has a positive effect on innovation, especially on the ventures knowledge quality. However, they find a negative impact on product introductions, which they explain by the so-called shark's dilemma. The sharks dilemma states that CVCs make use of their powerful position and use technologies and innovations developed by ventures for themselves (Howard et al., 2017; Katila et al., 2008).

As a deep collaboration between the CVC and the venture is essential, the portfolio of stat-ups under CVC management, will influence the innovation performance. If the number of ventures under management of a CVC is too high, the joint innovation rate of the

corporation and all its ventures under management will diminish and even turn negative (Wadhwa & Kotha, 2006). The main reason is resource constraints. CVC managers or other corporate personnel have a limited capacity to either support start-up innovation or extract pioneering ideas from the start-up. According to Wadhwa and Kotha (2006), this inverted U-shaped relationship between the number of CVC investments and innovation performance can be dissolved if CVCs provide the resources to get closely involved in each and every venture under management. Consequently, the set-up and size of the CVC vehicle should cater to the number of start-ups under management. Following up on the identified reversed U-shape relation between number of CVC investments and innovativeness, Wadhwa, Phelps and Kotha (2016) further investigate the impact of CVC portfolios on firm innovation. Using data from the same industry, they confirm their initially identified relationship. The authors go one step further and find that this effect is influenced by the depth of knowledge a portfolio venture possesses. Therefore, a corporation will be most innovative if its portfolio of start-ups under CVC management is moderately diverse and if the start-ups have sufficient technological knowledge (i.e. patents) and social networks (i.e. alliance partners). Although both studies are limited to telco equipment manufacturers, a general applicability of the findings can reasonably be assumed. Lastly, technology and information systems play a role in (service) innovations (e.g. A. Frey, Trenz, & Veit, 2017)[27]. Consequently, it can be hypothesized that a driver of innovation performance is the proximity and information exchange between the corporation – either through the CVC or through business units and R&D departments – and the start-up. Going forward, this opens a new stream of research regarding characteristics of CVC-venture collaboration and the impact on innovation output.

[27] See Steininger (2019) for a literature review on the link of information systems and entrepreneurship

Distinction of CVC and IVC innovation performance

In literature, the innovation effect of CVC is often compared to non-corporate VC, especially IVC. Thereby, the positive effect on venture's innovation performance from having access to corporate resources and capabilities an IVC cannot offer is determined. These studies present heterogeneous results with regards to the superiority of CVC in nurturing start-up innovation. Studying US biotech companies, Alvarez-Garrido and Dushnitsky (2016) find that CVC-backed ventures have a higher innovation output than IVC-backed start-ups. This can be attributed to the availability of complementary assets, like expert networks, marketing experience, legal support, R&D knowledge or manufacturing assets (Gompers & Lerner, 1998, p. 38). The authors further find that especially geographic proximity and regulatory demands influence a start-ups ability to leverage the corporation's complementary assets. Although both IVCs and CVCs are active in the biotech industry and start-ups play a big role in introducing new innovations, the dataset limited to one specific industry constitutes a drawback of the study. In the biotech industry, the ability of maneuvering through regulatory FDA approval processes is much more prevalent than in any other industry. Moreover, the industry is heavily patent-driven, whereas others are more driven by access to sales channels or a firm's image. Nonetheless, Chemmanur et al. (2014) come to a similar result, finding that CVC is stronger in supporting a start-up's innovative capacity than IVC is. Although CVCs seem to invest in riskier young enterprises with less promising financials, their superior industry knowledge and their long-term attitude, leading to a higher acceptance of failure, is more beneficial for the venture. In contrast, Pahnke et al. (2015) find that IVC outperforms CVC regarding the effectiveness of supporting ventures' innovation capacity. Although CVCs have essential resources and capabilities that would help start-ups to develop their innovations, their institutional logic and set-up constraints the

access ventures get to these resources and capabilities. Such constraints are complex hierarchies and the split of responsibilities between business units and corporate offices or a competitive rather than collaborative mind-set of R&D departments. Although the applicability of this study is limited through focusing on the minimally invasive surgical device industry in the US only, it hints at a noteworthy challenge CVCs face, namely bringing the best of both the corporate and the start-up world together.

Dushnitsky and Shapira (2010) find that CVCs invest in later stage start-ups than IVCs and tend to be less involved in syndications, a setting where a CVC and an IVC act together. Syndications describe a joint investment of multiple venture funds in a venture at a given financing round. Besides the financial effect, syndications allow to increase the input in form of training, coaching, capabilities, resources and network access a start-up can get. Although syndications are frequently observed, syndication between two CVCs is rare as they would compete about access to innovation (H. D. Park & Steensma, 2012; Souitaris & Zerbinati, 2014). Nonetheless, Maxin (2019) theoretically discusses a setting where two CVCs have the possibility to either invest individually or perform a syndication. Corredoira and Di Lorenzo (2016) test whether the positive effect of CVC on innovation still holds if CVCs form a syndicate for their venture investments. They show that the more power the CVC holds within the syndicate, the more influential the inventions of the start-up, i.e. the more innovative the start-up. Moreover, they detected that the positive effect on innovation diminishes over time and that it is hardly observable if the CVC is not the lead-investor of the syndicate. Although individual studies come to different conclusions, there seems to be the tendency that CVC outperforms IVC with regards to innovation performance. This positive impact prevails if CVCs lead syndicates.

Measurement of innovation

One of the largest hurdle researchers face when evaluating innovation performance of a firm is the difficulty to measure it. Innovation per se is a complex and multi-faceted construct. Referring to the definition given above, an innovation covers goods, services, processes as well as marketing or organizational methods (OECD, 2005). Innovation does not only refer to the development, but also the implementation of something completely new or significantly improved. Innovation occurs in work places, full businesses or in external relationships. It becomes obvious that the broad array of innovation cannot satisfactorily be measured in one variable. In a review of general innovation theory, Tian et al. (2018) identify new ideas, R&D spending, patents and articles in scientific journals, new products, new technologies or new designs, inventions or trademarks per capita as measures being used as measures for innovativeness. In the context of CVC, patents are the most widely used approximation. Researchers either use the count of patents as amount of knowledge (e.g. Alvarez-Garrido & Dushnitsky, 2016; Chemmanur et al., 2014; Pahnke et al., 2015) or the frequency of patent citations as measure of knowledge quality (e.g. Dushnitsky & Lenox, 2005; Howard et al., 2017; S. W. Smith & Shah, 2013; Wadhwa & Kotha, 2006; Wadhwa et al., 2016). In addition, patent citation and subsequent success of the new patent are used (e.g. Corredoira & Di Lorenzo, 2016). Selected papers use product introductions (e.g. Howard et al., 2017; Pahnke et al., 2015; S. W. Smith & Shah, 2013). In contrast, R&D intensity (Paik & Woo, 2017), content of regulatory documents (S. W. Smith & Shah, 2013) or publications (Alvarez-Garrido & Dushnitsky, 2016) are rarely used. Some studies use their own questionnaire and thereby let CVC managers rate the innovation performance (e.g. Siegel et al., 1988). Moreover, some researchers apply more general measures, like firm value (Dushnitsky & Lenox, 2006), in which innovation performance is indirectly included. All

these measures face one or the other disadvantage. Some of the drawbacks can be manually corrected, like truncation problems and time lags inherent in patent data. Others can only be called out and accepted. Measures often significantly differ across industries, making comparisons difficult. For example, patent data will differ for biotech and consumer goods industries. Moreover, each of the measures only represents a narrow part of innovation. Although none of the indicators used in literature fully satisfies the aspiration of describing innovation precisely, some broadly accepted innovation measures exist in literature.

In addition to the limitations regarding the measurement of innovation performance, most studies suffer from selection bias. For example, it can be argued that CVCs – having intimate industry experience and insights – are better in identifying and selecting innovative start-ups than IVCs are. This drawback is, however, empirically hard to separate and is partially mitigated by the fact that IVCs often focus on selected industries only and thereby also develop an excellent market knowledge. Some of the studies only focus on single countries, like the US (Alvarez-Garrido & Dushnitsky, 2016; Chemmanur et al., 2014) or Germany (e.g. Ernst et al., 2005; Weber & Weber, 2002) or individual industries, e.g. biotech (e.g. Alvarez-Garrido & Dushnitsky, 2016), telecommunication equipment (Wadhwa & Kotha, 2006; e.g. Wadhwa et al., 2016), medical devices (e.g. Howard et al., 2017; Pahnke et al., 2015) or semiconductors (e.g. Corredoira & Di Lorenzo, 2016). Thereby a global application – in both geographical and industry-wide terms – of the results remains debatable. CVC investments historically came in waves, having different underlying rationales for engaging in start-up funding. As most of the studies above use data from the 3rd wave and no study deliberately compares the different waves, there remains the theoretical possibility that some of the findings will not hold for other waves and are therefore not transferrable to the current 4th wave. Although the studies discussed above are inconclusive and the measures

used to approximate innovation are imperfect, there is strong evidence that CVC is a suitable approach to foster corporate innovation. Practitioners can derive what objectives, manifestations and structures for CVC prove most successful.

In summary, large corporations face an ever faster changing environment. Therefore, constant innovation is substantial to stay alive and to participate in the harvesting of technological advances. Such innovations need to be both exploitative (like gradual improvements of existing products, services and processes) and explorative (like radically new innovations). In theory, innovation is a make-or-buy or make-and-buy decision and comes from company internal resources (R&D), external sources (M&A) or mixed approaches like alliances, joint ventures or user innovation. Historically, young entrepreneurial firms proved successful in generating innovations, often disrupting whole industries and challenging large established players. Therefore, CVC is, among others, one vehicle for corporations to collaborate with innovative start-ups. Using CVC as a window on technology or mediator between corporations and start-ups and assigning them strategic in addition to financial goals proves successful in fostering innovation through access to external sources.

II.2.2.3 Example: Google obtaining innovations from Nest Labs

One example that articulately demonstrates how established firms use their CVC arms to gain access to innovation and of which a lot can be learned regarding culture and collaboration is Googles investment in Nest Labs. Besides its profound success with its search-engine, Google invests in areas like the Internet-of-Things (IoT) and Artificial Intelligence (AI). Google's attempts in autonomous driving and the voice-based AI platform Google Home are well-known in this area. At some point, the company noticed that it would

need access to hardware built-in at houses to further innovate in the automated home space. Therefore, Google instructed its CVC arm Google Venture (today GV) to find promising start-ups in this field. One of them was Nest Labs which was founded in 2010 and is a provider of hardware for smart-home solutions and automation products. Its portfolio includes e.g. thermostats, home security devices like security cameras, video doorbells and smoke detectors. In May 2011 Google Ventures led the Series B funding round, followed by the Series C round in 2012. Thereby Google gained access to a promising start-up with strong innovation power. The innovativeness in both technology and design mainly stemmed from an excellent team, led by Tony Fadell and Matt Rogers. Both worked previously at Apple. Tony is often seen as the father of the iPod and Matt was one of the first engineers working on the iPhone. Through the collaboration Google gained access to hundreds of Nest's granted patents and many more patent applications on file. Additionally, Bill Maris, partner at Google Ventures, served as one of only four members of the Nest board. As mentioned above, a close collaboration between the corporation and the start-up is inevitable to foster innovation performance. In January 2014 Google decided to fully acquire Nest for 3.2bn$. Rumors have it that Apple was in talks to acquire Nest before but that Google Ventures as investor with a board seat successfully prevented it. The example of Google Ventures and Nest exemplary shows how CVC helps a corporation to gain access to start-ups in order to foster corporate innovation.

II.2.3 Selection process

Start-ups pursue a collaboration with CVCs to satisfy their funding needs while corporations primarily seek contact with start-ups to foster their innovative performance. Although the need for a link between the two parties is obvious, a case-by-case collaboration is cumbersome to achieve. Consequently, a double-sided selection and matching problem arises, where neither start-ups nor corporations are easily interchangeable commodity goods.

The vast number of more than 300mn global start-ups (InnMind, 2016) and the high failure rate of start-ups (Badal & Ott, 2015; Freeman et al., 1983; Metzger, 2017; Solvang & Berg-Utby, 2009) increases the complexity for a CVC to find the 'right' one[28]. On the corporate side, the number of existing and active CVC funds is on a steady rise with 186 newly established CVCs in 2017 (CBInsights, 2017b). Although both CVCs and start-ups are often active in specific areas, like industries, technologies or regions, a larger number of potential CVC-start-up combinations is possible.

Therefore, choosing the right partner is one of the highest priorities. To do so, both parties need to reduce the initial information asymmetry and learn about the other party to reduce the risk of adversely selecting an inferior partner. The required information can be gained through various approaches and is often performed in multiple steps. To shed light on the pre-investment selection process, the following part is organized as follows: first, a theoretical review of ways to reduce information asymmetry and an introduction to matching theory is given. Next, the process of how CVCs select start-ups is discussed and specific advantages and disadvantages of CVC compared to other market players are evaluated.

[28] For example, 70% of tech start-ups fail and even 97% of consumer hardware start-ups cease existence in the seed phase (CBInsights, 2018)

II.2.3.1 Matching, signaling, valuation and negotiation theory

Multiple theories build the base for a thoughtful discussion of the selection process in the CVC context. The well-developed search and matching theory will be discussed and extended by a review of the so-called signaling effect. When deciding on investing in a start-up, the volume of the investment plays a crucial role. Therefore, a general introduction into valuation of firms will be given. Lastly, an elaboration of negotiation theory concludes.

Search and matching theory

Matching theory is a well-develop stream of economic research. It describes a mathematical framework used to explain the formation of mutually beneficial relationships between two players. Through answering "who gets what and why" (Roth, 2015, p. 1) it gives valuable insights into the functioning of markets. Especially for imperfect markets, matching theory determines how relationships can be build and how market exchanges take place.

The importance of the theory is underlined by the attention the topic recently received. Both the 2010 and 2012 Nobel prices in economics were awarded to researches for their contribution to this theory. In 2010, the individual work of Peter Diamond (1965, 1967, 1971, 1981, 1982b, 1982a, 1984), Dale Mortensen (1970a, 1970b, 1977, 1978, 1982a, 1982b, 1988, 1994a, 1994b, 2005) and Christopher Pissarides (1979, 1984b, 1984a, 1985, 1992, 1994, 2000, 2009), as well as their joint contributions (Mortensen & Pissarides, 1994, 1998, 1999a, 1999c, 1999b) to markets with search frictions was honored (The Royal Swedish Academy of Sciences, 2010). Only two years later, Lloyd Shapley (Gale & Shapley, 1962; Shapley & Scarf, 1974; Shapley & Shubik, 1971) and Alvin Roth (Niederle, Roth, & Sönmez, 2007; Roth, 1982b, 1982a, 1984b, 1984a, 1986, 2009; Roth & Sotomayor, 1990) were distinguished for their theoretical and practical work on stable matchings (The Royal

Swedish Academy of Sciences, 2012). Among multiple others, these five scholars extraordinarily contributed to a large research field.

The dual distinction through the Nobel committee illustrates two branches of research that developed independently of each other. Both aim at explaining incomplete markets and finding ways to ensure a matching of market participants. On the one hand, the macroeconomic matching theory developed out of the more microeconomic search theory, focusing on the search behavior of individuals (McCall, 1970; Mortensen, 1970b). The efficiency of search and matching processes plays a crucial role in research. Diamond (1982b) especially focuses on externalities and sets the stage for market thickness and congestion, where market thickness describes a sufficiently large number of market participants on both the buyer and the seller side, whereas congestion appears if too much thickness occurs, i.e. if too many players enter the market making a satisfactory match improbable (Niederle et al., 2007). Pissarides (1984b, 1984a) finds that inefficiencies result from too low search intensities and an either too high or too low share of match acceptance. The Mortensen principle goes a step further and states that – in a perfect world – the most efficient outcome of a match is achieved if the resulting surplus is fully allocated to the searching, i.e. the match enabling, party (Mortensen, 1982a, 1982b). Although a high transferability of a matches utility is achievable if the partners have sufficiently similar characteristics (Becker, 1973; Parilina & Tampieri, 2013; Shimer & Smith, 2000), no mechanism exists that would lead to a completely one-sided allocation of utility and thereby a fully efficient outcome. This is the case, as no party can fully internalize both costs and benefits of searches (P. A. Diamond, 1982a). In the course of time, the originally stable theory, developed into a more dynamic view, making sequential decisions after an initial matching possible (e.g. Mortensen, 1988).

On the other hand, a mathematical and game-theoretical approach to stable matchings exists. The seminal paper of Gale and Shapley (1962) builds the theoretical foundation through developing the first mathematical model of a stable matching market equilibrium. In the 1970s this model was further sharpened (e.g. Shapley & Scarf, 1974; Shapley & Shubik, 1971). Roth (1984a, 1986) strongly contributed through empirically supporting the theory with real-life examples. Since the early 2000s, the attention drifted towards practical real-life applications, thereby strongly impacting policy decisions, e.g. in the set-up of kidney exchange programs (Abdulkadiroglu & Sönmez, 2012; Roth, 2009; Roth, Ünver, & Sönmez, 2004).

For a better understanding of the theory, some basic terms need to be introduced, following Niederle et al. (2007). A matching describes the outcome of the respective game. The different parties that participate in a matching are called agents. The so-called assignment problem arises if a combination is desirable for partner A, but not for partner B (Mortensen, 1988). A matching occurs if either two players of distinct groups (e.g. men and women) form a relationship, or if a player matches with themselves. In the first case, the matching is blocked by a pair. In the second case, the matching is blocked by an individual as the individual k prefers staying independent over forming a relationship with someone else j. In this case, ‘j is unacceptable to k’. If a further reallocation of agents would not make any party better off, the matching is called stable.

Matching theory is only applicable if markets are not cleared through standardized market prices and an equilibrium of supply and demand. Therefore, matchings are observable when so-called market frictions exist. Such frictions cannot be circumvented in many markets. Sellers often face difficulties to find buyers for their products and vice versa or fail

to effectively coordinate between the different agents (P. A. Diamond, 1982a). Information asymmetries, high costs to identify potential partners or high transaction costs are origins of market frictions (Song, 2013). For example, the Diamond paradox states that even a minor search cost shifts the equilibrium price far away from the price that would have occurred in a perfect market (P. A. Diamond, 1971). Moreover, difficulties to determine an indivisible and heterogeneous good or the reliability of a partnering firm lead to market failures (Mortensen, 1988; Shapley & Scarf, 1974). In special cases, like kidney exchange or allocation of pupils to schools, no monetary prices exist at all. Therefore, the clearance of markets is nearly impossible. As a consequence of such market failures, either rules are agreed upon or clearinghouses established (Niederle et al., 2007). Clearinghouses can only be successful if the algorithms they use fulfill their requirements and if a safe market exists, where agents are willing to share information they have and act upon information they receive.

Markets where matching takes place are heterogeneous and are modelled in different ways. Therefore, markets are differentiated by (i) the number of agents to be matched and (ii) and the occurrence of preferences (Han, Gu, & Saad, 2017, p. 9; Niederle et al., 2007). First, there are 1-to-1 matches, where one and only one agent needs to be match to one and only one other agent, e.g. marriages or the assignment of a kidney to one organ receiver. Moreover, n-to-1 matches exist, where multiple agents of one side are allocated to one agent of the other side. For example, multiple students are assigned to one school. A situation where multiple agents of one side are matched with multiple agents on the other side are called n-to-n matches. This occurs, for example, if multiple workers are assigned to multiple projects within a firm. Preferences over the matching partner can be one- or two-sided. They are often one-sided if one of the involved agents is an object. For example, a kidney itself will not have

any preference over the agent it is matched with. In contrast, two-sided preferences arise if the agents from both sides voice their preferences. Marriages would be an excellent example of a two-sided market, where the agents from both sides have preferences. Figure 12 graphically represents the different classifications and gives selected examples:

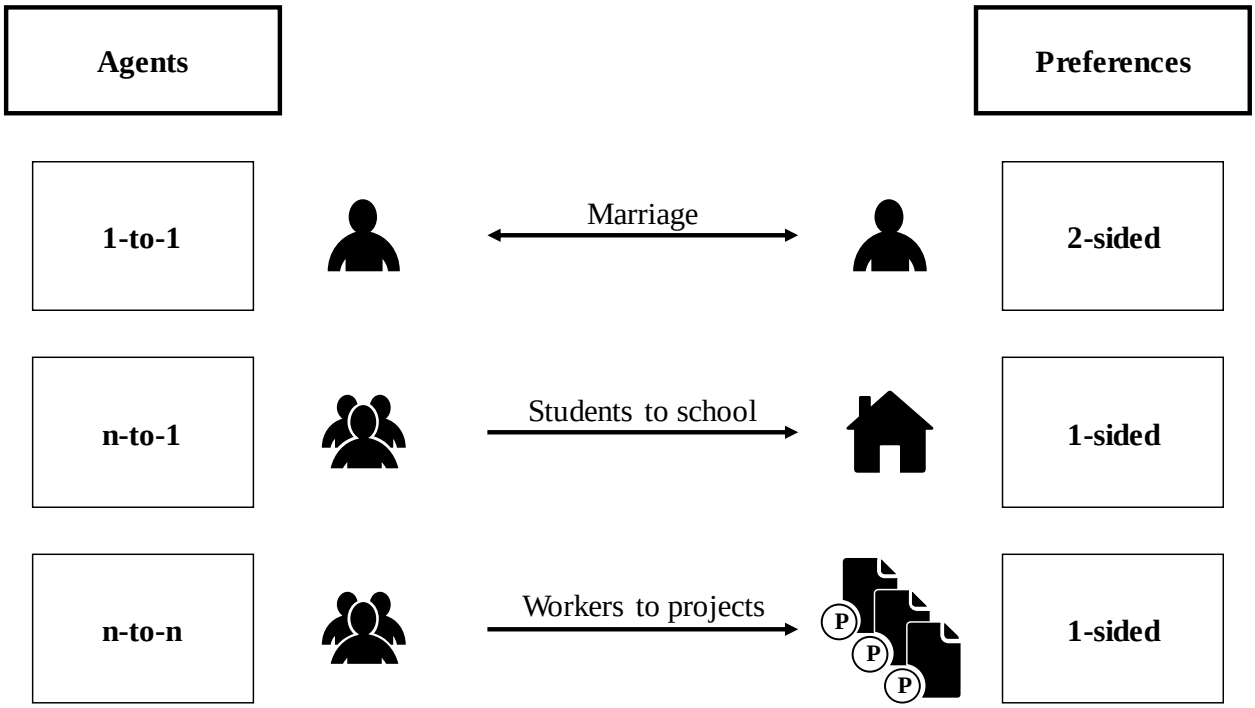

Figure 12: Classification of matching markets (derived from Han et al., 2017; Niederle et al., 2007)

Empirical work on search and matching theory is primarily available for selected markets. Starting with Mortensen (1970a, 1970b), the labor and unemployment market attracted the interest of many scholars. The well-known Diamond-Mortensen-Pissarides (DMP) model explains how matches and subsequent separations between workers and employers develop (P. A. Diamond, 1982a; Mortensen & Pissarides, 1994; Pissarides, 1985). The model can be split in and adjusted for multiple other models, allowing the testing of a broad array of assumptions. As an extension of the work on unemployment, a public finance (e.g. taxes and social insurance), financial economics and monetary policy view developed (Acemoglu & Shimer, 1999, e.g. 2000; Bovenberg, 2003; Brettel & Cleven, 2011; P. A.

Diamond & Mirrlees, 1971, 1978; Duffie, Garleanu, & Pedersen, 2005; Kiyotaki & Wright, 1989, 1993; Song, 2013; Weill, 2007). Moreover, the housing market constitutes a good practical example for the search and matching theory, resulting in multiple studies (e.g. Abdulkadiroglu & Sönmez, 1999; Albrecht, Anderson, Smith, & Vroman, 2007; Wheaton, 1990). Besides these economic markets, the marriage market is a well relatable and easily understandable example for search frictions (e.g. Burdett & Coles, 1997; Gale & Shapley, 1962; Mortensen, 1988; Parilina & Tampieri, 2013; Shimer & Smith, 2000). Following the stable matching stream initiated by Roth and Shapley (Gale & Shapley, 1962; Roth, 1982b), college admissions and pupils to school and kindergarten matching, dating and marriages, kidney exchange and housing allocation for socially deprived citizens are the main applications (e.g. Han et al., 2017; Roth, 2015).

In order to solve complex matching and assignment problems, different kind of algorithms were developed. As different algorithms might lead to different outcomes, the choice of a suitable algorithm is key and depends among others on the classifications outlined above. Niederle et al. (2007) present a summary of the four leading algorithms. The first is the Deferred Acceptance Algorithm for marriage market, based on Gale and Shapley (1962). In simple words, a man proposes to his first choice of woman. The woman than either accepts or rejects the offer. A rejected man makes a proposal to his second most preferred woman. This is repeated until no further rejections occur. The Top Trading Cycle (TTC) algorithm was developed for a 1-on-1 matching in the housing market (Shapley & Scarf, 1974). Each agent calls out his or her preferred house. Following an ordered list, the exchanges occur. Agents that did not get their preferred house repeat the game with the remaining houses until all agents are allocated one house. This algorithm was extended into a class of Top Trading Cycles and Chains (TTCC) algorithms which include indirect matches through chains (Roth

et al., 2004). Hylland and Zeckhauser (1979) developed an algorithm for house allocations without prior ownership. This often-used algorithm is called Random Serial Dictatorship (RSD). All agents searching for a house are listed in a random uniformly distributed order. Then, every agent – starting from top of the list – gets to choose his or her preferred option from the remaining houses. In fact, the RSD algorithm is equivalent to a mechanism called Core from Random Endowments (CRE), where houses are first randomly assigned to owners (Abdulkadiroglu & Sönmez, 1998). Both TTC and RSD were further generalized by Abdulkadiroglu and Sönmez (1999) through developing an algorithm that allows for existing tenants, new tenants, occupied houses and vacant houses. Using the You Request My House – I Get Your Turn (YRMH-IGYT) algorithm, only vacant houses are considered initially and agents are brought in a random order. Following the order of agents, every agent can choose his or her preference from either its own house or any of the available homes (making his or her own house available). Given that the top preference of the agent is an occupied house, the owner of the occupied house is moved up in the list and gets to choose his or her preference right before the agent that would normally be in line. The discussion of these algorithms shows that multiple theoretically developed and practically proven ways for solving assignment problems exist.

Concluding, the search and matching theory describes imperfect markets characterized by information asymmetries and high search costs. Moreover, 1-to-1, 1-to-n or even n-to-n combinations between agents possible and the existence of indivisible and heterogeneous goods is required. By now, the attentive reader should notice that the CVC-start-up market clearly follows these patterns. Accordingly, the theory should give a basis for discussing the selection process and match-making between CVCs and start-ups.

Signaling theory

A first step in bringing the CVC and the start-up together is the signaling of a desire to collaborate, in other words the aim to establish a matching. Signaling theory, which is often discussed in the context of contractual agreements, is a solution to information asymmetry. When partners lack sufficient information to decide on whether or not to collaborate, signals will help to ease the decision.

Historically, various foundations of signaling theory are available. Among others, Veblen (1899) discusses socio-economic institutions and how occupation of individuals signals their belonging to different social classes. Additionally, the theory of signaling finds application in fundamental discussions of the reasons for giving gifts (Mauss, 1925). In the modern world, signaling theory is observable in two different research areas, being economics and biology. The discussion in economics is based on information asymmetries (Akerlof, 1970) and formalized by Spence (1973, 1974) and his – Nobel Prize awarded (The Royal Swedish Academy of Sciences, 2001) – work on job markets. In biology, the Handicap Principle (Zahavi, 1975) explains why animals have seemingly disadvantageous physical characteristics, like the extraordinary plumage of male peacocks, in order to signal their quality in the context of sexual selection. Whereas the economic literature is based around formal models and a more mathematical view on the signaling problem (Riley, 2001), the research in biology focuses on merely theoretical arguments without diagrams and calculations (Bird & Smith, 2005). Moreover, an independent research stream reviewing signaling from a game-theoretic view exists (e.g. Cho & Kreps, 1987; Crawford & Sobel, 1982; Gibbons, 1992).

In economics, signaling theory describes a situation where one party sends a signal to another party in order to establish a relationship (Spence, 1973, 1974). The two parties are often named principal and agent, where the principal searches for an agent with specific characteristics but has limited information about the agents in the market. Agents differ by the manifestation and quality of the characteristics they have, resulting in either high (denoted P_H) or low (P_L) performance. Due to information asymmetry, the expected performance of an agent is ex-ante unknown to the principal. In order to avoid adverse selection, especially agents with P_H strive at signaling their true capabilities to the principal. As the initial theory was developed using the example of a firm (the principal) trying to find a suitable worker (the agent) (Spence, 1973, 1974), Spence's example will be used to lay out the key concept. Employers receive multiple applications for a job. As assessing applications is a costly procedure, firms need to find a way to reliably assess the quality of an applicant. Each applicant truly interested in obtaining the job wants to distinguish herself from the competing applicants. The performance or productivity $P \in \{P_H, P_L\}$ with $P_H > P_L$ is exogenously distributed to the agents and cannot be changed through any activity. Initially, the true performance is only privately observed by the agent themselves, whereas firms make hiring decisions based on the expected performance E[P], with $P_H \geq E[P] \geq P_L$. Therefore, agents choose a signal, like education E, before they are hired. Education can be e.g. obtaining a university-degree versus not obtaining any additional education. It is important to notice that P is fully independent of E, meaning that obtaining additional education or training will not increase the actual performance on the job, but only serve as a signal for the ex-ante performance level. Education E cannot be obtained for free but comes at some cost C_E. Workers with high performance face a lower cost for obtaining the education than workers with low performance: $C_E(P_L) > C_E(P_H)$. This so-called single-crossing condition describes

the key assumption of the model and leads to the fact that the indifference curves of P_H and P_L only intersect once. Moreover, firms discriminate wages in line with the performance P. Employees showing a high (low) performance P_H (P_L) will receive the wage W_H (W_L), with $W_H \geq W_L$. Figure 13 shows the resulting indifference curves:

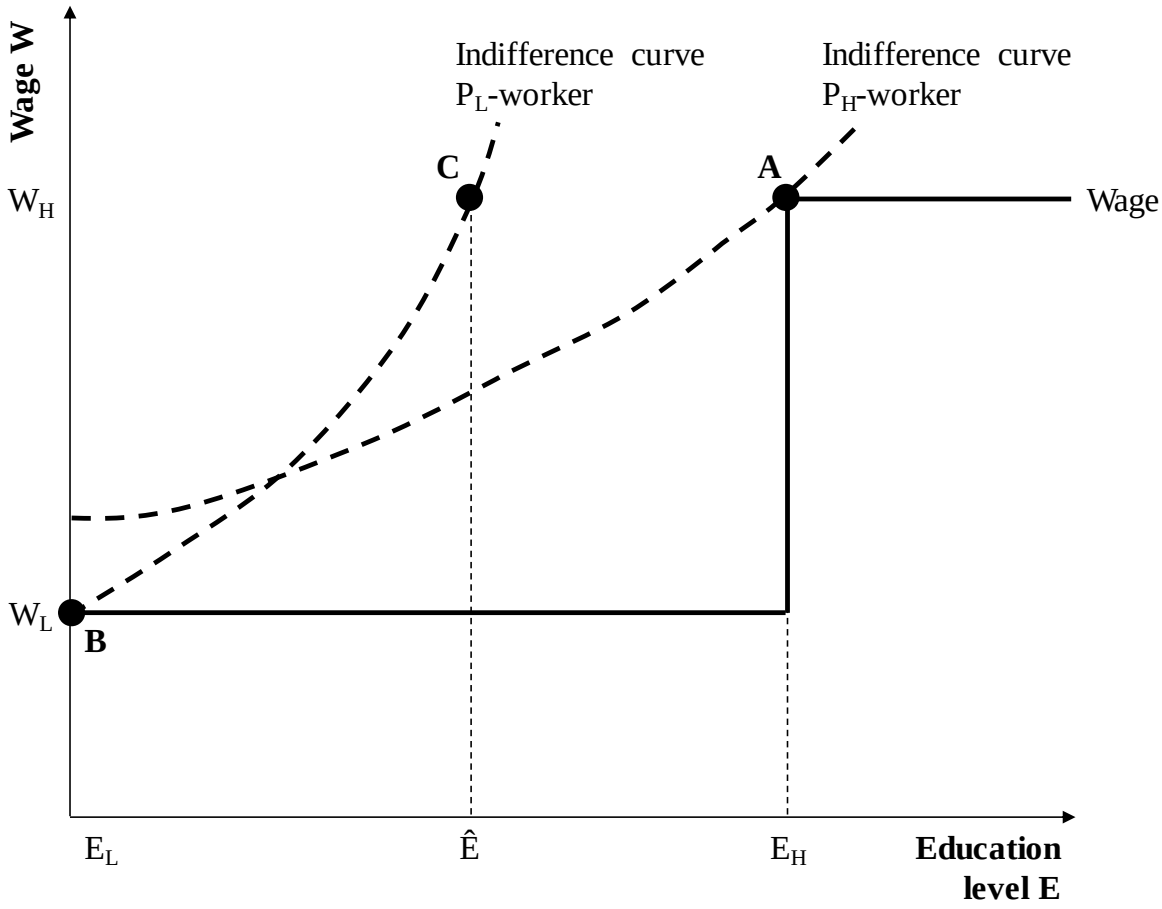

Figure 13: Indifference curves for job applicants (adapted from Spence, 2002; The Royal Swedish Academy of Sciences, 2001)

In line with the homo economicus assumption, workers will only accept wages where the utility of a wage $u(W) = W - C > 0$. Firms, in contrast, only hire workers if they make a profit $\pi(W) = E(P) - W \geq 0$. Bringing things together, firms will only make a wage offer if

the occurrence of the signal education E reliably justifies a high wage for the worker[29]. The graph illustrates that workers with a high productivity will choose E_H and thereby receive a higher wage at A. In contrast, P_L-workers are worse of when choosing A and therefore stay at a low education – low wage level at alternative B. According to Spence (1973) this leads to the most beneficial equilibrium for a society. Whenever all workers chose the same education, a pooled equilibrium with W_L will result. A pooled equilibrium will also result if education is not a reliable signal for performance. A specific equilibrium can be found at C. $\hat{E}$ is the minimum education level P_H-workers require to distinguish themselves from workers with low performance capabilities. According to Riley (1975) this constitutes the only signaling equilibrium at which employers will keep wages robust and refrain from experimenting. Following Cho and Kreps (1987) all equilibria introduced by Spence can be seen as Bayesian-Nash equilibria. Further additions and limitations can be introduced to the model, like discrimination of W and C_E for male and female workers or different types of education E. Thereby, further equilibria are possible. Moreover, inherent simplifications, like that productivity is fully independent of education can be relaxed or a time variable, like repeating games, introduced in more complex models, without altering the key conclusions. For Spence (1973) signals are public, i.e. every firm receives the same signal. A second form of signaling, namely preference signaling exists (see e.g. Avery & Levin, 2010; R. S. Lee & Schwarz, 2017; S. Lee & Niederle, 2014) which can also be informal (Roth & Xing, 1994). As a worker's preference differs by firm, such signals are private and often not shared with the firm although they most of the times come with zero cost.

[29] Notice that in the case of separation, where workers with P_H chose to gain education E, two different wages W_L and W_H will be offered

Signaling theory can be applied to multiple settings. The initial research focused on labor markets and workers. Spence (1973) elaborates on whether low versus high education can be used as a signal for workforce performance. Riley (1979) was one of the first to empirically test and verify the predictions of Spence. Subsequently, different scholars confirmed the findings on labor markets (e.g. Bedard, 2001; Lang & Kropp, 1986). Farber and Gibbons (1996) extend the initial model through including further career information as signals. Similarly, signaling is applied in the context of college admissions (e.g. Avery, Fairbanks, & Zeckhauser, 2004; Avery & Levin, 2010). Waldman (1984) takes a slightly different angle and finds that companies tend to keep workers in jobs below their true ability to signal to the market that the employees are not worth trying to headhunt them. On the one hand, this leads to a positive effect for the company – namely keeping a good employee – on the other hand, this destroys overall value for the society as workers perform below their maximum ability. Moreover, a promotion of a worker with a low education, signals his or her strong capability to actually perform well on the job (Bernhardt, 1995). Signaling is also studied in a marketing context, analyzing whether brands and advertising can be used to signal the quality of a product (e.g. Barone, Taylor, & Urbany, 2005; Milgrom & Roberts, 1986; P. Nelson, 1974). A further field that attains a lot attention from signaling scholars since early on is the topic of dividend payments. Dividends are often higher taxed[30] than mere capital gains. Nonetheless, companies consistently pay dividends to their shareholders. John and Williams (1985) are one of the first analyzing this finding and conclude that dividends act as signaling device through transporting company-internal information that is not included in public reports. Building on this seminal work, further research on the signaling effect of dividends is conducted (e.g. Baker, Mendel, & Wurgler, 2016; Shapiro &

[30] Through double taxation

Zhuang, 2015; Tsuji, 2012), also taking into consideration adverse effects during the financial crisis (Nguyen & Tran, 2016). A more holistic literature review on the signaling power of dividends can be found in Deeptee and Roshan (2009).

Reuer and Ragozzino (2012) apply signaling theory in the context of firm IPOs. Their findings reveal that the public reputation of the underwriting bank provides valuable information on forms of collaborating with the new public firm. When firms desire to set up franchises, they send a signal (most often regarding the profitability of the endeavor) to the market to attract partners (Fadairo & Lanchimba, 2012; Michael, 2009). Central banks around the world heavily use signaling for the monetary policy. Public statements, meeting minutes, reports and interest rates[31] are closely monitored by market participants to learn about the state of the economy and potential future central bank actions (Andersson, Dillén, & Sellin, 2006; Melosi, 2016; Tang, 2013). Havrilesky (1993) even developed a so-called SAFER index[32] that weekly summarizes the signals on monetary policy given by administration officials. In a broader sense, signaling is also studied in matters of corporate social responsibility (e.g. Su, Peng, Tan, & Cheung, 2016), corporate reporting and disclosure (e.g. Hamrouni, Miloudi, & Benkraiem, 2015; Lys, Naughton, & Wang, 2015) and management successions (e.g. Schell, Fröhlich, Moog, & Hack, 2015). More recently, the effect of signaling finds application in new markets, like crowdfunding (e.g. Vismara, 2018), peer-to-peer lending platforms (e.g. Yan, Yu, & Zhao, 2015) or internet dating (e.g. S. Lee & Niederle, 2014). In short, research across multiple applications consistently finds that signaling reduces information asymmetries.

[31] Like repo rate, main refinancing operation rate, federal funds rate
[32] SAFER = Signaling from the Administration to the Federal Reserve

Summing up the discussion on signaling theory, it becomes obvious that sending signals between parties is a powerful and well-functioning tool that helps to reduce information asymmetries. As the theory is robust to empirical testing in a broad range of applications, it can reasonably be expected that using signals will also be successful in the selection process of CVCs looking for partnering start-ups. Therefore, sending signals in both ways from the CVC to the start-up and vice versa seems adequate.

Valuation theory

As part of the matching theory, preferences of different agents need to fit to make a matching stable. In signaling theory, the main outcome for the agents (the worker) were prices (the wage). So far, both preferences and prices were considered as abstract constructs that were exogenously determined. Now it is time to turn these concepts into more specific monetary values, as every CVC needs to know how much money it has to invest in a venture and every start-up wants to know how much money it receives from a CVC. The approach for putting a price tag at an asset is called valuation. Within the next few paragraphs, the goal of valuations and its origin are summarized. Afterwards, well-known models are discussed.

Valuations aim at deriving a monetary value of an asset or liability. An asset can take various forms, e.g. a whole company, real-estate, a financial instrument like an option, an investment project or an intangible asset, like a software. In some cases, also liabilities (e.g. tax liabilities) are valued. The specific objectives differ from case to case, especially by who performs the valuation (e.g. acquirer vs. target). However, a common word of caution needs to be given on all valuations. Valuations are subjective, incorporate uncertainty and will change over time. These biases are dissociated with the models and approaches used, but stem from the assumptions and inputs used, which are often a function of a valuer's

objectives, overall market sentiment and specific characteristics of the asset to be valued. In the time leading up to the burst of the Dotcom bubble, a large range of companies was strictly overvalued. The valuation of a large company with decades of history operating in a stable environment clearly incorporates less uncertainty than the valuation of a new start-up operating in a trendy high-tech environment. Nonetheless, valuations are far more than merely deriving a value for an asset. Not only the final outcome, but also the way of attaining the outcome is vital. Thereby, a lot can be learned about the asset, e.g. the market conditions a company operates in, its business model or its financial stability.

Valuation theory has its origin in the 1950s, when more and more analytical methods were incorporated in the finance theory (Jensen & Smith Jr., 1984). Historically, the majority of valuation theory builds on the Modigliani-Miller theorem regarding the irrelevance of the capital structure of firms (Modigliani & Miller, 1958). Already starting discussions on the security market line in his dissertation (Sharpe, 1961), Sharpe's seminal contributions (1963, 1964), jointly with the work of Treynor (1962) and Lintner (1965) can be seen as foundation of the so-called capital asset pricing model (CAPM), which is essential for many valuation approaches. In this vein, Markowitz (1952) and Roy (1952) developed the modern portfolio theory strongly contributing to the consideration of risk in the CAPM. The arbitrage pricing model (APM) (Chen, Roll, & Ross, 1986) and various multi-factor models (e.g. Fama & French, 1993) are further advancements.

Referring to a different approach to valuations, Black and Scholes (1973) are key contributors to option pricing. The work of these authors tremendously contributed to valuation theory known today. Besides, several researchers and practitioners provide excellent guidance on valuations. One of the most well-known and most active players in

this field is Damodaran. Therefore, the following summary of valuation approaches is largely based on his work (Damodaran, 2002, 2009), which is also recommended for further reading.

Four main approaches on valuations exist. Although they differ in their assumptions and complexity, they are similar enough to lead to comparable results. (i) The discounted cash-flow (DCF) model calculates the present value of future expected cash-flows, (ii) relative valuations are based on multiples on common variables, (iii) contingent claim valuations are an option-based pricing model and (iv) asset-based approaches calculate the liquidation value or replacement cost of an asset. Approaches (i), (ii) and (iii) are discussed in more detail below. Key formulas are stated and dissected to derive hurdles for start-up valuations. Approach (iv) is rarely used for company valuations and is therefore omitted here.

The discounted cash-flow approach builds the foundation for most other concepts. It is a fundamentals approach to derive at an intrinsic value of an asset. Although it can be split in multiple sub-forms, the basic idea remains the same and is most explicitly explained by looking at the following formula:

$$Value\ of\ firm\ = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} + \frac{Terminal\ Value_n}{(1+r)^n}$$

where n describes the years with forecasted cash-flows, CF_t describes the expected future cash-flow in year t and r describes the risk-adjusted discount rate, normally the weighted average cost of capital (WACC). For CF_t normally historic cash-flows are used and a growth rate is applied. Independent of using a direct or indirect method to derive cash-flows, start-ups normally lack historic data. Using the indirect method, future earnings are needed. To derive expected earnings, historic revenues, a profitability margin and a growth rate are

needed. Regarding growth rates, Damodaran recommends using either past earnings, equity analyst forecasts or fundamental data (i.e. amount and quality of reinvestments). As stated, the discount rate r is a measure of risk and is based on the so-called weighted average cost of capital (WACC):

$$r = WACC = \frac{E}{E+D}\, r_E + \frac{D}{E+D}\, (r_D - tax)$$

where E denotes equity, D describes debt, r_E refers to the cost of equity, r_D to the cost of debt and tax is the corporate tax rate. Again, different variables need to be estimated for the asset under valuation. In line with the discussions above, start-ups normally do not bear debt. Therefore, the second term of the equation becomes 0 and the WACC is equal to r_E. The derivation of r_E is most often based on the well-known CAPM[33]:

$$r_E = r_f + \beta\, (r_m - r_f)$$

where r_f denotes a risk-free rate (especially government bonds) and r_m describes an expected market return, making $r_m - r_f$ a risk premium. As r_f and r_m can be obtained independently of the asset to be valued, especially β is of interest. β refers to a company specific risk-measure and describes how much more (or less) risky an asset is compared to the market. Statistically it is the asset's covariance with market returns over the market portfolio's variance, as derived from modern portfolio theory (MPT) (Markowitz, 1952). Theory suggests three possible ways of estimating betas. First, historic market betas can be calculated, especially if historical share prices are available for publicly traded firms. Secondly, fundamental betas can be derived from looking at the firm's business and its operational and financial leverage.

[33] The CAPM has three underlying assumptions, namely no transaction costs, divisible assets and same information for all players

Lastly, bottom-up betas based on the betas of publicly traded companies in the same business are possible.

Relative valuations are a heavily applied approach, especially in VC. Common variables, are used to derive at a firm value through multiplying them with multiples observed in the market:

$$Value\ of\ firm = I_f * M_{m/f}$$

where I_f describes an indicator of the firm to be valued, often referred to as common variable. M describes a multiple which can be derived from either the market (M_m) or the firm itself (M_f). Common variables are often financial indicators that are available for a large set of companies, like earnings, revenue, cash-flows or book values. In addition, sector-specific and non-financial variables are possible. For example, during the 2000s, the number of website visitors was used broadly. The multiplicators can come from comparable assets, like firms in the same market, or from trading multiples, like. market transactions. Moreover, historical multiples of one firm can be used to value the firm at another point of time. Often, a set of comparable companies is collected and the average multiplicator computed. Relative valuations are a fast approach which comes with some general limitations. First, company internal considerations are often neglected as a link to firm fundamentals is missing. Moreover, the comparability of a unique firm to the used market firms is often a source of discussion among valuers. The approach is easy to manipulate[34]. It incorporates market errors, for example if all firms are overvalued during a bubble, the value of the firm of interest will be overstated, too.

[34] For example, through including or excluding selected firms

The third approach, namely 'contingent claim valuations' comes from the trading of financial options and is increasingly used in other fields, especially so-called real options. Often, future cash-flows and therefore the company valuation are contingent on the occurrence of a specific event. Existence of patents or exploration of natural resources are two areas where option-based valuations find application. Options can come in form of a call or a put. Without going further into detail or deriving the formula, the well-known Black-Scholes (1973) model is given by:

$$Value\ of\ a\ call = S\,N(d_1) - Ke^{-rt}\,N(d_2)$$

with

$$d_1 = \frac{\ln\frac{S}{K} + \left(r_f + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$$

and

$$d_2 = d_1 - \sigma\sqrt{t}$$

where S is the current value of the asset, K is the strike price of the option, t is the lifetime of the option, r_f is the risk-free rate for timeframe t and σ^2 is the variance in the ln(value).

Summing up the discussion on valuations, it becomes obvious that multiple well-proven valuation approaches exist. Although they are broadly used by practitioners to value firms, hurdles and limitations for start-up valuations remain. Deriving the value of a firm is an important step to come closer to a contractual agreement, especially regarding the size of an investment. However, a valuation result is rarely exactly the same as the price paid for an investment. As Warren Buffet said, "price is what you pay; value is what you get" (2008, p.

5). As prices are driven by – among others – supply, demand and negotiation power of the involved parties, an introduction to negotiation theory is indispensable.

Negotiation theory

Negotiation is often the final step in a search process leading up to a contractually agreed transaction. As negotiations are present in many situations of daily life and multiple streams of academia, it is hardly possible to describe a formal theory (Lande, 2017). Scholars of economics, business, law, politics and international relations, but also mathematicians, psychologists and sociologists contributed to the theory (Alfredson & Cungu, 2008). What is guaranteed is the origin of the word. Negotiation stems from the Latin words *neg* and *otsia*, meaning no leisure. Originally, it described the mere presence of 'business', but in the 17th century the meaning shifted towards a diplomatic dialogue between parties. Although a long history of negotiations exists, the topic gained increased attention after World War II and developed upon the omni-present conflict and attempts to diplomatically resolve the tensions of the Cold War (Alfredson & Cungu, 2008). Being a notable researcher in negotiation theory, Zartman (1975) saw negotiations as a process in which arguments are exchanged until two parties reach a point of convergence. As will be shown, this definition is too narrow and does not capture the complexity of negotiations. Nonetheless, it clearly states the goal of negotiations, namely reaching a joint agreement. The achieved agreement should yield a benefit for all involved parties. For this to be possible, a joint interest is required (Schelling, 1960) and areas of agreement are needed (Fischer & Ury, 1981, p. 7). In general, multiple ways to reach an agreement are available. They included different tools, tactics or process steps (e.g. Druckman, 1986; Saner, 2012). Moreover, different strategies can be applied to reach a beneficial agreement. In this context, game theory, especially the so-called prisoner's

dilemma contributed to the theory on negotiation (Snyder & Diesing, 1977). The initial idea for the prisoner's dilemma stems from Dresher and Flood in 1950 and was generalized by Tucker in 1951 (Tucker, 1983)[35] and Axelrod (1981). All kinds of different game-theoretic models for negotiations or bargaining situations are available, like sequential bargaining (Grossman & Perry, 1986) or bargaining with time preferences (Rubinstein, 1985), all assuming imperfect information.

Independently of how negotiations are approached, they all have in common that at least two parties communicate. Therefore, the parties and their relationships are highly influential. As human beings perform the negotiations, they are rarely emotion-free (Druckman & Olekains, 2008) and mutual trust becomes a key success factor (Ross & Lacroix, 1996). Parties often have different or even seemingly opposing goals (see e.g. Carnevale & De Dreu, 2006). Moreover, external pressure, e.g. values, social norms, public pressure from media, culture and further environmental factors influence negotiations (Olekains & Adair, 2013). A large field of literature specifically considers the role of gender in negotiations (e.g. Bowles, Babcock, & Lai, 2007; Craver, 2016; Kimmel, Pruitt, Magenau, Konar-Goldband, & Carnevale, 1980; Mazei et al., 2015; Paddock & Kray, 2011). Another area of interest is the discussion of power disparities among the parties involved. Whereas early scholars follow the thoughts of Machiavelli and von Clausewitz and argue that power differences are the major determinant of negotiation outcomes (e.g. Bacharach & Lawler, 1981), more recently the notion of differentiating negotiation skills evolved (e.g. W. Zartman & Alfredson, 2019). Although Tirole (1988) specifically focuses on borrower and lender negotiations, insightful findings on bargaining power emerge. Besides the number of parties

[35] Tucker happened to be Nash's PhD advisor (Méro, 1998)

and therefore the availability of additional options, the reputation of all parties involved is crucial and will set the tone from the beginning. The topic of negotiations is too broad to fully cover here. For further reading, Lande (2017) and Menkel-Meadow (2009) are recommended. What remains is the insight that negotiations are not to be underrated and that they play a crucial role in bringing parties to a joint agreement.

In order to discuss the process of how CVCs select start-ups and vice versa the theoretical foundations were discussed. Search and matching theory create the basis, whereas signaling simplifies and supports the search process. As both matchings and signals are dependent on preferences and monetary considerations, valuation theory was introduced. Finally, a glimpse on the role of negotiations was given. The next part will discuss the application of the underlying theories in the CVC context.

II.2.3.2 Selection process for CVC

In the following section, the process of how CVCs identify and select start-ups to invest in is discussed. Thereby, the approach of practitioners is brought together with the perspective of researchers. A similar process is used consistently across industries, regions and different forms of VC funds. Historically, researchers concluded that IVC and CVC follow similar processes (Tyebjee & Bruno, 1984; Wright & Robbie, 1998), whereas more recently especially Souitaris and Zerbinati (2014) argue that the investment processes differ. However, the general process steps are similar and only the focus on specific criteria or directions might differ. During the due diligence phase, for example, IVC focuses more on financials, whereas CVC stresses technological considerations. The process can be structured along the following five steps:

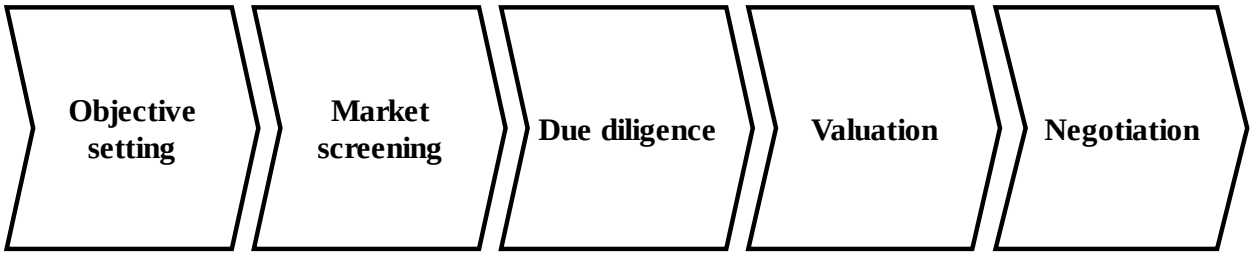

Figure 14: CVC process of selecting start-ups (adapted from Wright & Robbie, 1998)[36]

After setting the objectives for an investment and defining key characteristics of portfolio firms, start-ups available on the market are screened. Using different criteria, a short-list of potential targets is derived and different due diligences are performed on few ventures. A handful of start-ups is valued and negotiations are conducted. As the whole process of screening, due diligences, valuation and negotiation absorbs both financial and human resources from the CVC, some form of internal gatekeeping process is normally established where senior managers of the CVC or the corporate investment committee need to sign off the advancement to the next stage and release the required budgets (Christofidis & Debande, 2001). One of the goals of this pre-contracting process is to reduce information asymmetry. Empirical evidence shows that following such a standardized process increases the chances of successful investments (Mason & Harrison, 2002). As the number of start-ups in consideration is reduced from step to step, the knowledge about and understanding of each potential portfolio firm is gradually increased. In the following, each step is discussed in more detail.

[36] Wright and Robbie (1998) describe a broader process than the one discussed in this work, as they include all steps from setting up a VC fund to a post-exit phase

Objective setting

CVC follows financial and strategic objectives (Chesbrough, 2002; Siegel et al., 1988). More precise objectives are derived on (i) the general CVC level and (ii) an investment-specific case-by-case level. Normally, objectives are jointly set by CVC management and corporate leadership. More than half of all US CVCs consider both a window on new technologies and support for existing business as important objective (MacMillan et al., 2008, p. 9). External innovation and a boost of internal R&D are therefore the most important strategic goals (Benson & Ziedonis, 2009; Ernst et al., 2005; Gompers & Lerner, 1998, p. 19) and should guide investment decisions. A further objective of investing in start-ups might be the access to highly qualified personnel and talent (Ernst et al., 2005) or the awaking of an entrepreneurial mindset within a corporation (Dushnitsky & Lenox, 2005). Selected companies use CVC units as access to white spaces with regards to new markets and geographies (Drover et al., 2017) or as a scouting tool for future full acquisitions (Asel et al., 2015). To pursue these objectives, CVCs often focus on specific industries or technologies to ensure proximity to the corporation's core business and thereby already narrow down the scope of potential targets. Often start-ups from the same industry and with a focus on similar technologies are preferred (Wadhwa & Basu, 2013). Early limitations, due to limited funds or personnel, are inevitable as a too wide array of potential targets inhibits the CVC's managers ability to efficiently select and subsequently manage portfolio companies (Wadhwa & Kotha, 2006), especially if sufficient managerial know-how and capability is absent (Cassiman & Veugelers, 2006). Moreover, preferences on the development stage of start-ups emerge. With regards to financial objectives, sufficient return within a short time, international scalability and a promising novel concept are required (National Venture Capital Association, 2015), but are often seen as secondary objective.

Market screening

Based on the investment objectives set by the CVC and corporate leadership team, a screening for potential investment targets is initiated. To efficiently cope with the large number of start-ups, multiple market screening methods and sources developed. The approaches can be split in proactive and reactive CVC screening (Sweeting, 1981). Since the early days, especially desk-research using specific criteria and checklists is used (MacMillan, Siegel, & Narasimha, 1985). Tyebjee and Bruno (1984) cluster screening criteria along market, product, management team, environmental risks and successful expected exit and describe the process as a balancing of expected returns and risks. Whereas IVCs mainly use financial criteria, CVCs expand their checklists by strategic considerations (Souitaris & Zerbinati, 2014). In the course of time more efficient approaches developed. Venkataraman (1997) stresses that trust in social capital and networks simplifies the selection process for any kind of collaboration with entrepreneurial firms. Volberda and Lewin (2003) raise the topic of environmental selection. Corporate business units can express referrals of start-ups (Souitaris & Zerbinati, 2014). Decomposing the decision on whether or not to further pursue an investment in a start-up into its components, leads to superior predictions of potential outcomes (Zacharakis & Meyer, 2000). Moreover, some form of signaling is crucial for both start-ups and CVCs. Syndications[37], previous funding round networks through well-known venture capital players (normally IVCs) or business angels, as well as corporate business units are used as pre-selection (e.g. Corredoira & Di Lorenzo, 2016; Hill, Maula, Birkinshaw, & Murray, 2009; Howard et al., 2017; Sorenson & Stuart, 2001):

[37] A syndication is a joint investment of multiple venture capital funds

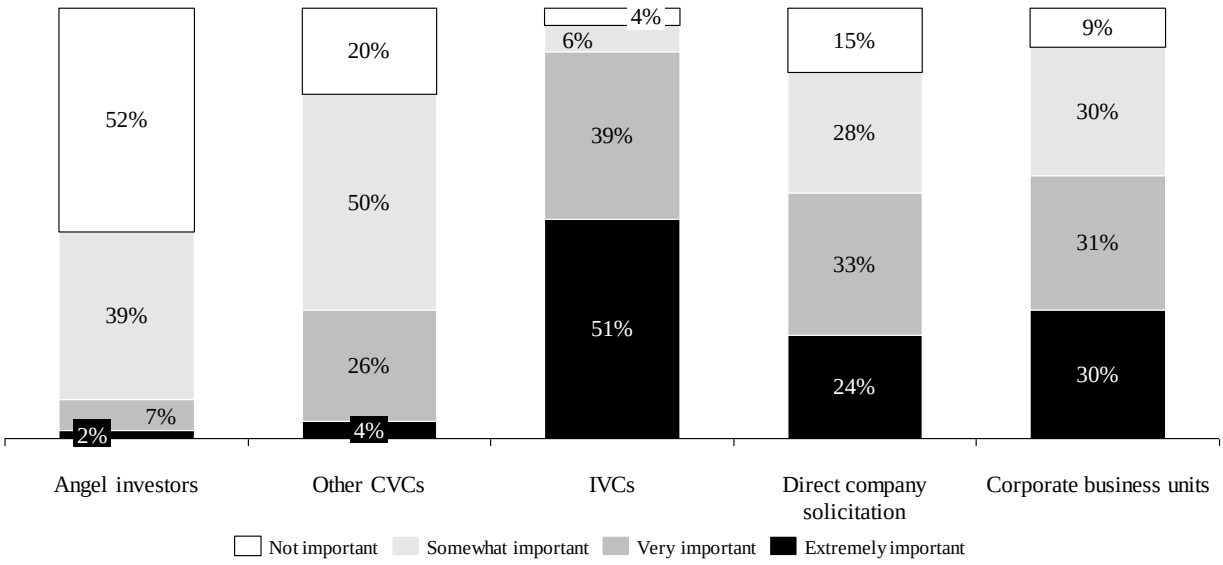

Figure 15: Sourcing of CVC investment deals (MacMillan et al., 2008, p. 15)

Accordingly, CVCs tend to invest in later funding rounds than IVCs (MacMillan et al., 2008, p. 4), whereas start-ups that receive public grants are more likely to receive VC funding as well (Islam, Fremeth, & Marcus, 2018). Besides only making use of signaling for pre-selection, CVCs in turn signal to their fund providers, i.e. the corporation, that they invest in highly rated businesses with high expected future performance (van Osnabrugge, 2000). In addition, CVCs tend to send signals to the market themselves. Once a CVC developed a brand, self-selection of entrepreneurs occurs (Gompers & Lerner, 1999). If a CVC has the reputation of only accepting high caliber start-ups working on a specific technology, such start-ups will proactively reach out to the CVC. To reach such a differentiating standing, CVC funds often perform marketing activities. For example, participation in start-up fairs, conferences and advertising in start-up press is used to obtain the attention of start-ups (Christofidis & Debande, 2001). Generally, the majority of ventures is rejected early on, such that a short-list of potential targets results out of the screening phase. Given the screening and initial evaluation was successful, a confidentially agreement or a letter of intent (LOI) is signed and due diligences are initiated (Christofidis & Debande, 2001).

Due diligence

A due diligence describes a thorough investigation or audit of a potential target firm. The phrase has its origin in US security law, where it describes the obligation for security holders, lawyers, accountants and underwriters to provide sufficient information – as part of the prospectus – on the security to the market, especially to potential buyers (Camp, 2002, p. 1). Etymologically, the word means 'reasonable care'. Although due diligences in the venture capital context slightly differ from the meaning in the area of securities, the idea of reasonable care remains. Generally, due diligences are performed in multiple contexts. Besides the mentioned security sales and VC investments, due diligences play a crucial role in any other large transaction, like mergers and acquisitions, real-estate transactions or IPOs. Theoretically, due diligences can be performed by both parties involved in a transaction. Normally, however, the buying party has much more necessity to get information about the asset to be acquired. In the CVC context, however, start-ups are well advised to also examine their potential investor.

Camp (2002, p. 2) provides a detailed discussion of due diligences in the broader VC context and argues that a due diligence is nothing else than getting answers on a large set of questions about the target company in order to reduce the risk of an investment (J. S. Perry & Herd, 2004). Consequently, due diligences are the most detailed and thorough attempt to reduce information asymmetries between CVC and start-ups and therefore constitute a major step in the creation of matchings. CVC aims at better understanding the start-up to evaluate what return (financially and strategically) can be expected from an investment or what protection against potential risks is needed.

Different forms of due diligences exist. Howson (2008, p. 5) differentiates in hard and soft forms of due diligences. Often due diligences are performed on financial, legal and commercial subjects (Howson, 2008, p. 3). Financial due diligences are concerned about crunching numbers, verifying financial models, business plans and projections, detecting creative accounting and reviewing tax implications. In a VC context, financial due diligences already take the potential exit into consideration. Legal due diligences review existing contractual obligations, often regarding intellectual property and patents. Commercial due diligences refer to an assessment of the targets strategy and market including key customers and competitors (Howson, 2006, p. 3). As the hard facts and numbers are rarely available for start-ups, soft factors like the culture and the management team gain more attention (Camp, 2002, p. 23). A thorough human and cultural due diligence is inevitable (Carleton & Lineberry, 2004). If later on cultural clashes evolve and disagreements arise, key talent might leave, leading to declining productivity (Harding & Rouse, 2007). In a globalized world, national cultural differences need to take into considerations, as they influence the perceived outcome of due diligences (Angwin, 2001). Furthermore, functional due diligences are performed with regard to marketing (McDonald, Smith, & Ward, 2017) or IT (Stein, 2017).

For start-up due diligences, a technical understanding of the target's product offering is key. Often ventures barely have an idea or a prototype and buyers still have to evaluate the technological implementation and potential. In doing so technical experts are required. In general, multiple parties are involved in due diligences. Often external support especially from lawyers, auditors, accountants and management consultants is called in (Christofidis & Debande, 2001). Although these external sources bring market experience, they often fail to understand the acquiring company and its market. A lack of market understanding is especially harmful as due diligences are of higher quality if industry-experience is available

(Sorenson & Stuart, 2001). With regard to deep technical knowledge and cultural understanding, corporation-internal personnel prove advantageous over external resources. For example, in a study of private equity due diligences, Cumming and Zambelli (2017) find that due diligences improve the subsequent performance of the investee – even more so, if internal personnel is involved in the due diligence. Dushnitsky and Lenox (2005) find that CVCs leverage corporate personnel with regards to technological, market and business considerations and risk. Souitaris and Zerbinati (2014) conclude that especially the technological and market expertise of in-house personnel are a strong asset for CVCs in the due diligence process as it helps to fully understand the target, identify potential synergies and evaluate a cultural fit. Moreover, they recommend to heavily use internal business unit experts in order to create buy-in for further collaborations with the venture once the deal is closed. In line with the positive effect of using internal personnel for due diligences, 85% of CVCs report that corporate personnel supports the due diligence process to a moderate or even large extent (MacMillan et al., 2008, p. 19). To achieve high quality due diligence results, venture capitalists spend half of their time with screening the market and performing due diligences of potential targets (Tyebjee & Bruno, 1984). A due diligence already constitutes a learning opportunity for the corporation and – if performed accordingly –already supports a firm's innovation capacity, even if no venture is finally contracted.

Summing up, high quality due diligences are vital to reduce information asymmetries and to develop towards a successful matching between a CVC and a venture. CVCs focus more on later stage start-ups as the large amount of data and information required to perform a high quality evaluation is more readily available for more mature ventures (Sorenson & Stuart, 2001). Once sufficient data on a start-up is collected, a financial valuation is performed.

Valuation

After a handful of start-ups are identified as potential investment targets, their financial value is determined. Thereby, the CVC approximates how much funding is required and which price should be paid to acquire a share of the venture. As introduced above, various valuation methodologies exist and are heavily used by practitioners to value mature companies or assets and liabilities. Start-ups, however, show specific characteristics making their valuation challenging. Audretsch and Link (2012) highlight such limitations of start-up valuation. Start-ups are – by definition – young entrepreneurial companies without a long history of readily available financial data or direct competitors (Damodaran, 2009). If a start-up is in the idea or proof-of-concept phase no revenue and probably not even the price for a product are available. Analysts argue that a firm cannot be valued without a history of revenue or at least one marketed product or service (Damodaran, 2002). Damodaran (2009) states that without historical data and revenues, especially discount rates are hard to estimate and need to be based on market estimates. In addition, start-ups are – if at all – revenue driven and fail to generate profits. Therefore, the forecasting of cash-flows and the determination of a terminal value are challenging, limiting the application of DCF approaches. Moreover, the lack of revenues in the first few years leads to a situation where 100% of a firm's value resides in the terminal value, something that is not satisfying for conservative valuators, especially when taking into account the high failure rates of start-ups within the first years of existence. Similarly, lack of data complicates the estimation of a firms β, independently of which of the three discussed approaches is used. In addition, all input parameters – besides rf – are extremely hard to estimate for option-based start-up valuations. As start-ups often operate in a new type of business area through offering unique products and services, the identification of suitable comparable firms is challenging. Relative start-up valuations are

possible, yet some hurdles exist. First, actual (financial and non-financial) data of the start-up is hard to obtain. Moreover, the selection of comparables is often not an easy task. Start-ups might operate in completely new spaces, where no directly competitor is available. Additionally, it is questionable whether a small start-up can be compared to a large corporation. Start-ups frequently derive their value from intangible assets, like patents, trademarks or licenses (Goldman, 2008), whereas major established corporations are heavily build around property, plant and equipment, i.e. tangible assets (Damodaran, 2002). Start-ups are often owned by a founder or one or more investors. Both parties hardly diversify their investments, making an application of the capital asset pricing model (CAPM) difficult. Moreover, the CAPM has three underlying assumptions, namely no transaction costs, divisible assets and same information for all players. All three must be strongly challenged in a start-up environment. In addition, many founders initially pursue non-financial goals without considering the monetization of their venture (Goedhart, Koller, & Wessels, 2016). For example, the initial goal of Facebook was to make the world more open and connected (Statt, 2017) while the monetization through advertising only started in the course of time. Higson and Briginshaw (2000) find that investments in assets are delayed and become necessary only after scaling the business model. For example, Amazon reported negative net assets in their 1998 balance sheet and started to invest in own distribution centers only from 1999 onwards.

As a consequence of these hurdles, Vetter calls start-up valuations "mystery and black magic" (2016, p. 1). Nonetheless, both the entrepreneur and the investing party require a reliable valuation result (Cumming & Dai, 2011; Hochberg, Ljungqvist, & Lu, 2010; Hsu, 2004; Köhn, 2018). The first needs to know his or her share after a new equity investment is performed, whereas the latter wants to know the share of its control rights and the achieved

(financial) return at exit. Therefore, multiple adjustments to traditional valuation methods and the development of start-up and venture capital specific valuation approaches improve the reliability of start-up valuations. In the following, the major approaches and research contributions to valuation in the start-up context are discussed[38].

In a detailed review of literature on start-up valuation through venture capitalists, Köhn (2018) finds that the number of publications on the topic fluctuates and recently reached an all-time high, even higher than during the Dotcom boom of the early 2000s. This reflects the importance of reliable valuations for all involved parties and gives hope that start-up valuations remain reasonable and do not lead to inexplicable bubbles. Existing empirical work focuses on different determinants of start-up valuations. First, specific start-up characteristics, like the ownership of trademarks or the participation in strategic alliances, influence the resulting valuations (Block, De Vries, Schumann, & Sandner, 2014; Moghaddam, Bosse, & Provance, 2016). As the future of an entrepreneurial enterprise is highly uncertain and many landmark decisions have to be taken, high focus is put on key personnel. Capabilities, prior experiences and social skills of the management team, especially the founder, impact the development and implementation of future ideas (Goldman, 2008; Hsu, 2007; MacMillan, Zemann, & Subbanarasimha, 1987). Franke, Gruber, Harhoff and Henkel (2006) identify a preference bias for founders that are similar to personnel of the investor. Consequently, Damodaran (2009) recommends to perform two valuations – one where key personnel remains with the start-up and one where it leaves.

In addition, external factors, like overall market sentiment and price levels of public share prices or availability of funds, impact start-up valuations (Gompers & Lerner, 2000).

[38] Looking at the valuation tool-set and methodologies applied, no procedural differences between IVCs and CVCs emerge. Therefore, general VC research is also consulted in the following discussions.

From a theoretical perspective, the valuation of an asset should be largely independent of the valuator itself. However, this is not the case in practice. Cumming and Dai (2011) find that the investors reputation and size influence the start-ups valuation. Moreover, the type of the VC firm, e.g. independent VCs, captive VCs, university VCs (Heughebaert & Manigart, 2012), or the size of the VC network (Hochberg et al., 2010) has impact on the start-up valuation. Looking specifically at CVC, start-up valuations differ by the objectives and the focus of the fund on specific investments (Röhm, Köhn, Kuckertz, & Dehnen, 2018). Moreover, cultural and legal aspects also play a role. Batjargal and Liu (2004) find that close ties between the parties are indispensable in China whereas Cumming and Walz (2010) conclude that biases in reports resulting from differences in accounting regulations impact returns.

Valuation results significantly differ based on the methodology applied (Wright et al., 2004). Therefore, a more detailed assessment of both classical and venture capital and start-up-specific valuation methods is required. In general, two streams of valuation methods for start-ups are available. The following graph gives an overview on frequently used valuation techniques:

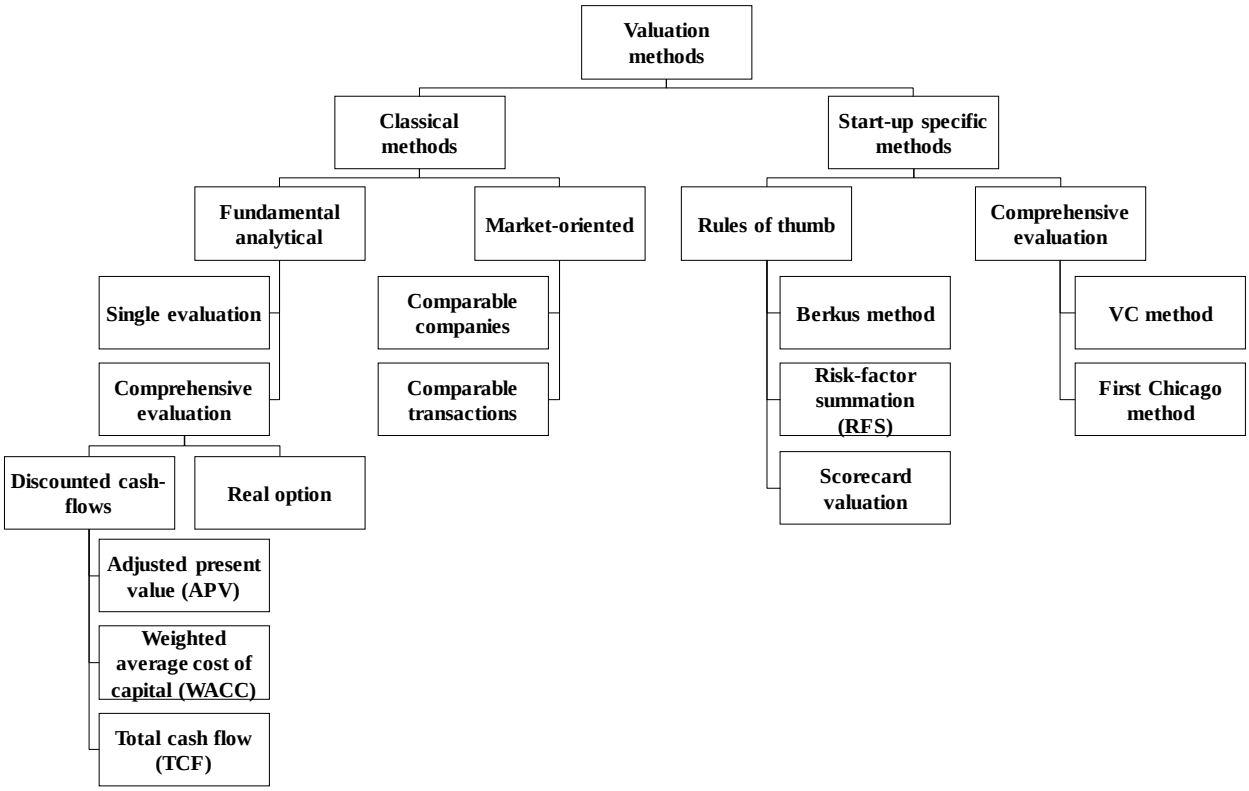

Figure 16: Frequently used valuation methods (adapted from Achleitner & Nathusius, 2003; Festel, Wuermseher, & Cattaneo, 2013)

On the one hand, there are the classical methods that are also used for mature and established corporations. These approaches can – with adjustments – be used for start-up valuations. On the other hand, there are methods that are specifically tailored to start-ups and the venture capital business.

'Classical models' can be differentiated by fundamental approaches, looking at a company's financial and operational metrices in detail and market-oriented models, applying multiples from comparable companies, transactions or the like. Although limited research is available on valuation methods used for private companies (Elnathan, Gavious, & Hauser, 2010), multiple researchers recommend comprehensive fundamental approaches, especially the discounted cash-flow methods (see Festel et al., 2013 for a summary). Although such valuations are more difficult to obtain for start-ups than for established corporations, the

general idea that the value of a firm is the present value of future cash-flows remains (Damodaran, 2002). Goedhart et al. (2016) take a practitioners perspective and recommend using the DCF method as it offers most insights into the firm. Damodaran (2009) recommends deriving start-up cash-flows both top-down (i.e. from the full market to the company level) and bottom up (i.e. through estimating the ventures internal capacity). Normally, the first will give an upper, the second a lower bound. Obviously, it is challenging to define the market for a completely entrepreneurial venture, forecast how the market grows and derive the market share of the start-up. Moreover, a firm's internal capacity is dependent on many factors, like competitors or subsequent investments. The terminal value often accounts for the majority of a start-up's valuation. It can be calculated assuming either a going-concern of the start-up with stable growth, or a limited number of years in the future, or a firm liquidation at the end of the forecasting period (Damodaran, 2009). Additionally, relative multiples can be used, but are not recommended as they are not firm intrinsic.

For the derivation of a discount rate, 25% of VCs that use DCFs apply the CAPM (Achleitner, Zelger, Beyer, & Müller, 2004). Dittmann et al. (2004) find a superior investment performance when using DCF methods with WACC- and CAPM-based discount rates. When using CAPM-based discount rates, an adjustment for the scale of diversification of the investor is necessary (Damodaran, 2009). Focusing on early stage start-ups, Festel et al. (2013) recommend a regular DCF methodology with a specific derivation of β. Instead of relying on the basic CAPM model, they derive a β for the overall VC market and adjust it based on start-up specifics. These discounts and premia are derived from business plans and discussions with the venture's management along technology, product and offerings, financials, organization and implementation capabilities. Each of these categories is split in multiple sub-categories. A questionnaire helps to determine the β-adjustment on a [-1,1]

range. This approach extends the β adjustments compared to multi-factor approaches e.g. the Fama-French model which also includes a size adjustment. Although such an approach is directionally valid and implicitly accounts for high failure rates of start-ups, it remains highly subjective and the authors fail to explain the extend of the adjustments. For example, no evidence is given why a 'problematic headquarters location' increases β by 1 and not 0.8 or 1.5. Independently of how β and the discount rate are derived, applying a dynamic discount rate that changes over time helps to account for changing start-up characteristics (Damodaran, 2009).

In contrast to implicitly including the start-ups failure rate in β, Goldman (2008) argues that discount rates and failure rates should be considered separately from each other. Fernandez (2012) recommends DCF as the best method to apply, especially when extending it by a real option approach for future cash-flows to recognize uncertainty[39]. Similarly, Gupta and Chevalier (2002) find that traditional valuation models underestimate the value inherent in uncertainty and also recommend using a real options approach to account for future decisions. Finally, fixed or firm-specific adjustments for illiquidity can be included, if required (Damodaran, 2009).

'Market-oriented approaches', especially price-earnings multiples are heavily used by VCs (Wright & Robbie, 1996). They are relatively simple to apply but entail the risk of valuing rather a market sentiment instead of a start-up's capabilities to generate future cash-flows. In the late 1990s and early 2000s, for example, the general overheating of the internet market made the application of market-oriented valuation methods impractical. The share price of Kodak serves as a more recent example of an overheated market reaction. The

[39] Start-ups often face an all-or-nothing situation, where they either lose everything or generate high future cash-flows. Often this is based on the market environment and the decisions taken by management

company fell short in its digital transformation, filed for bankruptcy in 2012 and came back in business later. On January 9th, 2018 the company announced the creation of KodakCoin, a blockchain cryptocurrency which can be used to trade photo licenses, leading to a more than tripling of the share price in one day (Morningstar, 2018), mainly attributable to market expectations (more precisely the high expectations on the blockchain technology)., whereas a fundamental analysis of Kodak did not justify such a high company valuation (Katz, 2018).

As demonstrated by this example, market-oriented valuation models should be used with reasonable care. Damodaran (2009) hesitates to use relative start-up valuations. Comparables from public firms come from companies in different lifecycles that often do not face an illiquidity problem. In addition, they already overcame the probability of failure, leading to a survivor-biased valuation. Comparable transactions of private firms are often hard to find or include other value-impacting specifics. For example, a premium might be paid if the founder agrees to stay with the start-up for the next few years. Often such additional agreements are not made public. Therefore, very few truly comparable transactions are available. Consequently, either outliers strongly impact the result, or one needs to go back in history too long to find a large enough set of comparable transactions. Therefore, selected researchers recommend adjustments to more market-oriented approaches. Audretsch and Link (2012) argue that the key to valuations of entrepreneurial enterprises is the correct selection of comparable markets. Whereas most scholars chose comparables based on products, services, or industries, Audretsch and Link (2012) propose to select comparables based on technological considerations. For the valuation of a start-up, its future success should be forecasted by considering the development of adjacent technologies. The example given is of lightweight material in cars, which will only prove successful if safety devices are developed to reduce car accidents. Therefore, a lightweight

material start-up cannot be valued without considering the technological progress of safety devices.

In addition to classical methods, specific start-up valuation approaches for venture capitalists are available. As shown in Figure 16, these can be split in simple rules of thumb and more sophisticated and comprehensive valuation approaches. Referring to rules of thumb methods, especially (i) the Berkus method, (ii) the risk-factor summation and (iii) the scorecard valuation is used. The 'Berkus method' is named after its spiritual father Dave Berkus, who developed the method in the 1990s and refined it in 2016. It can be used for early-stage pre-revenue start-ups, making it a method that is also applied by business angels. For any of the following five conditions, the company value is increased by 0.5mn$: (i) sound idea, (ii) prototype, (iii) quality management team, (iv) strategic relationships and (v) product rollout or first sales (Berkus, 2016). Accordingly, the maximum value of a start-up being valued that way is 2.5mn$. The basic idea behind the approach is that each of the conditions reduces a risk typical for entrepreneurial ventures. For example, a prototype reduces technology risk and strategic relationships reduce market risk.

The 'risk-factor summation' (RFS) method follows a similar logic. It was developed by Ohio TechAngels for pre-money valuations of pre-revenue firms. For this method, twelve risks categories are considered and rated on a five-point Liker-scale from very positive to very negative valuation impact of the risk. The risk categories are management, stage of business, political and legislation, manufacturing, sales and marketing, funding and capital raising, competition, technology, litigation, international risk, reputation and potential lucrative exit (Payne, 2011b). For very positive impacts, the company value is increased by 0.5mn$ for positive impact by 0.25mn$ and for no impact, no change to the valuation results.

The same values are subtracted from the company values for (very) negative impacts. Summing up the results of all twelve risk categories gives the pre-money valuation.

A further rule of thumb valuation is the so-called 'scorecard valuation'. In this case, pre-revenue valuations of comparable start-ups (mainly comparable regarding sector and region) form the base. The average valuation of these comparable start-ups is then adjusted along seven categories to obtain a value for the start-up of interest (Payne, 2011a). Table 1 shows the seven categories and the respective pre-determined weights:

Table 1: Categories and weights for scorecard valuation (adapted from Payne, 2011a)

Comparison factor	Weight	Exemplary rating
Strength of entrepreneur and team	30%	120%
Size of opportunity	25%	150%
Product/ technology	15%	50%
Competitive environment	10%	120%
Marketing/ sales/ partnerships	10%	100%
Need for additional investment	5%	80%
Other factors (e.g. great early customer feedback)	5%	70%

The valuator has to determine whether and by how much the start-up of interest deviates from the comparable firms. For example, the size of opportunity for the target company could be at 150% of the size of opportunity of the comparable company, whereas the product could only be half as good, i.e. at 50%. Summing up the products of weight and target company rating gives an overall factor (in this example of 110%) which is then applied on the valuation of the comparable firm to get the value of the start-up of interest. Although the weights are pre-determined, the evaluation of the start-up compared to the base company is subjective, reducing the validity of this valuation approach. Concluding the discussion on rule of thumb valuation approaches, one has to acknowledge the speed and simplicity of

applying these methods. However, the oversimplification, the missing scientific foundation and superficial inspection of the intrinsic value of a start-up make these methods nothing more than a back-of-the-envelope supplement to more fundamental and comprehensive valuation methods.

Two more comprehensive and sophisticated start-up valuation techniques are the (i) 'VC method' and the (ii) 'First Chicago method'. Both methods have in common that they are mainly applicable for post-revenue start-ups. The 'VC method' is based on discounted cash-flows and is differentiated from other DCF methods by the derivation of the discount rate. As the name of the method indicates, it takes the perspective of the VC and is used in 75% of the cases when DCF is used in the VC context (Achleitner et al., 2004). The applied discount rate is therefore the required rate of return for the investor. Such a target rate of return is normally higher than otherwise applied discount rates as it includes the risk of complete failure of some of the start-ups the VC invested in (Sahlman & Scherlis, 1987). If 50% of the start-ups fail, a return of at least 10x-30x the investment is needed (Damodaran, 2002) for IVCs that only pursue financial objectives. As CVCs also pursue strategic objectives, a lower financial return is often accepted. The discount rate is applied on the terminal value, which is based on a multiple (often price-earnings multiple) of (public) comparable companies or similar IPOs and acquisitions.

Although the approach seems straight forward, some words of caution are necessary. First, one needs to be aware that the VCs target rate of return is an equity value. If the start-up is partially financed through debt, the cash-flows and (potentially) the terminal value need to be adjusted accordingly. Second, it is unreasonable to incorporate the risk of start-up

failure as a constant within the discount rate[40]. Therefore, Damodaran (2009) argues that the method is flawed.

In contrast, the 'First Chicago method' applies weighted scenarios and a combination of DCF and multiples. Cash-flows are forecasted until the exit date, from which onwards a terminal value is calculated based on multiples. This is done for different scenarios, named best case, normal case and worst case. Goedhart, Koller and Wessels (2016) suggest weighting them according to the expected probability. Thereby, the uncertainty of a start-up's future is reflected in the valuation. The expected probabilities, especially the probability of failure can be derived using sector averages, simulations or a Probit regression model (Damodaran, 2009). The present value of all three scenarios is calculated, often by using the required rate of return for the VC (Achleitner & Lutz, 2005). The weighted average of the three present values then constitutes the valuation of the start-up. Obviously, the weighting of the three scenarios is based on the anticipated probability of occurrence and can be subjectively set by the valuating party, although the normal case should reflect the highest probability. For post-revenue start-ups, this method has a good reputation among practitioners.

Given the variety of start-up valuation approaches, it is recommended to use multiple methods in parallel (Wright & Robbie, 1996). DCF-based approaches should form the base as long as they are adjusted to better reflect start-up specifics. Besides deriving an intrinsic value, using such methods significantly broadens the understanding of the start-up, the market it operates in and the major drivers for future success. Thereby, information asymmetries are further reduced and the risk of miss-valuations and failed investments is

[40] As discussed earlier, the probability of start-up failure is dynamic over time

partially mitigated (Dittmann et al., 2004). Applying weighted scenarios or option-pricing methods helps to reflect future decisions with significant impact. Although simple multiples and rules of thumb fulfill the objective of obtaining some value for the start-up, they fail to achieve the overarching goal of reducing information asymmetries.

As a result of the valuation, a number, or preferably a range of numbers, for the value of the full start-up emerges. In a next step, CVCs have to determine how large their investment should be, i.e. what share of the company they want to hold rights on. The ownership share has a major impact on both the CVC, other investors and the owner of the start-up, especially regarding control rights and exit returns. Often, additional claims are part of the agreement, e.g. preferred dividends or preferences in liquidation case, making the determination of an appropriate share even more complex. Therefore, valuation results and other terms of the deal are subject to heavy negotiations.

Negotiation

Fairchild (2004) finds that historically hardly any negotiations between start-ups and VCs took place as VCs merely dictated the terms of the deal. However, he recognizes a shift in the early 2000s when valuations and control rights became negotiable (see e.g. Kaplan & Strömberg, 2003). To get a more comprehensive understanding of negotiations between CVCs and start-ups and as large similarities exist between different VC-forms, literature on negotiations in the broader VC context is considered. Particularities for corporate VCs are stressed where significant differences to other forms of venture capital exist. A pure consideration of negotiations involving CVC only would be inconclusive, especially as the availability of empirical work for negotiations is even limited for VCs in general (Köhn, 2018).

Negotiations are performed to gain consent and mutual understanding on key terms of a deal. Theoretically, every element of a deal can be negotiated. Investors, however, argue that some provisions are exogenously given by market circumstances. Two superordinate objectives for negotiations are distinguished, namely (i) positional and (ii) relational objectives (Sapienza, Audrey Korsgaard, Goulet, & Hoogendam, 2000). Figure 17 gives an overview of the overarching objectives, topics to negotiate and related outcomes:

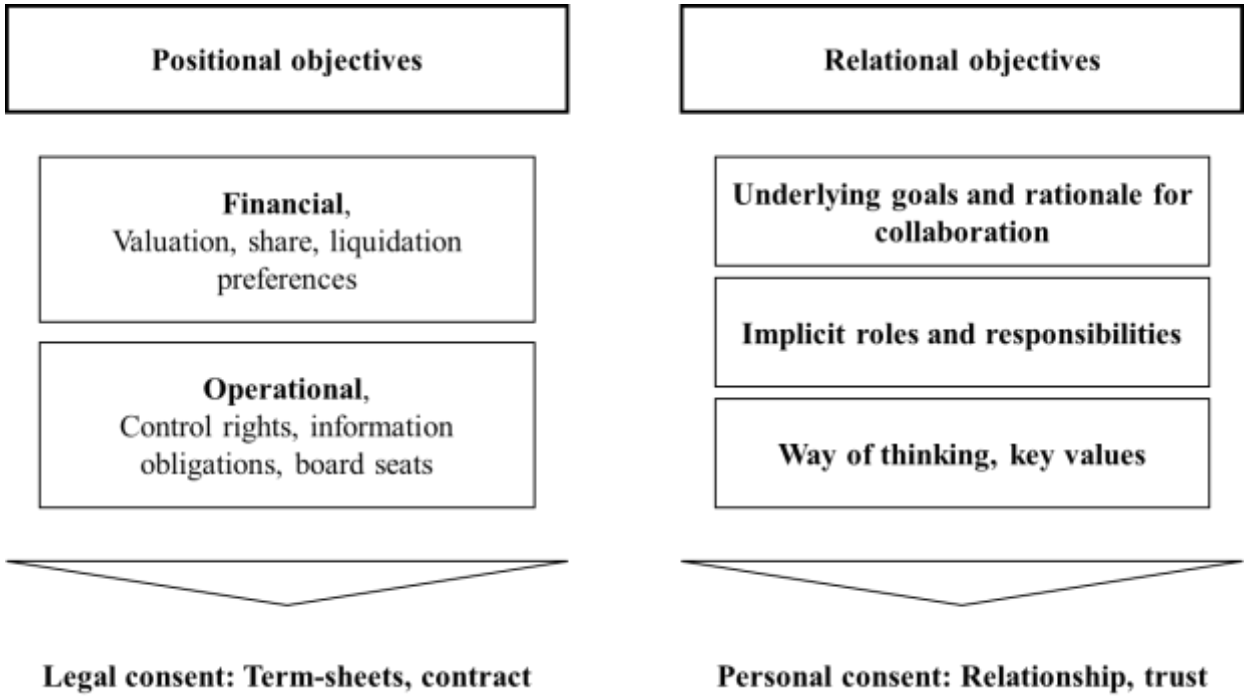

Figure 17: Overarching objectives of CVC-start-up negotiations (derived from Erikson & Berg-Utby, 2009)

Positional objectives are right-based and focus on the content of legal agreements. Players that focus their negotiations around positional objectives defend their own view and are less willing to take into consideration the situation of the other party. For many scholars, agreeing on a start-up valuation is the key discussion point in negotiations (Festel et al., 2013; Heughebaert & Manigart, 2012; Tyebjee & Bruno, 1984, 1986).

Accordingly, Yang, Narayanan and Zahra (2009) find that valuations change during negotiations and are agreed upon only shortly before the signature of a final agreement. The rationale why valuations need to be negotiated between investors and start-ups is the reduction of information asymmetries. Negotiations do not evolve around one final price tag, but around the validity of the start-ups business plan and its underlying assumptions (Douglas, Carlsson-Wall, & Hjelström, 2014; Tyebjee & Bruno, 1986). Therefore, the valuation needs to be transparent and especially β, i.e. the underlying risk, is discussed (Festel et al., 2013). However, in the words of Malhotra (2013) a negotiation should increase value, not only valuation. Therefore, financial terms need to be traded-off against operational terms. Operational terms are mainly focused on control rights (Douglas et al., 2014), covenants (Tyebjee & Bruno, 1984) or management incentives and board seats for CVC personnel (Christofidis & Debande, 2001). Kirilenko (2001) demonstrates that disproportionally high control rights for a VC are traded-off against better financing terms for the start-up, especially a more balanced risk-sharing. Moreover, start-ups are often willing to give up over-proportionally much control for additional funding (Malhotra, 2013; Tyebjee & Bruno, 1986), a decision with long-term consequences. Although every party should try to maximize its own outcome of the negotiation, disadvantageous consequences can result from a positional negotiation. Erikson and Berg-Utby (2009) find that start-up personnel is more often exchanged during VC-start-up collaboration if pure positional bargaining is applied during negotiations. Keeping in mind that ambitious founders and start-up management teams are crucial for a start-up's success, laying them off is a strong signal from the VC.

Negotiations in the CVC context are important for the two parties involved to get to know each other (Landström, Manigart, Mason, & Sapienza, 1998) and thereby go beyond merely solving agency problem (Isaksson, 2006). In contrast to the purchase of a house,

successful negotiation and deal signature form the beginning, not the end, of a CVC-venture collaboration. Therefore, relational objectives need to be taken into consideration during negotiations. The other party needs to be understood well. Does the CVC invest for financial or strategic reasons? Is the CVC restrictive regarding the provision of access to their network or not? Is the start-up management interested in a long-term role within the corporation or will they leave the start-up shortly after the CVC investment? Often, terms proposed by the other party give a strong hint on their underlying motivations, goals and concerns (Malhotra, 2013). From that, implicit roles a party has and the responsibilities each party is expected to fulfill can be derived (Isaksson, 2006). The most difficult part of a negotiation is to understand the other party's way of thinking and key values. Pursuing relational objectives in negotiations leads to the development of a trustful relationship and team spirit between the parties (Sapienza & Korsgaard, 1996). The benefits of a good relationship are manifold. A CVC is more willing to introduce a start-up it has a trustful relation with to business experts, suppliers or potential customers. Although many eventualities can be discussed in positional negotiations and are included in contracts, not every future situation can be foreseen. Drawbacks, disappointments and some form of failure are normal for start-ups. In cases where unexpected and controversial issues arise after many years, a deep understanding of the other party's underlying values is vital. Many times, the initial founders of a start-up negotiate with CVCs. In such cases, a person that spend a tremendous amount of time, took a considerable personal risk and invested a large fraction of their own savings, will not behave fully rational, but be guided by emotions, stressing the importance of relational objectives even more. Therefore, personal similarities between CVC and start-up negotiators simplify the discussions (Cable & Shane, 1997) and differences, e.g. regarding gender (T. Nelson, Maxfield, & Kolb, 2009) need to be taken into consideration. Malhotra (2013)

explicitly stresses that a trustful relationship is crucial in such situations and gives an example of a start-up that failed to build trust and mutual understanding with their VC during the negotiation phase. In that case, the start-up's focus on positional bargaining resulted in a superior financial deal on paper but an unsuccessful collaboration later with hardly any advice and coaching from the VC. Chahine and Goergen (2011) empirically verify the expected behavior that the party with superior bargaining power negotiates to its own advantage and the disadvantage of the opposing partner. Although it is intriguing to make use of one's superior power, a CVC-venture collaboration is more successful in the long-run if the outcome of negotiations is balanced and thereby mutual trust established (Landström et al., 1998).

Two different negotiation processes are possible, as demonstrated in the following Figure 18:

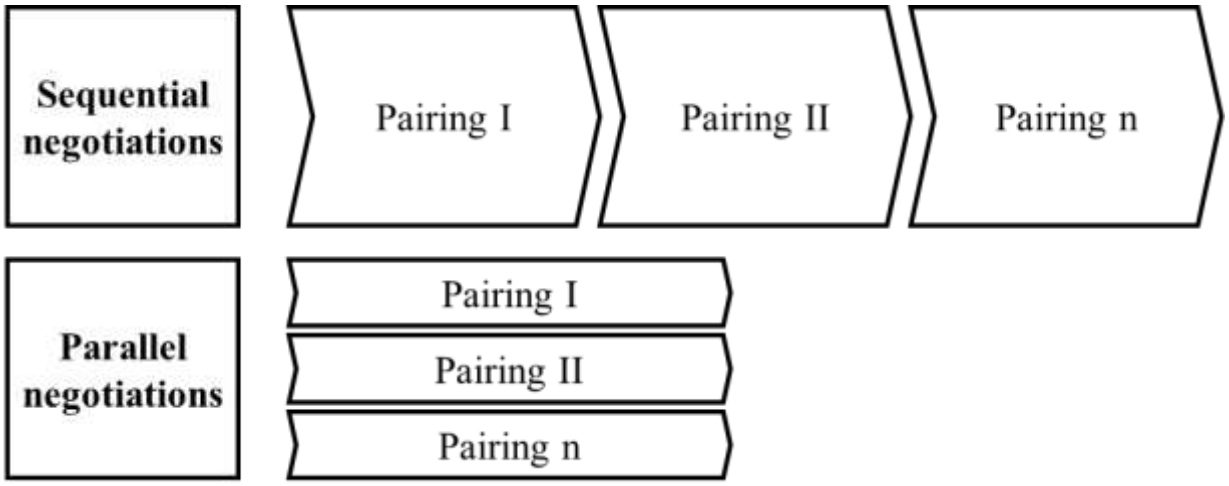

Figure 18: Sequential and parallel negotiation process (adapted from Casamatta & Haritchabalet, 2014)

In their analysis of an optimal negotiation strategy for entrepreneurs, Casamatta and Haritchabalet (2014) differentiate among sequential and parallel negotiation processes. In sequential negotiations, either one or both parties grant exclusivity, meaning that no

discussions with other start-ups or CVCs are underway. In reality, mostly start-ups grant exclusivity, while CVCs might follow multiple deals in parallel. Once the negotiation fails, the start-up gets into contact with another potential investor. Start-up leadership can collect learnings from the failed attempt to improve the business plan and negotiation tactics. Often, however, the second CVC will learn about the failed first attempt, be more hesitant in its offer and low-ball for tactical reasons. Apparently, negotiating in chains normally takes longer than parallelizing the process. Time is a scarce resource for start-ups in need for money for further expansion and management should not be distracted from its core business for too long. For that reason, starting discussions on non-negotiable terms as early as possible during the due diligence (Christofidis & Debande, 2001) and conducting parallel negotiations with multiple investors is recommended. Casamatta and Haritchabalet (2014) find that parallel negotiations lead to more favorable deals for start-ups. However, they stress that the probability of an agreement between a VC and a start-up increases if deals are negotiated exclusively. In both process forms, the start-up and the CVC need to find their source of leverage and try to understand the other party before going in negotiation talks. As CVC-venture contracts are imperfect, re-negotiations might take place in the course of time, especially during new financing rounds. Kaplan and Strömberg (2003) find that terms are re-negotiated in at least 30% of the cases. The changes are mainly regarding increased automatic conversion prices, skipped funding milestones or altered performance benchmarks. Often, new investors occur in additional financing rounds, making the stakeholder landscape even more complex. In such a context, the above-mentioned deep mutual understanding and trustful relationship becomes even more central in achieving agreement.

As the stakes in negotiations are high, key personnel from both the start-up and the CVC participate. Negotiators need a broad array of capabilities, including technical

understanding of the technology, knowledge about the market, financial and business sense to comprehend and challenge valuations and legal expertise to draft term-sheets and contracts. Moreover, both the start-up's ideas and operations, as well as its match to the corporation and synergies from a potential collaboration should be known to the negotiating parties. Therefore, multiple individuals need to be involved in negotiations. CVCs often have portfolio managers that are responsible for a specific industry or technology, demonstrating a deep understanding of markets and trends. Moreover, CVCs and their various business units have the advantage of a large pool of experts they can bring in from the corporation, like engineers, attorneys or product experts (Benson & Ziedonis, 2009)[41]. Start-ups in contrast have a much smaller pool of people to source from. Often the founder plays the most important role in negotiations. Though costly, Malhotra (2013) recommends to engage experienced VC veterans and lawyers for negotiations. Nonetheless, negotiation teams should not be too large to allow for the development of close personal ties, to reduce complexity in discussions and to maintain confidentiality.

Besides the personnel of the negotiation teams, the relative bargaining power of the parties is a key determinant of the negotiation outcome. Some sources of power are specific to a start-up or CVC, while others are given by external circumstances. Macroeconomic market conditions and business practices influence negotiation outcomes heavily (Gompers, 1998). Inderst and Müller (2004) find that market characteristics and dynamics, like growth or interest rates, affect supply and demand for capital, which in turn influence the bargaining power, especially of investors. The most significant source of power differences, however, is the availability of competition. Increased competition among VCs reduces their bargaining

[41] In syndicates, negotiations with start-ups are normally performed by personnel from the lead VC (Kaplan & Strömberg, 2003)

power relative to the start-up (Inderst & Müller, 2004). Competition, in this case, is determined by both the number and the attractiveness of alternative VCs (Malhotra, 2013). Köhn (2018) extends the argument and concludes that VCs have the highest bargaining power, if start-ups cannot attract any other investor[42]. Although empirical literature on the influence of start-up competition on its bargaining power versus CVCs is rare, the same logic applies. However, one has to acknowledge that Inderst and Müller (2004) assume relative scarcity of VCs, an assumption that is hard to make for start-ups. Although competition is one of the most frequently cited factors influencing the outcome of negotiations, its effect is timely limited. Once a deal is signed, this specific source of power differences vanishes. Another source of power difference comes from the involved parties' reputation or image, which is difficult to influence in the short-term. Cumming and Dai (2011) detect that a strong reputation of a VC increases their bargaining power. In addition, they find that the fund size becomes more deterministic for negotiation power if the VC reputation is low. As start-ups are young, their reputation is less developed. Nonetheless, their image, especially that of the founder and key personnel, influences their bargaining power. A differentiating source of bargaining power that both VCs and start-ups have is their explicit offering. VCs differ in the services they bring to the table. The more services they offer, i.e. the more attention the start-up gets from the VC, the higher is the VCs bargaining power (Cumming & Dai, 2011). For start-ups the offering is differentiated by the stage they are in. Having merely an idea leads to less negotiation power than having a functioning prototype or even a market-proven product.

[42] Other forms of investors include business angels, family and friends or crowdfunding

Tyebjee and Bruno (1986) find that CVCs have more profound negotiations skills, due to their broader experience. While VCs regularly negotiate with young ventures, start-ups only rarely negotiate deals. Moreover, the authors find that entrepreneurs often have an IT or technical background leading to limited valuation knowledge and difficulties with regards to making business decisions under imperfect information. Through their background, entrepreneurs often have a better (technical) understanding of their products and offerings, while VCs have a better market knowledge (Douglas et al., 2014). Especially with regards to IVCs, technical knowledge is an advantage for start-ups. CVCs, however, can pull technical experts from the corporation, thereby leveling the start-up's technical advantage. The same is true for market and industry expertise. A strong source of bargaining power is a thorough understanding of the opposite party. According to Malhotra (2013) understanding the other party, their interests, weaknesses, strengths and their desired outcome is key. Having such knowledge allows to make valuable offers to the other party and consequently get concessions that are valuable to one self. Finally, for re-negotiations VCs have an additional source of power, namely the threat of exit (D. G. Smith, 1998, 2005)[43].

Even if no final deal is signed, the style and behavior during negotiations should be respectful and professional. Players in the venture capital industry are well connected and will not restrain from informing their network about unacceptable behavior during negotiations (Malhotra, 2013). Although both CVCs and start-ups invest money and time in bargaining with each other, a negotiation that does not lead to a contract is by far no outright failure. While both sides might be disappointed, neither start-ups nor corporations should fall for a sunk-cost trap. Not much literature on failure of VC-venture negotiations is available.

[43] Exits are discussed in more detail below

Although disagreement can remain regarding all terms of a deal, Baeyens, Vanacker and Manigart (2006) find that negotiations mainly fail due to different views on valuations. Large gaps in initial valuations often lead to failure of negotiations as trust-building is torpedoed from the beginning (Maxwell & Lévesque, 2014). Raith (2007) finds that disagreements on procedural issues like the process steps and timeline or the parties involved can have a severe impact on the success of negotiations. Moreover, negotiations fail if information on and trust in the other party is limited or asymmetrically distributed (Douglas et al., 2014). For example, a start-up disagrees with the valuation, especially the risk inherent in the discount rate, whereas a CVC fears not obtaining all required information from the start-up.

As introduced above, most of the discussion on negotiations is congruent for all forms of VC. However, minor differences might emerge. Research on this topic is limited to Heughebaert's and Manigart's (2012) study on the Belgian VC market. They analyze the impact of bargaining power on start-up valuations and differentiate in IVCs, captive VCs, university VCs and government VCs. Unexpectedly, they find that university and government VCs have higher bargaining power than independent and captive VCs. This finding is surprising keeping in mind the inferior reputation of government VCs (Bottazzi, Da Rin, van Ours, & Berglöf, 2002). Heughebaert and Manigart (2012) attribute the findings to low competition in the case of government VCs which focus on neglected niche markets. Especially for university VCs and to a lower degree for captive VCs, the strong bargaining power is explained through existence of a captive deal flow. For IVCs the power decreasing impact of high competition seems to be larger than the power increasing impact of a strong reputation. The authors neglect technical and industry expertise and therefore argue that the same is true for CVCs, especially in the case of market start-ups. In cases where CVCs develop internal start-ups, the rationale of captive deal flow used for university VCs might

hold. However, the share of such internal start-ups is too low to prove the point empirically. Depending on how reputation is defined, CVCs might have an advantage over IVCs. While IVCs might be well-known for their support of start-ups with regard to their internal development, CVCs have a much broader brand recognition outside the venture capital market. Thereby, CVCs gain bargaining power through offering start-ups the opportunity to leverage the corporate brand when reaching out to potential customers and suppliers. No tier-2 automotive supplier will be impressed when a start-up tells them that they are backed by an IVC fund, but their attention will increase when they hear that the start-up is (partially) owned by e.g. BMW. The proximity to a strong corporate brand, however, also entails a risk. Start-ups are often hesitant to accept investments from CVCs of the same industry as it limits their freedom to collaborate with other industry players (J. S. Harrison & Fitza, 2014). Staying with the example above, BMW's CVC might negotiate a non-compete clause with start-ups, forbidding them to cooperate with BMW's direct competitors. Thereby, the CVC significantly limits the start-ups market and consequently loses negotiation power compared to an IVC that does not limit the start-ups future sales potential.

Summing up, after establishing the need for start-up financing and corporate innovation, an appropriate 1-to-1 match between a CVC and one of the many start-ups is needed. Both CVCs and start-ups being heterogeneous, unstandardized and indivisible goods in imperfect markets makes finding the right partner challenging. During the selection process, information asymmetry is the largest hurdle that needs to be coped with. In theory, search for and matching with a potential partner is well developed and describes how mutually beneficial relationships are formed in markets with search frictions. Search and matching theory develop different approaches and algorithms to achieve matchings, all having in common that preferences of both parties need to be known and compatible.

Through critically reviewing a start-up along financial, legal, commercial, human, cultural, functional and technological dimensions information asymmetries are further reduced. Moreover, CVCs perform start-up valuations to determine the monetary value of the venture. Multiple well-proven valuation methods exist, especially the discounting of future cash-flows and the use of relative multiple-based approaches. As start-ups are hard to value due to low information availability and high uncertainty of their future, start-up specific valuation methods exist, e.g. the Berkus or risk-factor summation method. During negotiations the parties discuss until – in successful cases – they converge to a joint agreement. Additionally, negotiations play a crucial role in getting to know the other party and developing a trustful relationship. Once negotiations are successfully completed, CVCs and start-ups agree on the terms of the investment and are prepared to execute the deal.

II.2.4 Deal execution and contracting

After the venture valuation is performed and the details of the deal are negotiated and agreed upon, the deal is executed. The core of a deal execution is the signature of a contract. The term contract has its origin in the Latin verb ‘contrahere’, meaning ‘bringing together’. Contracts are an indispensable prerequisite for cooperation as they state both the rights and duties of all involved parties. Legally sound contracts make the terms of a deal binding, as the terms can be enforced by judges and courts. Thereby, contracts reduce uncertainty, increase mutual trust through giving security on how future matters will work out and establish a risk and reward sharing. This is also true for CVC. Therefore, the following part is organized as follows: first, a review of contract theory is given, including property-rights theory and second, contracts between start-ups and CVCs are discussed.

II.2.4.1 Contract theory

While a large research body on legal contracts exists, the focus of this section is on economists' contribution to contract theory. The distinction of Oliver Hart and Bengt Holmström with the 2016 Memorial Economic Nobel Prize for their contributions to contract theory highlights the relevance of contracts for economic discussions (The Royal Swedish Academy of Sciences, 2016). Contract theory developed out of organizational considerations in agency theory (Hart & Holmström, 1986). Principle-agent settings are characterized by information asymmetries and lead to moral hazard. Moreover, agents have no intrinsic motivation to fully behave in line with the principal's objectives. Therefore, Coase (1937) concluded over 80 years ago that optimal contracts should aim at reducing such agency problems, thereby limiting risks and costs for contracting parties. Often, however, an agent's behavior cannot be observed explicitly but only indirectly through an outcome (Holmström, 1979), leading to so-called hidden action and hidden information models (Hart & Holmström, 1986). Contracts are written for both spot trades and long-term cooperation. Although contracts are less important for the former and more crucial for the latter, Hart and Holmström (1986) recommend that every trade needs an explicit or implicit contract. The unclear future of long-term collaborations make the writing of contracts more difficult yet more important compared to spot transactions (Tirole, 2005, p. 292). As a solution, Hart and Holmström (1986) detect that contractually stipulated incentives help to align the envisioned behavior of agents with the principal's objectives. Accordingly, contracting can be seen as an analytical optimization problem, finding an equilibrium under imperfect competition (Hart & Holmström, 1986). As an outcome, the resulting collaboration proves more advantageous for both parties and leads to more output than could have been achieved by each party individually (Schmidt, 2017). In short, contracts lead from an ex-ante competitive

setting with conflicts of interest to an ex-post non-competitive collaboration through steering the agent's behavior.

Generally, contract theory is applied to various settings, including within firms, among firms, in firm-employee relationships or in financial markets (Hart & Holmström, 1986). Independently of the application, a contract should balance risks and rewards which is in the terms of Holmström (1979) a mixture of incentive (i.e. variable pay) and insurance (i.e. fixed pay). The so-called 'informative principle' was introduced by Holmström (1979) and later refined by Grossman and Hart (1983a) and states that optimal contracts link incentives to outcomes that can only be achieved through specific efforts of an agent. Such efforts are fully in line with the principal's objective and need to be based only on the agent's effort without being influenced by exogeneous factors. Therefore, Holmström (1979) and Hart and Holmström (1986) recommend relative incentives, like bonus payments based on share price development relative to competition. As it is difficult to measure and observe actions and performance stipulated in contracts, theory focuses on how to design contracts in order to take into account conflicting interests. By developing the career-concerns model, Holmström (1999) incorporated a time effect into contract design. In order to keep a high performance of an agent over a period of time, a contract should reward high performance today through high earnings tomorrow. Although the concept generally proves successful, it is not applicable for all situations. For example, the model will not work for a worker that is about to retire. The initial model is extended allowing for one incentive for multiple tasks of one agent (Holmström & Milgrom, 1987). In such cases a low share of performance-based incentives prevents workers from focusing on the highly incentivized tasks only. Subsequently, multi-task multi-incentive models (Holmström & Milgrom, 1991) and models where multiple players work as a team on one task (Holmström, 1982) were developed. In

the second case individualized flexible incentive schemes prevent free-riding. If an agent's action influences the output of another party, the agent's reward should take such indirect effects into consideration (Hart & Holmström, 1986). Independently of the model, scholars suggest different ways of deriving a contract with an optimal incentive scheme. Holmström (1979) recommends applying the first order condition of an agent's utility maximization. Although this approach seems intuitive, it does not lead to an optimal solution in all cases (Schmidt, 2017). Grossman and Hart (1983a) apply a two-staged process through (i) choosing an incentive that minimizes the costs for an agent and (ii) choosing that incentive that leads to a maximization of the principal's outcome.

Besides incentives, penalties are included in contracts. Although not broadly discussed in literature, they can be differentiated in (i) legal penalties based on agreed upon (often financial) consequences and (ii) relational penalties, like reputational damage (Hart & Holmström, 1986).

The attentive reader will notice that most of the studies quoted are from the 1980s. This is owed to the fact that scholars noticed more recently that perfect contracts, as those discussed above, are hardly observed in reality, turning the discussion towards so-called 'imperfect contracts'.

Not all terms of a contract can be determined in advance as not every future state can be known, making it impossible to enforce an output-maximizing future action (Schmidt, 2017). Even if a world without information asymmetry and moral hazard is assumed where perfect contracts could be written, the time and cost occurred in preparing wholistic incentive schemes would not justify the benefits of having a complete contract (Hart & Moore, 1990). If the informative principle holds, incentive schemes would be too complex to be included

in reasonably manageable contracts (Schmidt, 2017). In addition, contracts are characterized by unclear and imprecise wording, leading to ambiguous interpretations (Hart, 2017), making reliable performance measurement difficult. Moreover, some contracts impact agents that are not at the bargaining table or parties that reduce their transaction costs, e.g. through not reading the small print (Tirole, 2005, p. 536). All that leads to the emergence of incomplete or imperfect contracts without robust terms and incentive schemes. These incomplete contracts come with high transaction costs (Williamson, 1975, 1985), especially if parties attempt to complete contracts through court rulings or renegotiations and lead to several unintended consequences. First and foremost, a hold-up problem can occur where one party argues that it will not further collaborate until the contract is renegotiated (Hart, 2009). If, for example, the price of a product is fixed contractually but an external shock increases the production cost of that product, the selling party might refuse to sell the product at the agreed upon price and demand a renegotiation. Such hold-up situations occur if cost or value of a collaboration are imbalanced among contract partners. Moreover, hold-up situations are especially problematic if one party is dependent on the other party and cannot switch to a third party (Hart, 2017). Different hold-up variations are possible, ranging from simple renegotiations to a full termination of a collaboration. Generally, incomplete contracts lead to ex-post discussions about deadweight losses, especially if the involved parties are independent of each other (Hart, 2017). More importantly, Grossman and Hart (1986) conclude that in cases where not all future contingencies can be contractually fixed, contracts need to state who has the power to decide on not contractually covered future disagreements. The scholars' discussion of decision rights developed into what is today known as property-rights theory.

Property-rights theory

The theory builds upon two seminal papers by Grossman and Hart (1986) and Hart and Moore (1990). It originates in the question of what a firm is and discusses integration, i.e. the differentiation of firm-internal production versus market transactions in a setting without information asymmetry. The scholars consider long-term investments instead of mere spot transactions, where some part of the investment is non-contractible, for example the success of a new technology. Moreover, the investment is assumed to be relationship-specific between the involved parties. No ex-ante contract about the split of future profits from the investments is possible and not all eventualities can be contractually fixed in advance (Grossman & Hart, 1986). Accordingly, incomplete ex-ante contracts build the base of the theory. Contracts should then stipulate who has the decision-power, i.e. control, over issues not explicitly determined by the contract. In a later paper, Hart (2001) extends the initial idea and states that not only who has the decision-making power, but also how the process for reaching a decision works needs to be agreed upon in advance.

To enable decision-making, control rights need to be determined. Control rights are differentiated in (i) specific and (ii) residual. Specific control rights are explicitly stated in the contract and are clearly assigned to one party. Residual control rights refer to situations not specifically covered in a contract. In general, the assignment of residual control rights to one party can be seen as a low cost attempt of assigning all specific control rights explicitly (Grossman & Hart, 1986). Control rights can be either unrestricted or contingent on specific events or performance indicators, especially in the case of debt (Aghion & Bolton, 1992). Contingent control rights often serve as an incentive to perform (Tirole, 2005, p. 394). Moreover, different control rights can be allocated, e.g. for strategic decisions, day-to-day

operations, staffing or mergers and acquisitions. The seminal contributions of Hart, Grossman and Moore was to assign residual control rights to parties through property rights, i.e. ownership (Grossman & Hart, 1986; Hart & Moore, 1990). Normally equity with voting rights is used for the assignment of ownership (Hart, 2001). Grossman and Hart (1986) specifically discuss asset ownership, not the power over employees. Hart and Moore (1990) follow the same approach but acknowledge that asset control indirectly leads to control over humans, especially if compared to arm's length transactions. In later models Hart and Moore (1994) and Kaplan, Sensoy and Strömberg (2009) include a distinction of human vs. non-human assets. Increased integration through asset ownership leads to a reduction in opportunistic behavior and thereby a diminishment of the hold-up problem (Hart & Moore, 1990). Moreover, ex-post asset ownership influences ex-ante contracting decisions (Grossman & Hart, 1986; Hart & Moore, 1990). Consequently, the goal of increased contract efficiency is achieved and more relationship-specific non-contractible investments will be made (Hart, 2013).

Although the papers of Grossman, Hart and Moore are seminal contributions, limitations of the property-rights theory emerge. The scholars equate asset ownership with power to control the asset (Grossman & Hart, 1986; Hart & Moore, 1990). Keeping in mind that an asset can be collateralized, e.g. by debt-holders, one must admit that this simplification does not hold in absolute terms and misses the existence of informal control. Moreover, integration also comes with costs and adverse effects, for example incentives for the management of a previously independent firm are reduced, especially if the firm was previously management-owned (Grossman & Hart, 1986). Grossman and Hart (1986) therefore conclude that asset control can shift, but not fully remove, opportunistic behavior.

Having established the benefits and limitations of transferring property rights among contracting parties, the question remains how to allocate ownership. Allocating control is a trade-off, meaning that if one party gains control, another loses it (Grossman & Hart, 1986). Often the control over one asset is worth more than the control over another asset. Such asset specificity influences the owners power and needs to be taken into account during contracting (Hart & Moore, 1990). In their multi-asset multi-player multi-ownership-forms model Hart and Moore (1990) provide guidance on the allocation of ownership. They find that indispensable agents should have asset ownership even if they do not provide the most important input to the cooperation. In contrast, outside dispensable agents should not gain any control. Given an asset that produces a positive marginal benefit for party A but no one else, party A should exercise control over the asset. If multiple agents are required to benefit from an asset, a simple majority vote is recommended to determine asset usage. Moreover, complementary assets should be owned together to reduce hold-up and increase efficiency. In cases of coalitions, either the coalition or the complement should own assets, meaning that ownership should not be shared among parties (Hart & Moore, 1990).

Ownership and control

Ownership is transferred in form of financial securities. As financial securities are already discussed above, only a short summary with focus on the respective ownership rights is given. As outlined by the pecking order hypothesis, different types of securities exist. Although the hypothesis focuses on a differentiation along risks and information asymmetry, securities can also be differentiated by further factors. Most importantly, different returns investors obtain from different securities lead to differences in control rights required by investors. Control rights are not necessarily allocated in the most efficient way and the

financial stability of the entrepreneurial enterprise impacts the amount of control that is transferred to investors. Therefore, incumbent investors might forego growth opportunities to keep control. For example, the founders of Snapchat Evan Spiegel and Bobby Murphy rejected a 3bn$ offer from Facebook in 2013 to keep control over Snap Inc.

In general, equity holders assume control over the entrepreneurial enterprise as long as the firm runs well, whereas debt holders take over control if the company is under distress, especially if covenants are breached (Aghion & Bolton, 1992; Dewatripont & Tirole, 1994). Analyzing the connection between a firm's governance and its financing structure, Aghion and Bolton (1992) provide seminal input for the discussion of control rights of equity. Using a simplified model in which two states are possible ex-ante contracting and investors can take two actions subsequently, they develop a pecking order of control. Entrepreneurial control is fully maintained by the initial founder if non-voting equity is issued. If investors feel not sufficiently protected, however, they will demand a share of voting equity or convertible equity. Finally, investor control is achieved through only issuing voting equity:

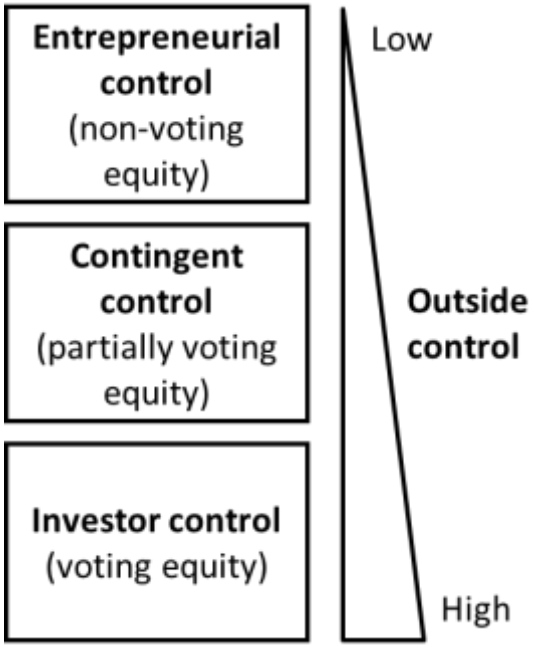

Figure 19: Pecking order of control (adapted from Aghion & Bolton, 1992)

Non-voting equity comes normally in the form of preferred stock, whereas common stock includes voting rights (Aghion & Bolton, 1992). Joint ownership can come in the form of a trust or a partnership and often uses convertible and ordinary debt or convertible preferred stock (Aghion & Bolton, 1992). An example of a convertible is if outside investors hold no control rights as long as revenues are low. Once revenues exceed a pre-specified threshold, investors take over control. Such a mechanism can be established if the incumbent management is suitable to set up an entrepreneurial enterprise but incapable of managing a larger more mature firm. Moreover, convertible (preferred) stock is often applied in the context of IPOs where preferred stock – often paired with additional control through board seats – is transferred to regular common stock (Tirole, 2005, p. 394).

Tensions among an entrepreneurial enterprise and different investors are intensified through the existence of informal control rights, which are in theory often not differentiated from formal control rights (Tirole, 2005, p. 399). Although management might have formal

decision authority, an alignment with other authorities, like supervisory boards or worker unions, is required on specific topics. Independently of the formal control rights allotted to investors, some influential minority investors or management boards might have more actual power through obtaining private information used to influence the decisions of other investors.

Ownership concentration

When discussing ownership, a prevalent topic of corporate governance theory is the existence of concentrated ownership. As the name states, concentrated ownership is about how concentrated or dispersed the ownership structure of a company is. For example, company A can be owned by three parties only, investor A with an 80% controlling rights and investors B and C with an 10% stake each. In contrast, company B is owned by 100 investors, with each party having 1% of the voting power. The two ownership structures have different implications on the control the management of a firm experiences from its investors. The concept of concentrated ownership has its origin in an influential and frequently quoted work from Berle and Means (1932). Comparing US corporations to private property[44], the scholars detected that managers are largely unaccountable to shareholders if hardly any ownership concentration exists. In this case ownership and control diverge. The authors call this phenomenon the unaccountability hypothesis. Therefore, voting rights are shareholders key instrument to influence managers. Mathematically, voting rights of more than 50% are

[44] The scholars use the example of a horse as private property

required to formally control a firm. However, investors holding a significant share of 10-20% are often already in control of a firm (Tirole, 2005, p. 403)[45].

Concentrated ownership can be established in different ways. Due to the separation of cash-flow and control rights, majority shareholders often have more control than what they are entitled to through their cash-flow rights (La Porta, Lopez-de-Silanes, & Shleifer, 1999). The additional control can be established in different ways. First, additional arrangements are possible, like giving majority shareholders board seats (La Porta et al., 1999). Second, cash-flow and control rights are differentiated through dual class stock, pyramidal ownership structures and cross-holdings (Choi, 2018). Dual class stock refers to different types of equity with dissimilar voting rights and is strikingly explained by the example of Google. During the Google IPO in 2004, Larry Page, Sergey Brin and Eric Schmidt received class B shares with 10 votes per share. All other shareholders received class A shares with one vote per share (Securities and Exchange Commission, 2004). Thereby, the three secured more than 66% of the voting rights with less than 32% ownership (Choi, 2018). In 2014, Google issued even class C shares without any voting rights (Securities and Exchange Commission, 2014). Similar constructs in recent IPOs of firms like LinkedIn, Under Armour or Facebook stress the importance of dual class shares in separating ownership and control, especially with the goal of keeping control concentrated. Pyramidal ownership is achieved through a chain of companies to actually control a firm (La Porta et al., 1999). For example, investor A and B each own 10% of the voting rights in a company. Investor A is the sole owner of investor B.

[45] Ownership concentration might not be confused with monopolistic power. Although both constitute a concentration of power, the first is regarding ownership structure and control, whereas the latter refers to a dominant market position of a firm (Morck, 1996)

Thereby, investor A controls a significant share (namely 20%) of the voting rights of the company.

Although the implications and efficiencies of concentrated ownership are subject of many studies (e.g. Aguilera & Crespi-Cladera, 2016; Choi, 2018; Demsetz & Lehn, 1985; Holderness & Sheehan, 2000; Morck, 1996; Yalden, 1996), economic theory cannot offer a final conclusion on whether ownership concentration is beneficial or not (Morck, 2000). Yalden (1996) and Morck (1996) independently establish that a balance between widespread and private ownership leads to the best outcome, which can be illustratively pictures as follows:

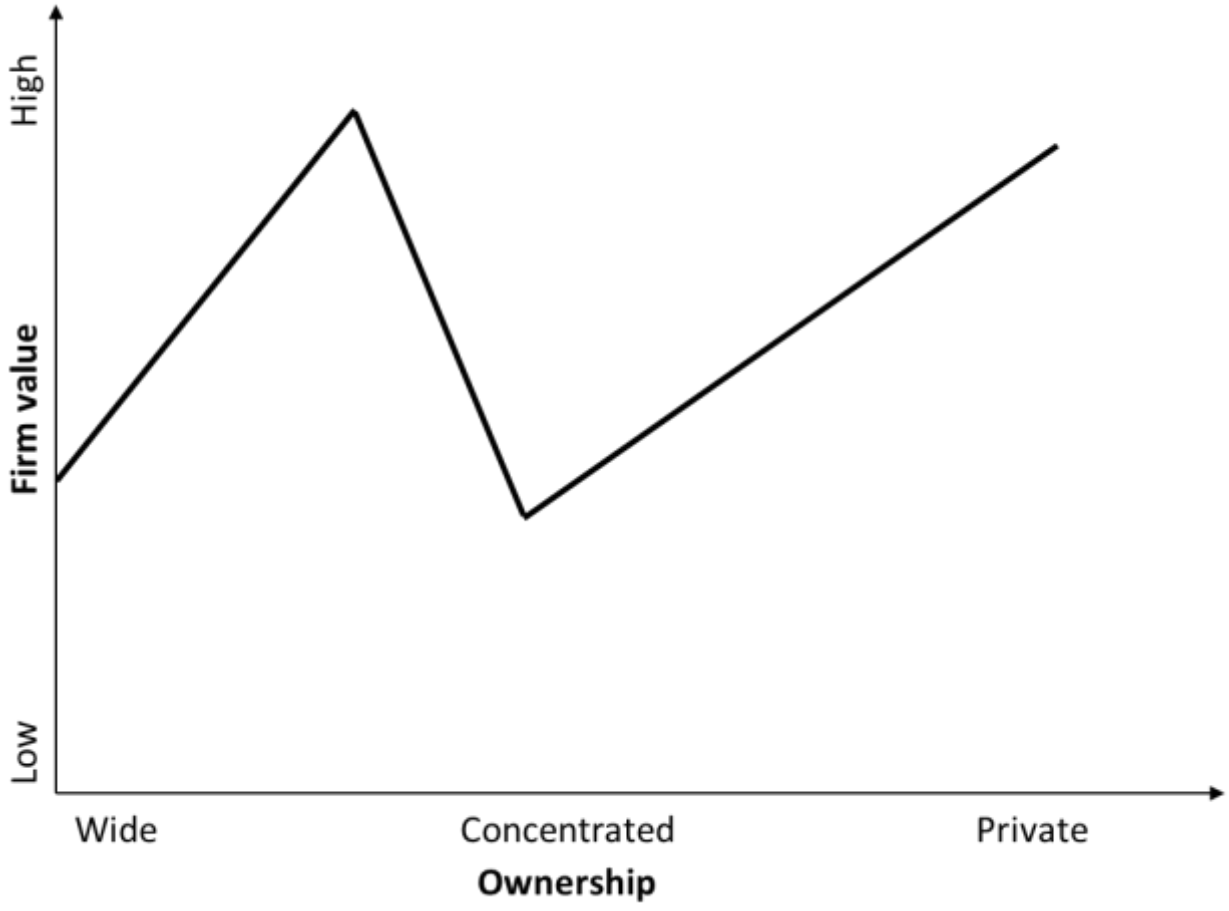

Figure 20: Implication of ownership structure on firm value (Morck, 1996)

Morck, Shleifer and Virshny (1988) test and confirm the theory empirically using Tobin's Q and percentage of board ownership. They find an increase in Tobin's Q from 0 – 5% board ownership, a decrease until 25% board ownership and a small increase afterwards. Although the theory holds empirically, the exact turning points are dependent on firm-specific characteristics and therefore hard to determine (Morck, 1996). In empirically analyzing whether legal block holdings lead to economic inefficiencies, Holderness and Sheehan (2000, p. 140) do not reach a finite conclusion. Neither do they find significant trading discounts for firms with majority shareholders[46] nor significant differences between firms with and without majority shareholders regarding board composition, capital market activity or premia for minority shareholders. As no final conclusion can be reached on the impact of concentrated ownership, both positive and negative effects need to be taken into consideration.

On the positive side, ownership concentration serves as an additional governance mechanism through improved check and balances of the management. Strong owners can put more pressure on the management team and monitor them closely (Choi, 2018). Through concentrated ownership the behavior of managers is more closely aligned with investors for two reasons. First, majority shareholders have the power to replace managers if their performance is inferior and put pressure on them to align management incentives with the overall corporate development (Aguilera & Crespi-Cladera, 2016). Second, the existence of concentrated ownership reduces the threat of hostile takeovers, which often lead to the layoff of the incumbent management team (Choi, 2018; Morck, 1996). Consequently, Morck (1996) concludes that ownership concentration leads to better performing managers, which in turn

[46] In their case shareholders with > 50% legal ownership

leads to higher share prices, keeping the incumbent investor loyal to the firm. One of the most positive effects of concentrated ownership is the long-term attitude of majority owners. Choi (2018) finds that majority shareholders enjoy non-transferrable and illiquid private benefits. Such benefits are specific to them and can therefore not be sold for a premium as no other party would enjoy it. A good example is the support of an investor's alma mater with company funds or through heavily recruiting from there. As an investor would not receive any proceeds for such a private benefit when selling her stakes in a company, a lock-in effect results. Choi (2018) elaborates that such a lock-in effect causes the investor to stay invested in the firm for the long-run focusing on more strategic issues, like long-term R&D investments instead of short-term financial returns. The author even argues that concentrated ownership is an essential corporate governance vehicle – even for US firms – and quotes the positive experiences with dual equity at Facebook and Google. Morck (1996) identifies another advantage of concentrated ownership. He argues that majority owners are often powerful investors investing in multiple enterprises in parallel. Consequently, they have sufficient power to influence (at least local) policy making and can create barriers to entry in the industries their investees are active in. The power to do so results out of their ability to – if they control sufficiently many firms – return favors to politicians. Concentrated ownership can also be formed through coalitions of different parties (Tirole, 2005, p. 47). Such coalitions are regarded as beneficial for the firm, as seeking for compromises ensures that needs and goals of all involved parties are taken into consideration.

On the other hand, concentrated ownership leads to unintended and unbeneficial consequences, which are – as Choi (2018) detects – heavily discussed in literature. Predominantly concentrated ownership leads to governance failure (e.g. Aguilera & Crespi-Cladera, 2016; Choi, 2018; Morck, 1996). For Morck (1996), the highest risk comes from

misusing investments, especially if managers are majority shareholders. In such cases, funds are invested for private benefits, instead of maximizing firm value (Choi, 2018). Holderness and Sheehan (2000, p. 154) find that all types of majority investors have an incentive to abuse their power, e.g. through increasing dividend payments to themselves. The scholars also cite abuses in the form of excessive compensations, furnishing private houses and buying expensive cars. Such abuses of power do not only harm the firm value, but also minority stakeholders. This is especially the case if management collaborates with majority shareholders (Aguilera & Crespi-Cladera, 2016). According to Tirole (2005, p. 359), a major threat of concentrated ownership is that entrepreneurial freedom is restricted, with potentially harmful effects on the development of the entrepreneurial enterprise. Moreover, ownership concentration makes it hard for new investors to find suitable investments, as incumbent shareholders fear the threat of dilution (Morck, 1996). In the worst case, this leads to a drying up of financial markets and severely restricts a firm's capability to secure additional funding. Moreover, the above-mentioned lock-in through non-transferrable private benefits of ownership concentration hinder a potential change of control (Choi, 2018). Concentrated ownership leads to a free-riding problem, where minority shareholders refrain from controlling the management and rely on the majority shareholder (Aguilera & Crespi-Cladera, 2016). In the special case of family-owned majority shareholdings economically unskilled people might inherit the large responsibility to control a firm, something they might not be capable of (Morck, 1996).

Although the mentioned negative effects of concentrated ownership cannot be fully reduced, ways to mitigate them exist. Already Berle and Means (1932) argued for a free information flow and legal protections of minority shareholders. Such minority shareholder protection laws exist (Morck, 1996) and seem to actually work in reality (Holderness &

Sheehan, 2000, p. 141). The before-mentioned dual class stock, pyramidal structures and cross-holdings already mitigate the risk of funding dry-up, lost control for the entrepreneur and threat of takeovers (Choi, 2018). Morck (1996) argues that minority shareholders should pay an initial discount to balance the threat of abuse. Holderness and Sheehan (2000, p. 141) disagree, stating that this would lead to a lemons problem with the vanishing of minority investments at all. As investors also care about their market reputation, majority stakeholders are pressured to refrain from abusing minority shareholders (Holderness & Sheehan, 2000, p. 151). Additionally, incentive systems can be structured in a way that they further mitigate the threat of majority shareholders focusing solely on their private benefit (Choi, 2018). In order to mitigate the before-mentioned risk of too close links between powerful investors and politicians, laws regulating e.g. personal links, individuals directly switching from corporates to politics and vice versa as well as processes for public bids exist (Morck, 1996).

Summing up, contracts are essential for executing deals between different parties in order to cope with information asymmetries in principle-agent settings. In theory, complete standard contracts can be written that cover all potential eventualities. In practical life, however, writing all-covering contracts is either impossible or too costly. Therefore, imperfect contracts prevail. Under the so-called property-rights theory, ownership reduces the uncertainty of imperfect contracts. The theory states that all residual – i.e. not explicitly stated in the contract – decisions are to be made by the party that has ownership over the respective asset. Such ownership can be achieved in different forms, particularly through financial securities, like (voting) equity. In addition, parties have to determine what share of ownership is transferred to which investor, i.e. whether an ownership concentration is desirable or not. After discussing all these questions in detail from a theoretical point of view, the next part will look at CVC contracts.

II.2.4.2 CVC contracting

The following section specifically focuses on contracts between CVCs and start-ups. It discusses in detail various contract terms, describes the process of writing contracts and summarizes existing studies on the effect of different contractual stipulations. CVCs and start-ups are fundamentally different organizations, as outlined earlier in this work. Consequently, a collaboration between the two parties requires mitigating conflicts from different interests and objectives to make the principle-agent relationship successful. Although minor differences in contract design between various forms and geographical locations of venture capital funds exist, the primary problems in the objectives of contracts remain the same. If reasonable, the broader literature on VC contracts will therefore be used and specific differences are highlighted separately.

Contracts between a CVC and an entrepreneurial enterprise aim at reducing agency costs (Cumming, 2005a; Fairchild, 2004), more precisely solving problems regarding moral hazard, information asymmetries, hold-up, disagreements and decision rights (Kaplan & Strömberg, 2004). According to Gompers (1999), information asymmetries are the main reason for agency costs in CVC-venture collaborations. Kaplan and Strömberg (2004) find that the principle-agent setting and especially resulting hold-up problems influence contract design. Hold-up often results out of private benefits for entrepreneurs, especially in the context of exit rights (Fairchild, 2004). Private benefits can stem from an environmental or regional responsibility or a specific scientific interest in a project (Gebhardt & Schmidt, 2006). Private benefits are essential for entrepreneurs, being valued at 143% of an entrepreneurs total annual financial income (Moskowitz & Vissing-Jorgensen, 2002). In contrast, VCs receive almost no private benefits from control (Kaplan & Strömberg, 2003).

Different contractual solutions to these problems exist. Gompers (1999) recommends coping with conflicts of interest through aligning incentives. Sahlman (1988) concludes that contracts focus on value[47] through balancing risks, cash, time and incentives. Triantis (2001) considers minimizing information cost as primary solution. Ewens, Gorbenko and Korteweg (2018) recommend strong incentives paired with intense information sharing. Similarly, Burchardt, Hommel, Kamuriwo and Billitteri (2016) detect that screening and monitoring activities reduce agency problems.

When discussing solutions to principle-agent problems, one has to be aware that they can be considered from two different angles, namely the CVC and the start-up perspective. Most scholars view the investor as principal. In contrast, Smith (1998) considers the entrepreneur as principal and states that contracts need to solve the problem of investor shirking, opportunism and incompetence. He finds that the first and the second are partially, yet not fully mitigated through contracts and that start-ups need a 'gamblers mentality' as they always assume a large risk. The third problem, namely a failure to provide promised value-adding services to the start-up, is hardly addressed in contracts.

Kaplan and Strömberg (2003) find that VC contracts are far more complex than what theory predicts, especially as different rights are used in parallel and as one specific right is often subdivided in multiple dimensions. Moreover, contracts are dynamic and especially control rights change as VCs return operational rights to the entrepreneur but obtain additional exit rights over time (Bienz & Walz, 2006). Although VC contracts are often highly standardized (Landström et al., 1998), writing contracts as a governance device is

[47] Contracts can either increase or decrease value or redistribute it among the contracting parties

often a costly endeavor (Barney, Busenitz, Fiet, & Moesel, 1994), especially if different states of the world shall be covered (Gebhardt & Schmidt, 2006).

In order to write contracts in an efficient way, the involved parties often follow a standardized two-step process. First, the negotiated terms are summarized in term-sheets. These are short, bullet-point style agreements between the parties. Parties should not be misled by the brevity of term-sheets as the content might be difficult to understand for laymen (Malhotra, 2013). Such term-sheets state the primary terms of the deal, especially regarding funding, control rights, board seats and exit procedures (Christofidis & Debande, 2001). As term-sheets are not legally binding, they are in the second step transformed into legal contracts. According to Smith (1998) the final legal documents include stock purchase or investment agreements, shareholder agreements, a certificate of designation or incorporation and registration rights agreements (often referred to as VC contract). Moreover, employment and confidentiality agreements and CVC operating agreements are signed. In addition, specific voting agreements and co-sale or right of first refusal agreements are possible. Specifically for CVCs, the corporate parent is often included in the final deal approval to achieve buy-in and ensure strategic fit of the deal (Souitaris & Zerbinati, 2014).

Contract provisions

The different provisions and terms included in CVC contracts are discussed next, without using too much legal vocabulary. Even in the specific context of CVC, economists refer to the different rights on an abstract level, often referring only to cash-flow and control rights (e.g. Bienz & Hirsch, 2011; Bienz & Walz, 2006; Burchardt et al., 2016; Correia & Meneses, 2017; Kaplan, Martel, & Strömberg, 2007; Kaplan & Strömberg, 2001). Especially the separation of financial and control rights is often assumed in models and observed in

reality (Fairchild, 2004; Hellmann, 1998). Other scholars pick selected and more precise contractual provisions for discussion (e.g. Bascha & Walz, 2002; Cumming, 2005b, 2005a; Denis, 2004; Ewens et al., 2018; Kaplan & Strömberg, 2003; Schizer & Gilson, 2003).

In the following, contractual provisions are clustered and explained. Each cluster describes different rights stemming from fundamentally different objectives of both CVCs and start-ups. Rights are allocated separately (Kaplan & Strömberg, 2003) and their manifestation is dependent on start-up characteristics, like stage, asset intangibility, founder experience and investor characteristics (Bengtsson & Sensoy, 2011; Cumming, 2005a) and to a lower degree on legal regimes, accounting standards and environmental and institutional set-up (Kaplan et al., 2007)[48]. If start-up performance is low, cash-flow rights are more focused on down-side protection and control rights for the CVC will be stronger compared to a well performing start-up (Bengtsson & Sensoy, 2011; Ewens et al., 2018). Stronger control rights will allow to turn things around to the better or even replace the full management (Gebhardt & Schmidt, 2006). When start-ups perform well, cash-flow rights are often maintained, while control rights are reduced (Kaplan & Strömberg, 2003). For well-performing start-ups, the CVC focuses more on limiting the entrepreneur's consumption of private benefits instead of controlling every single decision (Gebhardt & Schmidt, 2006). Bengtsson and Sensoy (2011) recommend keeping the down-side cash-flow protection low due to risk sharing costs and instead using other ways, like monitoring, to cope with agency problems. Moreover, Gompers (1999) finds that contracts become more efficient if cash-flow and control rights are separated and that cash-flow rights based on equity ownership are often not sufficient to control the entrepreneurial enterprise accordingly. An investor, especially a

[48] Bengtsson and Ravid (2009) find that especially culture and style influence contract forms in different locations

CVC, might only buy a 20-30% equity stake, with the remainder often being owned by the founder or other investors. Nonetheless, the CVC wants to assume control over crucial decisions, e.g. major investments or IPOs. Especially, the existence of private benefits and the attempt to use financing as an incentivizing device makes the separation of cash-flow and control rights in CVC contracts necessary (Correia & Meneses, 2017; Gompers, 1999). Moreover, a separation is needed as start-ups should have sufficient control if they are well-performing, whereas CVCs want to take over the lead in case of low performance, e.g. a threatening liquidation (Gebhardt & Schmidt, 2006).

The contractual provisions can be grouped in (i) cash-flow rights, (ii) control rights, (iii) covenants and (iv) other rights:

Table 2: Classification of legal provisions (adapted from Ewens et al., 2018; Gebhardt & Schmidt, 2006; Gompers, 1999; Hellmann, 1998; Kaplan & Strömberg, 2003; National Venture Capital Association, 2013; D. G. Smith, 2005; classification by author)

	Provisions
Cash-flow rights	• Type of security and valuation • Dividends • Liquidation preference • Redemption rights • Preemption rights • Super priority
Control rights	• Type of security • Board representation and voting rights • Protective provisions and decisions requiring investor approval • Staging and milestone financing • Founder share vesting • Drag-along rights • Exit rights
Covenants	• Right of first refusal and tag-along • Anti-dilution provisions • Conversions (automatic, optional, mandatory) • Pay-to-play provisions • Registration and lock-up rights
Other rights	• Value-adding services • Entrepreneur employment terms • Termination provisions • Exclusivity • Conditions to closing and counseling expenses

Cash-flow rights are in line with the start-up's basic need, namely to receive funding. Moreover, such rights are essential for investors, especially those that invest for financial reasons only. Cash-flows act as incentives and play a crucial role in aligning the interests of the involved parties, thereby reducing agency cost. Fairchild (2004) finds that the allocation of cash-flow rights is generally influenced by the amount of value-adding services offered, the reputation and the bargaining power of the involved parties. As shown in Table 2, the type of security plays a major role in determining both cash-flow and control rights. From a cash-flow perspective, securities determine the share an investor or any other security holder, like the founder or incumbent management, owns of the overall start-ups equity (Kaplan & Strömberg, 2003). Contracts on securities include the initial purchase price and the conversion price[49], a formula to derive adjustments to common stock and explicit events when conversion occur[50] in case of convertible securities (Gompers, 1999). Different classes of securities exist, which are also detected in CVC contracts, including debt, common equity or preferred convertible equity. According to Cumming (2005b) different securities are used to reflect the heterogeneity of entrepreneurial enterprises regarding agency problems, required monitoring and control or board seat requirements, making a one-size-fits-all security unrealistic. In addition, the securities a CVC receives are different from those a founder holds, especially regarding board, voting and liquidation rights (Kaplan & Strömberg, 2003). Moreover, the application of securities is dependent on external factors. Cumming (2005a) finds that after the bursting Internet bubble less common equity and more securities with downside protection were used to secure priority in case of a start-up's bankruptcy. The author further analyzes the use of different security forms and finds that

[49] Usually the initial purchase price
[50] E.g. IPO or when predetermined (often financial) milestones are reached

more mature start-ups with existing revenues are more likely to be debt financed, whereas younger start-ups and high-tech firms tend to use convertible preferred equity instead. Whereas staging leads to more debt financing, syndications tend to use straight or convertible preferred equity[51]. In contrast to expectations, Kaplan et al. (2007) do not detect a strong impact of capital market liquidity on the choice of securities. They only find evidence that common stock is more prevalent in IPO-heavy countries. Cumming (2005a) detects that a mixture of common equity and debt is preferred over preferred equity in cases where large amounts are invested. Such a mixture is used to specifically mitigate agency risks (Cumming, 2005b). Although Smith (2005) views preferred equity as inferior to a mixture of common stock and debt[52], many scholars broadly discuss (convertible) preferred equity as it is part of many VC contracts (e.g. Bascha & Walz, 2002; Correia & Meneses, 2017; Cumming, 2005b; Gebhardt & Schmidt, 2006; Gompers, 1999; Kaplan & Strömberg, 2003; Sahlman, 1988; Schizer & Gilson, 2003). Convertible preferred stock can be seen as combination of equity and an ex-ante call option, more precisely a fixed claim at face value, accumulated dividends and a call option on common stock (Bascha & Walz, 2002). It gives investors a primary claim on the start-up's earnings and liquidation, thereby shifting risk from the CVC to other shareholders, especially the entrepreneur (Sahlman, 1988). The convertible part allows to exchange the preferred stock to – in most cases – common stock at pre-specified events, e.g. during an IPO. Therefore, convertible securities come with an additional incentivizing effect for the entrepreneur to show high effort and refrain from improper risk-taking (Gebhardt & Schmidt, 2006; Gompers, 1999). Convertible securities aim at reducing (double-sided) moral hazard (Correia & Meneses, 2017), mitigating adverse selection (Gompers, 1999) and

[51] Especially straight preferred equity mitigates agency problems among multiple investors
[52] Preferred stock has the disadvantage of no voting power versus common stock and the disadvantage of no insolvency protection versus debt

efficiently managing conflict of interests (Bascha & Walz, 2001). In other words, convertible securities play a major role in solving agency problems. Convertibles allow for stage-contingent pay-outs, i.e. milestone financing, reduce the threat of window dressing[53] and maintain more flexibility at exits (Bascha & Walz, 2002). Convertible preferred equity ensures a strong claim in case of liquidation, more money raised compared to debt[54] and a reduced dilution of the entrepreneur's ownership share (Cumming, 2005b). A further advantage of convertible stock is that it allows to implement an ex-ante agreed optimal exit (Bascha & Walz, 2001). Especially under US law, convertible preferred stock is heavily used due to tax advantages[55] (Schizer & Gilson, 2003). For other countries, a similar tendency to use convertible preferred stock under low capital gain tax regimes emerges (Cumming, 2005a). In line with the resulting benefits, convertibles are used in CVC contracts if the agreed upon goals are challenging to achieve, if CVC management is scarce and has many portfolio firms under management, if the CVC's required return is high and if the entrepreneur lacks a promising track record (Bascha & Walz, 2002). Similarly, Correia and Meneses (2017) detect that convertible securities are mainly used by more experienced VCs, for high risk high return projects and for early stage enterprises.

Liquidation rights refer to specific cash-flow rights if the start-up is not performing well and fails for bankruptcy. Independent of a start-up's actual fair value, a VC's claim in the case of a liquidation is at least the initial investment (Kaplan & Strömberg, 2003). Such

[53] The effect is further reinforced in case of staging

[54] Through issuing equity, the CVC also receives control right, increasing the willingness to fund higher amounts

[55] In the US, entrepreneurs/ founder of companies under venture capital management receive a better tax rate and tax deferrals. Their rewards are split in compensatory returns and investment returns. Compensatory returns are the payments entrepreneur receives for the services she performs for the start-up. This income is taxed at the ordinary income rate, which is often significantly above the tax rate on capital gains. In contrast, investment returns describe the value increase of the investment made. These are often taxed at less than the long-term capital gain tax rate, especially if the stock is classified as 'small business stock' (Schizer & Gilson, 2003)

claims are often amended by cumulative dividends. According to Kaplan and Strömberg (2003) redemption rights are linked to liquidations, as redemption rights describe the CVC's right to receive the liquidation value after a pre-determined period of time, even in the case when no liquidation event occurs, i.e. if the start-up is performing well. Redemptions are often paid out as face value of preferred stock and the remaining in common stock and are used to force a merger (Gompers, 1999). Preemption rights give the investor the right to participate in future financing rounds (Denis, 2004). This right is of special importance in multiple-stage start-up funding as it ensures that investors can maintain their initial equity share (Burchardt et al., 2016). According to anecdotal evidence in Souitaris and Zerbinati (2014), start-ups critically view the high demand of preemptive rights especially expressed by CVCs. Super priority is often separately stated in CVC contracts and describes the fact that a CVC's cash-flow claims are superior to other security holders.

Control rights help the CVC to achieve their major objective, namely to secure access to innovative ideas. Having control rights significantly reduces the investor's risk of losing its invested money through being actively involved in landmark decisions. As such, control rights help to mitigate information asymmetries, to reduce agency costs and consequently to reduce the hold-up problem (Hellmann, 1998). As proof of the property-rights theory, control rights are essential as contracts between CVCs and start-ups are incomplete (Kaplan & Strömberg, 2003). Generally, control rights have multiple dimensions to it (Bienz & Walz, 2006). Control rights come to some degree from issuing voting or non-voting securities to CVCs (Kaplan & Strömberg, 2003). Often VCs enter as a minority investor and only achieve equity majority in the course of multiple financing rounds, if at all. As VCs still require control early on, control rights are determined separately (D. G. Smith, 2005). Such additional control is mainly achieved through direct board control, i.e. board seats for CVC

personnel, a disproportionate share of votes or specific legal clauses requiring CVC consent on a broad array of topics (Gebhardt & Schmidt, 2006). Control through specific voting shares occurs, but is often lost in conversions and then balanced through additional cash-flow rights (Gebhardt & Schmidt, 2006). Specific contractual terms occur for exit rights. The time to (expected) exit heavily influences the amount of control rights required by a CVC, with a shorter time to exit leading to much higher CVC control (Bienz & Walz, 2006). Therefore, the ex-ante allocation of control rights always needs to consider the split of control during exit (Bascha & Walz, 2001). Especially during exit discussions, board control is an inevitably powerful tool, especially if linked to specific voting rights[56] (D. G. Smith, 2005). Often, different control rights are balanced. For example, operational control rights are returned from the CVC to the entrepreneur as the start-up grows older, while exit rights are gained (Bienz & Walz, 2006).

Board rights include the handling, selection and replacement of top-management and the overseeing of strategic decisions (Kaplan & Strömberg, 2003). Besides assuming board seats, CVCs can become mere board observers. Thereby, their control but also fiduciary duties are reduced. Around 1/3 of CVCs look for full voting seats, whereas 3/4 always or frequently pursue non-voting observer seats (MacMillan et al., 2008, p. 17). Even without formal board control, CVCs tend to influence the selection of third party board members, ensuring a fit with the CVC's objectives (D. G. Smith, 2005).

The power to replace the management is probably the most essential protective provision allocated to CVCs. Protective provisions are explicit allocations of control rights to specific parties, especially for decisions that require a supermajority of all investors

[56] The board must initiate exit proceedings, while shareholders can only approve it

(Gompers, 1999). According to Gebhardt and Schmidt (2006) two main reasons for replacing incumbent start-up management exist both leading to inferior start-up performance, namely too much focus of the management on private benefits and a required change in management capabilities as start-ups grow older and become more mature. Before a replacement of management is necessary, it must be determined who has the power to do so. According to Gebhardt and Schmidt (2006) CVCs focus mainly on financial and strategic issues, without considering private benefits, whereas founders might overrate private benefits and will – in most cases – refrain from replacing themselves. Hellmann (1998) finds that replacing the incumbent management leads to a loss in non-transferrable private benefits and a drain in experience gained over many years. Consequently, the overall utility is often reduced through replacing incumbent management. The replacement probability can be diminished through large severance packages. Moreover, the scholar finds that investors without enough control rights have no incentive to search for a new management if they have no significant benefit through superior start-up performance. Even if the incumbent management is not replaced, giving the CVC the power to do so leads to two contrary effects. On the one hand, the incentive effect forces the entrepreneur to focus more on the start-up's performance instead of private benefits. On the other hand, the threat of replacement could also incentivize the incumbent management to harvest private benefits as long as they are still available to them. Hellmann (1998) does not reach a final conclusion on which effect dominates. However, he detects that VC control is higher, i.e. the change in management more frequent if the proficiency of professional replacing managers increases, the productivity of incumbent management decrease, the private benefits of incumbent management decreases and the bargaining power of the VC increases. Further protective provisions exist with regards to major events like mergers and acquisitions or new financing (Kaplan & Strömberg, 2003).

For new financing rounds, the focus of the VC often lies on the number of new board members new investors can maximally select (Gompers, 1999). In addition, significant changes in business plans, like headcount changes require investor approval (Bienz & Walz, 2006). If asset sales or purchases surpass a pre-determined threshold, management needs approval of the CVC in order to limit entrepreneurial risk-taking and unbeneficial asset deals[57] (Bienz & Walz, 2006; Gompers, 1999). As the founder and entrepreneur often plays a crucial role for an entrepreneurial enterprise's success, investors prevent the entrepreneur from selling her stakes without CVC approval. According to Gompers (1999), only few protective provisions exist regarding day-to-day management issues, as VCs only get involved on that level if things go severely wrong. In contrast to IVC, CVCs are expected to include more protective provisions concerning technology and patents. For example, CVCs need to prevent their portfolio firms to sell their patent to corporate competitors.

Another source of CVC control is the provision of staged milestone financing. Staging occurs if not all money is paid out to a start-up at once but in various tranches (Bienz & Hirsch, 2011). In contrast, round financing occurs if each and every payment from the investor to the entrepreneurial enterprises is negotiated from scratch. Milestone funding is often dependent on pre-agreed thresholds and KPIs and leads to more complete contracts (Bienz & Hirsch, 2011). Through withholding or threatening to withhold future funding, the CVC obtains additional control over the start-up (D. G. Smith, 2005). Additionally, it reduces investor's risk as funding and valuations can be reconsidered over time (Sahlman, 1988).

[57] For example, it should be prevented that the entrepreneur sells (buys) an asset to (from) close acquaintances at a price discount (premium)

Further CVC control rights come from vesting the entrepreneur's shares. The main goal of vesting is to ensure that the entrepreneur stays with the firm, performing well for a specific period of time (Kaplan & Strömberg, 2003). Vesting means that the entrepreneur loses the claim on her equity share if she leaves the company early, often within five years (Hellmann, 1998). Vesting ceases contingent on the entrepreneur's performance or her time with the firm (Kaplan & Strömberg, 2003).

Drag-along rights force an entrepreneur or other minority shareholders to sell their equity shares jointly with the shares of the majority investor if the CVC initiated such a sale (Burchardt et al., 2016; Cumming, 2008).

A large share of control rights focuses on the event of an exit. (Convertible) securities, accumulated dividends and board control play an important role (D. G. Smith, 2005). Moreover, preemption rights, tag-along clauses, drag-along provisions and so-called piggy back rights[58] serve as exit covenants (Bienz & Walz, 2006). A clear determination of exit control rights is required as (i) different parties have different exit interests regarding the split of the monetary return and the mode of exit and (ii) a complete contracting of the exit is impossible ex-ante, e.g. with regards to firm valuation (Bascha & Walz, 2001). Whereas CVCs tend to be more relaxed about the timing of the exit, limited life-time IVC funds push for timely exits.

Covenants describe the do's and don'ts for all involved parties. They include clearly defined terms for situations that are anticipated in advance. Covenants are used to agree ex-ante on specific terms, whereas control rights determine who gets to decide on ex-post arising issues. They are differentiated in affirmative or positive and negative covenants. Positive

[58] Piggy back rights give every investor the right to include its shares in an IPO

covenants require a specific activity, whereas negative covenants prevent an action (D. G. Smith, 2005). According to Barney et al. (1994), covenants are necessary to counter (i) managerial opportunism and (ii) competitive opportunism. The first refers to a misuse of money through entrepreneurs, the second refers to entrepreneurs leaving the company shortly after a CVC investment, starting with a competitor. Both lead to a decreasing CVC wealth and therefore need to be prevented. Consequently, more contractual covenants are observed for start-ups with high agency problems, e.g. high R&D spend (Gompers, 1999).

The right of first refusal gives the CVC the possibility to invest additional money in subsequent funding rounds, thereby maintaining its equity share (Sahlman, 1988). Normally the terms offered to the CVC in such subsequent funding rounds must be at least as beneficial as those offered to new potential investors (Cumming, 2008). Selected statements from CVC units provide hints that CVCs tend to use right of first refusal provisions with caution as they might impede a financial burden on the corporation (Basu, Phelps, & Kotha, 2016).

Tag-along rights are the counterparts to drag-along rights and allow minority investors to sell their stock at the same terms of majority shareholder do (Burchardt et al., 2016). As CVCs care about the share of their investment, anti-dilution provisions are part of many contracts (Denis, 2004). Normally, anti-dilution provisions protect the VC against a dilution of their ownership in subsequent funding rounds at the cost of the entrepreneur (Kaplan & Strömberg, 2003). According to Kaplan and Strömberg (2003) a ‘full ratchet protection’ gives a VC the maximum protection through fully balancing out differences in issuing prices in subsequent funding rounds versus issuing prices in the initial funding round. In contrast, the more frequently used ‘weighted average approach’ only reimburses for the average of issuing prices of the initial and subsequent funding round. Conversion rights refer

to the automatic, optional or mandatory transfer of preferred stock to common stock (Kaplan & Strömberg, 2003). Pay-to-play provisions reduce investor rights if they do not participate in subsequent funding rounds (Ewens et al., 2018).

Other rights refer to provisions that are peripheral to (financial) CVC contracts but are still deemed important enough to be included in CVC contracts. Such provisions include e.g. the CVC's obligation to provide value-adding services, like mentoring or network access to the entrepreneurial enterprise. According to Bengtsson and Sensoy (2011) such services help to further mitigate agency problems. Moreover, the employment terms for the entrepreneur are often fixed contractually and state the terms of the agreement. In the VC context, hardly any severance packages for founders are detected (Hellmann, 1998). This finding is in disagreement with the optimal contract that would include severance packages for the entrepreneur that do not fully compensate her in case she is replaced[59] (Hellmann, 1998). In contrast, non-compete clauses are included in most CVC contracts (Kaplan & Strömberg, 2003) as the entrepreneurs individual effort is essential for the start-ups success (Gompers, 1999).

According to Kaplan and Strömberg (2003), the rights discussed above are often not absolute but contingent on measurable financial and non-financial performance indicators, like EBIT thresholds or FDA approvals. Contingency means that the rights change, e.g. are granted to the CVC and withdrawn from the entrepreneur, based on whether specific goals are achieved or not. As such, contingencies are another tool to contractually ensure intensified CVC control rights if the entrepreneurial enterprise performs badly. Additionally, contingencies are more prevalent in contracts including unexperienced founders and high

[59] According to the author's analysis, the resulting higher replacement rate would lead to superior performance

risk start-ups as well as small private yet highly experienced investors (Correia & Meneses, 2017). Although all rights can theoretically be made contingent on specific measures, Gebhardt and Schmidt (2006) find that contingent control rights are frequent in VC contracts to hinder the entrepreneur from focusing too much on private benefits, instead of the well-being of the start-up. They conclude that contingent control allows to implement the most efficient solution to allocating control rights. Moreover, they detect that cash-flow rights at the exit are often made contingent through the use convertible securities. Although contingencies seem beneficial to be included in contracts, they are ex-ante difficult to contract, especially with regard to meaningful thresholds for the agreed upon indicators (Bascha & Walz, 2001).

Provision application

After learning about the various provisions, more valuable insights come from analyzing the frequency of different terms being used and their effect on start-up and CVC success. Table 3 summarizes selected studies on the usage of VC contract terms and is by no means exhaustive:

Table 3: Applications of contract terms (author's comparison)

	Ewens, Gorbenko, Korteweg 2018	Gompers 1997	Kaplan, Martel, Strömberg 2007	Kaplan, Strömberg 2003
Cash-flow rights	• Almost all with convertible preferred equity • Participating preferred equity lowers exit success • Average equity share: VC 45%, optimal for successful exit 7% • Low equity shares for low quality VCs versus high quality VCs	• Equity share for VCs in first financing round of 40% • Optional redemption rights 68% • VC super priority in 66%	• Convertible preferred: US 95%, others 54% • Ordinary common stock: US 1%, others 28% • Fully diluted ownership share: US 47%, others 36% • Liquidation preference/ seniority for VC: US 97%, others 34% • Redemption rights: US 72%, others 34% • 0% of VC using convertible preferred equity failed • 34% of VCs using common stock failed	• 95% use convertible preferred stock among others, 80% only use convertible preferred stock, 40% use participating convertible preferred stock • Average cash-flow share: VC 50%, founder 30%, others 20% • Cumulative dividends in almost 50% (in addition to liquidation rights) • Senior liquidation rights for VC in 98% • Redemption rights in almost 80%, normally 5 years
Control rights	• VC board seats and participation rights lower exit success and shift value from start-up to investors • No participation and board seats for low quality VCs, participation rights and board seats for highest quality VCs	• Average number of VC board seats: 2.7, leading to board control • More board seats if start-up with higher share of intangible assets, fewer VC board seats if VC competition • Limitations on asset sale 58% and asset purchases 56% • Limitations on selling equity 62% and issuing new equity 66%	• Board control: US 25%, others 12% but similar share of firms that obtain board seats at all • Milestone funding: US 53%, others 39% • Vesting: US 44%, others 37%	• Average number of board seats: 6 • Average board seat share: VC 42%, founder 35%, other 23% • In 18% VC assumes full board control if inferior start-up performance • Share of voting rights: VC 54-62%, founder 25-34%, other 12-13% • Founder share vesting in 40%
Covenants	• Pay-to-play provisions for low quality VCs, no pay-to-play provisions for high quality VCs	• Anti-dilution protection in 100% • Mandatory conversion at IPO 92% • Automatic conversion based on performance goals 38% • Automatic conversion more frequent for early stage start-ups • Conversion price as multiple of initial investment price	• Anti-dilution protection: US 94%, others 56%	• Anti-dilution protection in 95%, almost 80% based on weighted average • Automatic conversion rights in 95%
Other rights				• Non-compete clause for entrepreneur in 70%
Study set-up	10,000 first financing rounds of US start-ups from 2002 to 2015	50 US VC contracts which average closing date December 1988	145 VC investments in 107 start-ups in 23 countries, by 70 VCs from 1992 to 2001	213 VC investments in 119 firms by 14 US VC funds from 1986 to 1999

	Bienz, Walz 2006	Cumming 2005a	Cumming 2005b
Cash-flow rights	• Debt-equity mixes used most frequently • Equity: first round 40%, third round 70% • Liquidation rights: 86% for all VCs, 93% for IVCs only, mainly constant over financing rounds • Larger share of debt, smaller share of convertibles compared to US • Preemption right: third round 42%	• Common equity 29%, straight debt 15%, convertible debt 15%, convertible preferred equity 11%, straight preferred equity 9%, mix straight debt and common equity 5%, mix common and straight preferred equity 2%, other combinations 14% • Early stage start-ups more likely straight preferred or common equity	• Common equity 36%, straight non-convertible debt 15%, convertible preferred equity 12%, convertible debt 12%, mix straight debt and common equity 11%, straight preferred equity 7%, other combinations 7% • Seed start-ups more frequently common (5-7% more likely) or preferred (4% more likely) equity, less frequently debt • High-tech/ life science start-ups 3-6% more likely to use convertible preferred equity • Syndications less frequently common equity, 5% more likely to use straight preferred equity • Large investments predominantly straight preferred equity or other combinations • Smaller investments rather convertible debt, common equity and mixture of the two • If share concentration of one investor increases: concentrated investor is more likely to use common equity, debt or convertible debt; less likely to use convertible or straight preferred equity
Control rights	• Board and voting rights: first round 29%, third round 51% • Vesting in 12% • Sales right used in more contracts than IPO rights (IPO rights used in less than 3%) • Exit rights for VC increase over time		
Covenants			
Other rights	• Non-compete clause for entrepreneur: first round 50%, third round 94%		
Study set-up	290 German VC contracts in 464 financing rounds from 1990 to 2004	12,363 Canadian/ US PE and VC investments in Canadian start-ups from 1991 to 2003	3,083 Canadian VC transactions from 1991 to 2000

The table demonstrates that different scholars focus on different rights, countries or areas of interest. Ewens et al. (2018) use a dynamic search and matching model to find the optimal contract in terms of most beneficial start-up exit. They detect that investors most of the time obtain more equity than the optimal solution would be. Therefore, the average observed contract only leads to a result of 82% of the first-best solution. According to the authors, the first-best value would be achieved if a VC holds 7% equity, no participation rights, no board seats and a pay-to-play provision. They trace back the negative effect of participation rights and board seats to window dressing, asset substitution and reduced incentives and conclude that these effects are larger than the positive effects of improved governance and control. Gompers (1999) finds that cash-flow rights, control rights and covenants are fully separated from each other. Covenants are used if agency costs or conflicts of interests are high which the author sees as more prevalent for early stage start-ups, high R&D firms and entrepreneurial enterprises with high market-to-book ratios. Kaplan and Strömberg (2003) cover a broad array of VC rights and thereby offer distinguished insights into VC contracting. They find that 70% of the contracts use some form of contingencies. Moreover, they detect a positive correlation between the existence of contingencies and the existence of voting rights and board seats. The specifics in the findings of Bienz and Walz (2006) is partially explainable through their German dataset. What differentiates their analysis is their comparison of different funding rounds. They find that over time a shift away from debt to more upside-focused equity occurs and explain that with the need for higher VC incentives to offer value-adding services to the start-up. The initial large share of debt can be traced to a prevalence of public government VCs within their dataset. Cumming (2005a) focuses on securities only and does not include any (non-security-related) control rights or behavioral finance effects, like relationships and mutual trust. Cumming (2005b) detects that

large differences exist in the coefficients of functional equivalents and therefore concludes that no replacement of securities through securities with similar effects occurs. The author states that the choice of a security is dependent on the type of entrepreneurial enterprises to be financed, i.e. different forms of agency problems. Although the studies cover a long time-frame, contractual provisions seem not to change completely over time. Smith (1998) hypothesizes – without presenting empirical evidence – that the Internet as powerful information sharing tool will reduce information asymmetries and thereby improve contractual design. Bengtsson and Sensoy (2011) focus on downside protection for VCs. They find that more experienced VCs use less downside protection but offer more value-adding services and own more board seats instead. As expected, they detect that downside protection diminishes if the entrepreneur's experience increases or in cases of syndication.

Regional differences exist, especially – but not only – between the US and other countries. In discussing local differences, scholars mainly focus on different securities used in VC contracts. As outlined by Kaplan and Strömberg (2003), US VCs focus on convertible preferred stock, mainly for tax reasons (Schizer & Gilson, 2003). According to Cumming (2005a), the US focus on convertible preferred equity is due to tax advantages and additional entrepreneurial incentives from undervalued stock options. For other countries no such concentration and convergence towards one specific security is observable (see e.g. Kaplan et al., 2007). Although similar tax incentives exist in Canada, differences comes from longer holding periods after Canadian IPOs for common stock than for preferred stock (Cumming, 2005b). In Canada, a heterogeneous set of securities is used, with convertible preferred equity being by far not the most frequent one (Cumming, 2005a, 2005b). For Germany, Bascha and Walz (2002) find a share of only 26% pure equity, 14% debt-equity mix and 10% convertible securities and therefore, a completely different picture to the US. They trace this back to

structural differences, e.g. the existence of so-called ‘silent partnerships’ in Germany. Moreover, the dataset of Bienz and Walz (2006) on Germany includes a larger share of public government VCs than US datasets, which explains the larger share of debt financing. However, they find that learning occurs and that German VCs tend to adopt more US style contracts, at least regarding control rights. Using a broad dataset covering 23 countries, Kaplan et al. (2007) find that US style contracts are superior with regards to survival rates of VCs. Besides the above-mentioned different securities included in contracts, liquidation rights, exit rights, milestone financing, vesting and anti-dilution rights are less often used outside the US, leading to lower incentives for the entrepreneur to perform well. The authors find that in common law countries liquidation preferences, vesting, anti-dilution provisions and redemption rights are more likely, whereas milestone financing is less likely compared to civil law countries and conclude that legal regimes, not environmental factors like creditor protection, efficiency of legal systems or tax regimes, lead to contract differences. However, Kaplan et al. (2007) also detect that US style contracts can be replicated in other countries and that this is done by more experienced VCs. The authors conclude that US style contracts can be superior independently of the legal regime. However, the better results could also be owed to the fact that VCs are more familiar with US style contracts.

Intriguingly, Bengtsson and Ravid (2009) find regional differences regarding contract design of VCs being active in the same country, namely the US. They noticed that the US National VC Association had problems to agree on one contract template with different VCs as what seemed reasonable for East Coast VCs was rejected by West Coast VCs and vice versa. Therefore, the scholars use a dataset of 1,800 US VC contracts and detect what they

call 'California effect'[60]. For California VCs they find less cash-flow contingencies, fewer board seats and board majorities and less restrictive covenants. Ownership stakes, however, tend to be larger at the West Coast[61]. Especially cumulative dividends and redemption rights are used more often at the East Coast. Independently of whether the VC or the start-up is based in California, any link to California makes contracts less investor-friendly through lower cash-flow and control rights. Moreover, the closer VC and start-up are regarding location, the less investor-friendly contracts are. As all VCs and start-ups act under the same legal and institutional environment, the scholars explain the differences through sociological and cultural factors. First, the high concentration of both VCs and start-ups in California leads to more competition, impacting the contract design. This, however, is not sufficient to explain the California effect. Secondly, the differences emerge from an informal less strict culture in the Silicon Valley, compared to e.g. Route 128 in Massachusetts. Moreover, proximity of players reduces ex-ante contracting search and post-contracting monitoring costs through formal business and informal personal interactions. As this study proves, culture and style influence contract design even within a country.

As stated before, most work on contracting defines VCs in a broad sense, without differentiating by the different sub-categories. However, few scholars provide deep-dives on the differentiation of heterogeneous forms of VC funds. Nonetheless, differences in contracts are observable along all rights. CVCs normally pay higher valuations (Hellmann, 2002). With regard to the equity share, entrepreneurs own fewer shares and have less control under CVC than under IVC management (de Bettignies & Chemla, 2004). Cumming (2005a) finds

[60] They call it California effect, although the differences to VCs from other states are even more pronounce when only including Silicon Valley VCs in the treatment group
[61] The authors hypothesize that this is done to balance lower cash-flow rights

in the US and Canadian dataset that CVCs are 2.8% points more likely to use convertible preferred equity than the average VC is, while no significant differences are observed regarding straight common equity or debt. Using a Canada-only dataset, Cumming (2005b) notices that CVCs are – compared to VCs in general – 8% more likely to use straight debt, 7% more likely to combine straight debt with common equity, 2% more likely to use other combinations, 12% less likely to use straight common equity and 3% less likely to use straight preferred equity. When differentiating CVCs by internally and externally oriented funds, the first give more control to the corporation whereas the latter give more control to the entrepreneur (de Bettignies & Chemla, 2008). In contrast, Hirsch and Walz (2013) find no significant differences regarding control mechanisms among different VC forms[62] and conclude that monitoring and controlling entrepreneurial enterprises is always beneficial, independently of the VC form. However, active involvement in start-ups is specifically high for IVCs, medium for bank-dependent VCs and low for public VCs (Hirsch & Walz, 2013). Masulis and Nahata (2009) detect that CVCs get fewer board seats than VCs in general, even less so, if the CVC acts as lead investor in a syndication. Whereas IVCs acting as syndication lead get board seats in almost 100% of the cases, CVCs only get board seats in 70%. Lastly, CVCs offer fewer value-adding services than IVCs (Masulis & Nahata, 2009). Summing up, CVC contracts tend to focus more on downside protection, whereas IVCs look more at the upside (Cumming, 2006). Scholars provide different explanations for the detected differences. First, different contract designs might not necessarily be dependent on the VC, but on the start-up. Therefore, firm selection effects might dilute the findings. Second, different governance structures of VC forms impact contract design (Hirsch & Walz, 2013)

[62] The scholars compare IVC to captive VCs from banks and governments and do not include CVCs in their analysis

leading to heterogeneous contract designs even if similar start-ups are concerned (Hirsch & Walz, 2013). Third, competition between a start-up and a venture fund plays a role. Masulis and Nahata (2009) expect start-ups to be more restrictive when entering contracts with competitive CVCs. In fact, the scholars empirically confirm this hypothesis. If start-ups face competitive CVCs, start-ups try to mitigate arising moral hazard problems through less control rights for the CVC and more start-up personnel on the board. In contrast, they find a higher representation of CVC personnel on boards if CVCs are complementary to the start-up. They thereby follow the argumentation of Hellmann (2002) who states that the benefits of a CVC's strategic orientation can turn to a burden if the utilities of the corporation and the start-up are misaligned. Finally, de Bettignies and Chemla (2004) explain their finding that entrepreneurs own fewer shares and have less control under CVC contracts with a higher job security for the entrepreneur. If the start-up fails, entrepreneurs can get a job at the corporation, which is not possible under IVC management.

In summary, contracts aim at mitigating adverse effects, like moral hazard resulting from information asymmetries in principle-agent settings and have the objective to stipulate incentives that drive the behavior of an agent in a way such that the achieved outcome of the agent's actions maximize the principal's utility. No perfect contracts exist, as future states of the world cannot be predicted ex-ante, as doing so would be disproportionally costly, as wording in contracts remains ambiguous, imprecise or incomplete and as it is impossible to develop incentives that lead to the expected behavior of agents. Incomplete contracts lead to hold-up problems, shirking, ex-post disagreements, risks and uncertainties. Property-rights theory detects that ownership over residual control rights gives the power to decide on non-contractually fixed issues. CVCs and start-ups acknowledge the need for contracting and recognize that no perfect contracts can be written, especially due to the highly uncertain

future of start-ups. Therefore, CVC contracts focus on cash-flow rights, control rights and other covenants. Through the strong focus on both cash-flow and control rights, CVC contracting closely follows theoretical considerations regarding imperfect contracts as classical moral hazard, signaling and screening, contracting and the pecking order hypothesis are confirmed. In short, CVCs and start-ups enter incomplete contracts with a precise allocation of cash-flow and control rights. Although these contracts do not clarify all potentially upcoming eventualities, they prepare for a professional and reliable collaboration between CVCs and start-ups.

II.2.5 Collaboration and monitoring

After contracts are signed and funding is transferred, a formal working relationship is established between a start-up, a CVC and other corporate units, where the CVC acts as mediator:

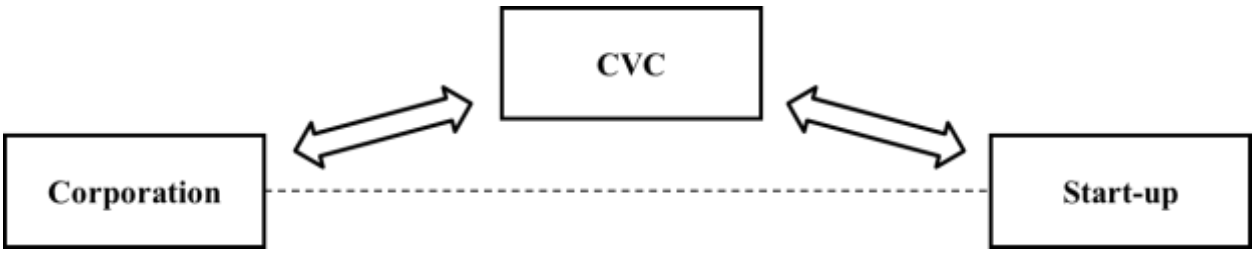

Figure 21: Relationship between corporation and start-up, mediated through CVC (derived from Dushnitsky & Lenox, 2006; Ernst et al., 2005)

The collaboration between the three parties goes beyond mere financial investments and includes scientific, technical, engineering and commercial support[63]. The collaboration

[63] Three quarters of CVCs offer scientific or technical support to their start-ups under management, around half of the CVCs provide commercial support and around 40% help with engineering-related questions. Thereby, the start-ups get support from experienced personnel, whereas corporate employees learn from start-ups. Additionally, most CVCs grant start-ups access to potential customers (above 80%), potential suppliers (60%) and potential partners (almost all) (MacMillan et al., 2008, p. 21)

is characterized by information asymmetries, leading to double moral hazard. In line with principal-agent theory mutual monitoring is required. Monitoring is often done through formal or informal governance mechanisms, like assuming board seats. A close collaboration comes with large benefits from mutual learning and access to resources. Nonetheless, collaboration and monitoring induce costs, like effort to manage the collaboration or expenses from preparing reports for the other party. If no collaboration occurs, the parties fail to benefit from the distinct advantages of having each other as partner. If collaboration is highly intimate, however, start-ups fear the loss of their entrepreneurial freedom. Therefore, the parties must consider the benefits and costs of collaboration and monitoring and balance them accordingly. In order to shed light on how such collaborations between corporations and start-ups can be made successful, the following section is structured as follows. First, the theoretical background on collaboration and monitoring in a principle-agent setting is reviewed. The second part focuses on CVCs and discusses the rationale, intensity, forms and consequences of collaboration.

II.2.5.1 Monitoring and collaboration theory

The collaboration between a CVC and a start-up constitutes a typical principal-agent setting with information asymmetry. More precisely, a double moral hazard situation exists where the CVC as principal and the start-up as agent wants to prevent the other party from shirking. Therefore, it is beneficial for both parties to engage in some form of bonding (Grossman & Hart, 1983b). The goal of the collaboration is to manage the principle-agent relationship in a best possible way, i.e. to ensure that corporations get their window on technology and start-ups get access to financing and strategic resources. According to Jensen and Meckling (1976) the best way to align the interest of principals and agents includes

monitoring, e.g. auditing, budget restrictions, formal control systems and incentives. Therefore, the theoretical backgrounds of monitoring and incentives are discussed next.

Monitoring

A monitor invests "resources into overseeing managerial behavior, thereby curbing moral hazard" (Tirole, 2005, p. 356). Monitors identify potential opportunistic behavior of agents, like the generation of private benefits, and take, if needed, counteractions on it. Through preventing other parties from opportunistic behavior, monitoring increases firm performance and value (H.-Y. Park, Chae, & Cho, 2016). Monitoring influences decision-making and is therefore a corporate governance instrument. However, monitors become insiders to a principle-agent relationship, inducing a risk that they fail to fulfill their monitoring duties (Tirole, 2005, p. 356). The risk is strengthened by the fact that monitoring is normally non-verifiable (Strausz, 1997). Monitoring might be amended by advising. Whereas monitoring rather focuses on the reasonability of managerial decisions, advising brings in the principals own experience and knowledge and helps to further improve a ventures performance (Tirole, 2005, p. 364). Often, not the decision itself, but merely the outcome of managerial decisions and activities are monitored. Varian (1990) finds that most studies assume monitoring of outcomes instead of actions, especially as full monitoring is in the most cases not possible or "prohibitively costly" (Holmström, 1979, p. 74).

As "monitoring reduces the agency cost […], but adds monitoring cost" (Tirole, 2005, p. 358), a critical assessment of the benefits and disadvantages of monitoring is required. On the positive side, monitoring reduces agency risks (Fiet, 1995). As these risks stem from information asymmetries, the value of monitoring proves higher when information asymmetries are high (Gompers, 1995). Additionally, the reduced information asymmetry

between principal and agent also impacts accounting information quality and thereby leads to higher investment efficiency (H.-Y. Park et al., 2016). Similarly, monitoring increases the accountability of ventures towards their investors (Tirole, 2005, p. 359). Conducting an experiment, Kirby and Davis (1998) find that monitoring prevents agents from risky investment decisions and escalating commitment. However, not only the venture and the investor benefit from monitoring, but also the monitor itself. Through obtaining private information, monitors are at an advantage towards other market players (Tirole, 2005, p. 355). The increase in knowledge and information about a venture that a monitoring investor receives often leads to a premium investment price (Tirole, 2005, p. 369).

Despite the positive effects of monitoring, several problems and disadvantages emerge. Monitoring comes with costs for both the monitor and the monitored party. If a venture can obtain financing without agreeing to monitoring they will therefore do so (Tirole, 2005, p. 358). First, monitoring is costly for the monitoring party (Tirole, 2005, p. 356). Clearly, the time spend monitoring can be seen as opportunity cost (Agrawal, 2002). Similarly, the monitored party has effort with collecting and distributing information to the monitor, like generating reports. Thereby, the monitor holds up the entrepreneur from investing time into their venture (Tirole, 2005, p. 372). Moreover, the interference from a monitor reduces the entrepreneurial freedom and limits the option space of ventures. Especially the threat of over-monitoring discourages the venture and hinders its development (Tirole, 2005, p. 356). Cultural differences and spatial distance between the parties increase the cost of monitoring even further (Hennart, 1993). A further problem of monitoring is the risk of collusion, i.e. when the monitor benefits from counter favors from the monitored party (Tirole, 2005, p. 356). Often, corporate resources are used for favors, although favors can also be in the form of interpersonal friendship (Tirole, 2005, p. 362). Through collusion, the

monitor fails to fulfill its duties and does not reduce information asymmetries for other principals. The threat of collusion can be mitigated through reducing the dependency of an agent on one monitor or through increasing the monitors dependency on the overall success of the investment (Tirole, 2005, p. 362).

Keeping in mind that monitoring will never fully reduce the risk of shirking, the costs and drawbacks make intense monitoring questionable. Therefore, it is essential to choose a suitable party as monitor. First, a monitor requires a specific knowledge that is often scarce (Tirole, 2005, p. 361). Monitors with the required capabilities often face conflicts of interest, like being direct competitors to the monitored party. The cost of monitoring is reduced when an experienced monitor is chosen. Although the owner of a venture bears all monitoring costs at the end (Jensen & Meckling, 1976), a more efficient monitor is beneficial for all investors. Second, a monitor requires a financial or non-financial incentive to engage in the monitoring activity (D. W. Diamond, 1984). If multiple investors are present or if some third party has some superior monitoring technology, the task of monitoring should be delegated to one party (D. W. Diamond, 1984; Strausz, 1997). Having multiple monitors would either result in duplication of work or no monitoring at all, i.e. a free-rider problem. Although it is possible to use an intermediary, like a bank, as monitor, principal investors often act as monitor themselves for efficiency reasons.

Incentives

The use of incentives helps to reduce moral hazard. Incentives are a powerful, yet regularly misused tool to achieve a reduction of moral hazard (Holmström & Milgrom, 1991). Theory around incentives builds on Holmström´s (1999)[64] seminal paper. Incentives can be a penalty if output is wasted and a reward if additional output is generated. Incentives come in form of financial rewards and non-financial factors, like future career perspective, reputation, power or status (Fama, 1980; Holmström, 1999). Incentives need to be linked to a measurement of performance. In theory, performance indicators should only be influenced by the incentivized management and not by any outside factors (Holmström, 1999). Incentives are often based on outcomes, not actions, although outcomes are also influenced by environmental effects (Radner, 1981). The more difficult it is to measure performance, the more rarely incentives are used (Holmström & Milgrom, 1991). Incentives are not only contractually stipulated but also come in the form of threat of takeovers or bankruptcy (Grossman & Hart, 1983b). Whereas initial theoretical models focused on one task for the agent (Holmström, 1989, 1999), Holmström and Milgrom (1991) extended their model to incentives for multidimensional tasks, which is closer to reality. In this case, incentives also allocate agent's priorities among the different tasks (Holmström & Milgrom, 1991).

In theory, an interplay of monitoring and incentives proofs successful for the mitigation of adverse effects from principal-agent relationships. Especially if group incentives are applied, monitoring is crucial (Holmström, 1982). Although monitoring reduces the need for costly incentives (Piskorski & Westerfield, 2016), a combination of the two ensures that agents act in their principal's interest (Tosi, Katz, & Gomez-Mejia, 2017).

[64] The paper was officially published in 1999, but written back in 1982 for an unpublished volume

II.2.5.2 Collaboration between CVC and start-ups

The following section elaborates on how CVC and start-ups collaborate once a contract is signed. CVCs act as principals that both monitor the start-up and support their development. Kaplan and Strömberg (2001) provide an excellent review of VC as principals based on common theories. Nonetheless, "we know little about how CVC may be facilitating or hindering the start-up's development" (Corredoira & Di Lorenzo, 2016, p. 2), especially as existing literature often lacks a clear separation of selection and treatment effects (Bernstein, Giroud, & Townsend, 2014; Kaplan & Strömberg, 2001). However, selected studies that separate the two find positive performance effects from monitoring (Bernstein et al., 2014). In order to ensure a successful collaboration, governance mechanisms are applied (Solvang & Berg-Utby, 2009) and a "transparent and sensitive management of the ongoing CVC–investee firm relationship" (Maula, Autio, & Murray, 2009, p. 275) is recommended. In literature, the collaboration is split in relational and procedural parts (Sapienza et al., 2000) or contractual, informal and equity (Minshall, Mortara, Elia, & Probert, 2008, p. 393).

In the context of monitoring and collaboration, disagreement evolves about how comparable CVC is with other forms of venture capital, like independent VC, university VC or government VC. Some scholars argue that the value adding services of IVC and CVC are generally similar (Dushnitsky & Lenox, 2006) and therefore "various groups of venture capitalists are not differentiated since that would not be relevant in the monitoring context" (Werner, Vianelli, & Bodek, 2016, p. 3). Although CVCs have, in general, overlaps with other VC forms, such simplifications are difficult as CVC offers more and other support to start-ups. First, CVCs are part of corporations that pursue their own interests, making collaboration sensitive to overlaps between the two parties (Hellmann, 2002). Secondly, a CVC can offer more support to the start-up through using corporate resources (Chemmanur

et al., 2014) or due to their additional industry insights and endorsement effects (Gompers & Lerner, 1998, p. 46). Nonetheless, the way CVCs collaborate with start-ups is to some degree comparable to the relationship between VCs and start-ups. Therefore, evidence on monitoring in a VC context is used as basis for the following discussion. However, the specifics of CVCs require further consideration. The following section first discusses the rationale for collaborating and monitoring. Second, the intensity of collaboration and different forms for monitoring are elaborated on. Lastly, implications of monitoring and both positive and negative performance effects are outlined.

Rationale for collaboration and monitoring

The main reason for collaboration and monitoring in the CVC context is to reduce information asymmetry and agency risks (Eisenhardt, 1989). Thereby, it is expected that the performance of an investment is improved for both the corporation and the start-up. Corporations collect information and data about the start-up regarding financials, R&D progress, employees (e.g. satisfaction) and target achievement of business plans (Werner et al., 2016). With that information the progress of the start-ups is monitored and required support or corrective actions determined (Wadhwa & Kotha, 2006). Moreover, the corporation learns about a start-up's way of doing things, its culture and attitude or details of its technology. The collection of start-up data is especially relevant in the context of staged investments (Gompers, 1995). Keeping in mind that start-ups often need multiple financing rounds, CVCs use the collaboration with a start-up to better evaluate future financing needs and the start-ups ability to grow, prosper and generate sufficient returns and advantages for the corporation (Christofidis & Debande, 2001). Start-ups, on the other hand, benefit from a close collaboration with corporations as they need to develop new products or service,

establish relationships with customers and suppliers or use capital-intense assets. CVCs play a crucial role in helping start-ups, e.g. through corporate networks, market reputation or existing assets (Cornell & Shapiro, 1988). In short, start-ups do not only require financial capital from CVCs, but also access to networks, capabilities, experts and assets of corporations (Gans & Stern, 2003). Therefore, the collaboration between CVCs and start-ups needs be beneficial for both parties and is therefore recommended to be co-developed (Corredoira & Di Lorenzo, 2016). Start-ups should collaborate with the CVC unit, but also key corporate business units, as they have the required skills, expertise and assets (Basu et al., 2016). Additionally, start-ups also benefit from collaborating with other start-ups under the management of a CVC fund.

Intensity and form of collaboration and monitoring

The intensity of a collaboration and monitoring depends on the role of the CVC, multiple characteristics of the start-up and the relationship between the two parties. As expected, a lead investor is more active in monitoring than other investors. According to Gorman and Sahlman (1989), lead investors visit start-ups once a month for four to five hours, whereas other investors spend two to three hours per quarter with the start-up. Moreover, the intensity of monitoring is dependent on the expertise of the investor. Heughebaert and Manigart (2012), find that funds with low expertise, in their case university and government VCs, should limit monitoring activities. Comparing CVC and IVC, Botazzi, Rin and Hellmann (2004) detect that the share of board seats and monitoring visits is similar with 68% and 70% for CVC and 78% and 76% for IVC, respectively. As expected, more monitoring occurs for younger, immature and therefore more risky start-ups (Christofidis & Debande, 2001; Werner et al., 2016). In a study of VC monitoring, Gompers (1995) finds

that more monitoring is required in R&D intense industries with high market to book ratios and low tangible assets to total assets ratios. Moreover, the intensity of monitoring is influenced by the relationship between the CVC and the start-up. If key employees of the two parties have a trustful friendship, less monitoring occurs (Weber & Weber, 2011). Additionally, collaboration intensity is reduced with increasing spatial distance among the two parties (Bengtsson & Ravid, 2009). Especially in weak IP regimes the collaboration between investors and start-ups is more intimate (Dushnitsky & Lenox, 2005). Lastly, the intensity of collaboration depends on the industry of the two parties (Dushnitsky & Shaver, 2009). Corporations invest in and collaborate closely with start-ups that have a technology similar to their own for learning sake. In contrast, start-ups fear unbeneficial effects from investments of same-industry corporations and therefore try to limit the collaboration with them.

Several forms of collaboration and monitoring are applied. According to Gorman and Sahlman (1989), VCs in general monitor management, find new suitable executives and provide advice as well as consultation. Moreover, VCs are an important sounding board for strategic decisions, a provider of network contacts and a personal coach to the start-up CEO (Sapienza, Manigart, & Vermeir, 1996). CVCs, in specific, engage with start-ups in three distinct ways, namely through transferring capabilities, influencing technology developments and limiting the sharing of internal information with third parties (Corredoira & Di Lorenzo, 2016). More precisely, CVCs assume board seats, influence senior management and employee salaries, offer direct support and consultation as well as establish in some cases joint ventures or alliances with start-ups.

Based on the resource dependence theory, directors are key in helping firms being successful. Due to the high influence board of directors have, they are a preferred monitoring and control tool for many investors (Garg & Furr, 2017)[65]. Historically, CVCs where hesitant in taking board seats, but learned over time the value of it (Howard et al., 2017). Nowadays, broad consensus exists that venture monitoring should be done through board seats and observation rights (Wadhwa & Kotha, 2006). Especially if investors hold significant ownership stakes, directors are heavily involved in venture boards (Fried et al., 1998). Venture boards normally consist of inside (e.g. CEO) and outside (e.g. CVC, IVC) directors and act both directly, like approving R&D budgets, and indirectly, like motivating or threatening personnel to ensure the envisioned performance (Howard et al., 2017). Board members have a vote in strategic start-up decisions like IPOs, sale of equity, hiring and firing of key personnel and the establishment of alliances (Fried et al., 1998). Directors do not only play a role in such decisions during board meetings, but also have the ability to influence the direction of the start-up at all times (Garg & Furr, 2017). Especially CVC board members are not financially motivated and are therefore rather focused on strategic links with start-up personnel or technological connections with corporate technologies (Dushnitsky & Lenox, 2005). Having directors from VCs on start-up boards has both positive and negative effects. On the positive side, higher IPO valuations during start-up exits (Chahine & Goergen, 2011) and a positive effect on the start-up's knowledge quality (Howard et al., 2017) are achieved. Having a CVC director has negative effects, especially on product introductions (Howard et al., 2017). Double-sided moral hazard, like pursuing corporate instead of start-up interests and preventing the development of start-up products that compete with the product portfolio of the corporation, impedes successful collaboration. Therefore, limiting CVC personnel on

[65] The authors offer a good review of literature on VC boards

venture boards might be one way to mitigate the well-known dilemma of "swimming with the sharks" (Katila et al., 2008, p. 295).

Besides assuming board seats, investors often have a say regarding the senior management team of a venture. On the one hand, investors bring in experienced managers: whereas 14% of VCs do so pre-investment, more than half influence the composition of senior managers post-investment (Kaplan & Strömberg, 2001). On the other hand, especially CVCs support senior management through giving access to key resources and offering mentoring and coaching (Bottazzi, Da Rin, & Hellmann, 2008; Kaplan & Strömberg, 2004). Additionally, CVCs influence the compensation of senior start-up personnel. In order to align the interest of the CVC with that of the start-up management, fixed base salaries are often modest and instead compensation is tied to the value of the start-up (Cornell & Shapiro, 1988).

Moreover, direct support for start-ups is offered, including business plan development, introducing strategic partners or assisting with potential acquisitions (Kaplan & Strömberg, 2001). All this is supported through "close relationships with the managers of their portfolio companies" (Sapienza et al., 1996, p. 439). Such social interactions between CVCs and start-ups are higher if the two parties are complementary (Maula et al., 2009). Direct support in the form of one-to-one consultations, joint development workshops and online seminars are the most suitable way to ensure mutual learning (Minshall et al., 2008). Lastly, the collaboration between corporations and start-ups can be formalized through joint ventures, alliances and strategic partnerships. In fact, Hsu (2006) finds that VC-backed ventures regularly engage in cooperation with corporations, like alliances or technology licensing.

Implications of collaboration and monitoring

Having all the different forms of collaboration and monitoring, one needs to ask what the implications and performance effects are. Clearly, mutual "involvement is an important determinant of innovation and success" (Bernstein et al., 2014, p. 3). Nonetheless, start-ups and corporations are vastly different, making a collaboration challenging, especially with regards to adjusting to new technologies, new situations or new forms of collaboration (Alvarez & Barney, 2001). Therefore, the consequences of collaborations matter. Performing a natural experiment about VC monitoring in general, Bernstein et al. (2014) find that more collaboration has a positive effect on start-up innovation and – in the long run – on IPO likelihood. Moreover, monitoring reduces the threat of managerial opportunism, like a misuse of investor's money (Barney et al., 1994). Looking at the effect on the corporation, Wadhwa and Kotha (2006) detected an inverted U-shape relationship between the number of CVC investments and corporate innovation performance if investor involvement is low and a positive link between the two variables for high investor involvement. In other words, more involvement is generally beneficial as a low collaboration intensity has negative effects on corporate innovation performance. Although these positive effects of collaboration and monitoring are detected empirically, one has to keep in mind that these are not only dependent on close collaboration ties, but also on endorsement effects (Stuart et al., 1999). Additionally, CVCs use the information gained from monitoring to decide on future activities and investments. If the outcome of monitoring is negative, no future funding will be provided to the respective venture (Gompers, 1995).

Nonetheless, in 20% of their investments, investors fear that the monitoring is too time-consuming and thereby costly (Kaplan & Strömberg, 2001), leading to only periodic checks (Gompers, 1995). The cost of collaboration and monitoring is often a time-based opportunity cost, like preparing and reading reports, performing plant visits, participating in meetings, analyzing start-up data and coaching entrepreneurs (Gompers, 1995; Sapienza & Korsgaard, 1996). Through the time spend and all the information gained from monitoring, the management of both the start-up and the CVC is overloaded (Sapienza & Korsgaard, 1996; Wadhwa & Kotha, 2006). Additionally, heavy monitoring and mutual interventions diverges management's focus from being productive to playing the politics (Milgrom, 1988; Milgrom & Roberts, 1988). In such cases, it might be suitable to mitigate such relationship risks through safeguards, like limited CVC board seats and balance between safeguards and interactions (Maula et al., 2009).

In literature, several ways of ensuring a successful and value-enhancing collaboration between ventures and CVCs are discussed. Four distinct prerequisites are essential for a successful CVC-start-up collaboration. First, the performance of CVC-backed ventures is higher if they have access and ability to leverage corporate assets (Alvarez-Garrido & Dushnitsky, 2016) which should be complementary to the start-ups assets (Gans, Hsu, & Stern, 2002). Second, start-ups and corporations should engage in cooperative commercialization strategies. Third, strong and precise IP rights are key for successful open collaborations (Gans et al., 2002). Last, direct and regular social interactions between start-ups and CVC allow for mutual learning and thereby produce strategic value, especially if the conversations are about specific topics of mutual interest (Maula et al., 2009; Sykes, 1990).

In summary, collaboration between corporations and start-ups is influenced by double-sided moral hazard, coming from information asymmetries. In theory, monitoring is discussed as a suitable governance tool to reduce agency risks and thereby prevent opportunistic behavior and increase firm performance and investment efficiency. However, one must be aware that monitoring is costly, impedes entrepreneurial freedom and that the monitor needs to be compensated accordingly. Besides monitoring, incentives are seen as a successful way of reducing moral hazard. Theory argues in favor of a combination of monitoring and incentives to ensure a successful collaboration between a principal and an agent. Collaboration and monitoring in the CVC context aims at improving the performance of all involved parties through getting mutual access to resources, capabilities, networks and technologies. Thereby, information asymmetries and agency risks are reduced. However, the benefits and costs of collaboration and monitoring need to be balanced. Whereas mutual "involvement is an important determinant of innovation and success" (Bernstein et al., 2014, p. 3), corporations and start-ups differ making intimate collaborations counterproductive. CVCs can apply multiple ways of collaborating with and monitoring their start-ups under management, including board seats, selection of and support for senior management, advise for strategic decisions and provision of network contacts and transfer of capabilities and technologies. Scholars find that especially close social interactions, like one-to-one consultations or joint workshops are well-suited collaboration tools.

II.2.6 Exit

Independently of how successful a CVC and a start-up work together, at some point the collaboration comes to an end. This step of separation is commonly termed ‘exit’. Separations happen for multiple reasons. From a start-up’s perspective, the CVC and the corporation might not cater to its needs anymore. A start-up might require much more funding than the corporation is willing or able to provide or some specific non-financial support the CVC cannot offer. Contrary, a start-up might also be merged and integrated into one corporate business unit due to its portfolio fit. Additionally, start-ups might not deliver the promised performance, leading to a withdrawal of corporate investments or even a full liquidation of the venture. From a corporate perspective, CVC investments are a way of pursuing its strategy. If the corporate strategy changes, a start-up might not be of corporate interest anymore, also leading to a retraction of invested funds and non-financial support. Although drastic, the exit of an investor is a regular and expected step in the CVC-venture collaboration. Therefore, exit control and decision rights are included in the initial investment contracts. Different forms of exiting a CVC-venture collaboration exist, like an acquisition of the start-up by some other party or the initially invested corporation, a going public of the venture or the liquidation of the firm. To elaborate on the theoretical foundations and practical applications of CVC investment exits, the following section is structured as follows. First, general factors influencing exits, like information asymmetries and agency problems are discussed. Afterwards, potential forms of exit are presented. Subsequently, the discussion turns towards the specific case of CVC exits through reviewing empirical literature on CVC investment exits.

II.2.6.1 Theoretical discussions of exit options

Although exits from investments are mainly detected in the VC or PE context, some general theoretical considerations will help to better understand exits. Therefore, a short background on and rationale for exits is given, the objectives and roles of involved parties are discussed and the benefits and costs of exits are elaborated on. Lastly, different forms of exiting an investment are considered.

Exits occur if either the investor or the investee decides to end the current form of mutual collaboration. In most cases, except a liquidation or full acquisition of a venture, a new investor enters. Due to the heterogeneity of involved parties, typical agency problems, like asymmetric information, moral hazard or misleading incentives, occur (Schwienbacher, 2009). For example, insiders have superior information than incumbent investors or especially new investors (Tirole, 2005, p. 93). For most forms of exit, a third party is required to buy shares or the whole firm. The high information asymmetries for such buyers often reduce the potential exit proceeds, i.e. the return for an incumbent investor. Therefore, the incumbent investor is well advised to choose a form and timing of exit that reduces such informational gaps, for example through closely assisting, supporting and onboarding a new investor (Cumming & MacIntosh, 2003b).

As exits take place before the full performance of the investment is visible, the issue of moral hazard is intensified (Tirole, 2005, p. 172). As two sides with often conflicting interests, namely the investor and the venture, are involved, double moral hazard problems exist (Bascha & Walz, 2001). Whereas investors mainly take into account financial considerations during exits, entrepreneurs also consider non-financial aspects, like private benefits or control. The thereby resulting disagreements, require an ex-ante contingent exit

control allocation (Aghion & Bolton, 1992). Therefore, exit rights are one of the key control rights in often imperfect investment contracts (Grossman & Hart, 1986)[66]. As new investors normally request specific control rights (Tirole, 2005, p. 93), exits not only change the funding of a venture, but also impacts control and monitoring. Thereby, exits – or the threat of exits – have two motivating effects (Tirole, 2005, p. 425). On the one hand, an ex-ante disciplining effect puts pressure on the incumbent management to ensure a good performance. On the other hand, an ex-post effect allows to correct previous strategic mistakes and pursue new ideas after an exit occurs. Clearly, investor exits are a decisive event in the lifetime of a venture. Cumming and MacIntosh (2003b) detect three main reasons for investor exits. First, as the value-add from the investor to the venture declines over time, a point will be reached where the value the investor can add to the venture is smaller than the cost, like monitoring, the investor incurs. Second, internal and external forces can shift the value-add and cost functions. For example, the venture technology might not prove successful, reducing the expected future return, or the investor runs into financial constraints, requiring a re-direction of investments. Third, the investor detects over time that the initial assessment of the venture was faulty.

Through exit rights, the risk of lock-in is mitigated, especially for the investor. Additionally, exits allow – at least in cases where the venture is not liquidated – to determine a market value of the whole firm, which is often not possible beforehand (Tirole, 2005, p. 93). Moreover, the exit of an investor sends a signal to the market. If the investor pulls out and the venture ceases existence, it is a clear sign for the failure of the entrepreneurial enterprise. In contrast, if the investor exits a venture with a strong financial return, it signals

[66] See II.2.4.2 for a more detailed discussion of CVC contracts

the superiority of the venture to the market. Lastly, especially the entrepreneur enjoys private benefits, like additional control or reputation (Aghion & Bolton, 1992). On the cost side, especially transaction costs occur, including marketing of sale, identification of potential buyers, negotiations, lawyers, contract writing, brokers and other professional services which are mostly covered – either directly or indirectly – by the seller (Cumming & MacIntosh, 2003b).

In general, the timing of an exit requires some consideration (Giot & Schwienbacher, 2007; Schwienbacher, 2009). Parties want to leave an investment if the return is the highest or if the investor is incapable of offering further funding or other benefits for the investee. Both the entrepreneur and the investor might cash out early in order to consume the invested money or undertake new investments (Schwienbacher, 2009).

Exit forms

Different forms of investor exit are available with different implications on the involved parties (Giot & Schwienbacher, 2007; Schwienbacher, 2009). Although investors normally chose the way that brings the highest (financial) return, the bargaining power of involved parties, the future influence, the potential buyer's willingness to pay, the public exposure of the venture and macroeconomic factors play a role (Cumming & MacIntosh, 2003b). In general, five forms of exit exist including IPOs, full acquisitions, trade sales of shares, buybacks, especially LBOs and MBOs, and liquidation of the venture (derived from Bascha & Walz, 2001; Cumming & MacIntosh, 2003b). The following Table 4 gives an overview of the different forms and summarizes their main advantages and disadvantages:

Table 4: List of exit forms (author's compilation)

	Description	Advantages	Disadvantages	References
Initial public offering (IPO)	• Company shares are sold publicly for the first time • Often done by public listings on stock exchange	• Access to new finance from many investors • Public recognition and image • Professionalization of firm	• Underpricing • Long-run underperformance • High costs	(Cumming & MacIntosh, 2003b; Ibbotson & Ritter, 1995; Röell, 1996; Schwienbacher, 2009)
Full acquisition	• Full acquisition of venture by new investor • Normally strategic investor • Often followed by integration	• Synergy potential with strategic investor • Superior price due to synergies • Strong signaling effect of venture performance	• Venture loses entrepreneurial freedom through integration • Often resignation of incumbent management • Creation of financial, social and market risks	(Cumming & MacIntosh, 2003b; Michalski, Wisniewski, & Gralewski, 2019; Reuer & Ragozzino, 2012; Tirole, 2005)
Trade sale of shares	• Sale of investor's shares to other third party (financial or strategic investor)	• Other incumbent investors remain • New investor often more valuable for venture in current stage than previous investor	• Limited ability to raise additional funds • Information asymmetries between incumbent and new investors	(Cumming & MacIntosh, 2003a; Schwienbacher, 2009)
Buybacks	• Buyback of shares through founder or management • Taking private of firm	• Founder/ management assumes control • Reduction of information asymmetry	• Often financed through high leverage requiring stable cash-flows	(Cumming & MacIntosh, 2003a; Tirole, 2005)
Liquidation	• Liquidation of venture, ceasing existence • Often write-off of funds for investor	• Stop of operations before further money is burned	• Failure of venture • Often negative return for investors	(Cumming & MacIntosh, 2003a)

IPOs constitute the primary exit form after successful investments. An IPO describes the process of offering shares of a company to the public financial market for the first time (Christofidis & Debande, 2001). During IPOs, underwriters sell company shares publicly to a large array of investors, often as public listings on stock exchanges (Cumming & MacIntosh, 2003b). Moreover, private placements or direct issues are possible, however are rarely used (Tirole, 2005, p. 95). IPOs are influenced by moral hazard and adverse selection (Ibbotson & Ritter, 1995), as well as other non-rationale behavior of market players (Ritter & Welch, 2002). Often this exit option generates the highest return, while keeping the incumbent management team in power. Especially entrepreneurs favor IPOs due to the collection of capital and the fact that they can maintain their shares (Ritter & Welch, 2002). Multiple reasons for IPOs exist. According to Röell (1996) the main ones are, in order of decreasing importance, access to new financing, improved image and publicity, motivation for management and employees, cashing in, exploiting market mispricing and 'others' like better relationships with professional services firms, definition of strategy or improved organizational structure. Ritter and Welch (2002) stress the financial reasons of raising capital and creating a public market where ownership can be transferred to cash, whereas non-financial reasons are secondary. Firms benefit from a public listing through an improved profile, image and name recognition (Cumming & MacIntosh, 2003b; Tirole, 2005, p. 93). Moreover, investors benefit from returning capital which can be used elsewhere (Denis, 2004). Although IPOs reduce the dependency on few investors, the resulting diverse ownership structure has, however, impeding effects on monitoring (Tirole, 2005, p. 93), due to high cost of information supply to investors (Ibbotson & Ritter, 1995) and the risk of free-riding (Cumming & MacIntosh, 2003b)[67]. Nonetheless, with regards to quality of monitoring,

[67] Often these costs are reduced through the use of underwriters

IPOs lie between a tender offer and a private deal (Tirole, 2005, p. 369), although the fact that a company is public reduces the monitoring need for the CVC (Christofidis & Debande, 2001). IPOs come with high upfront one-time costs for the disclosure of information, marketing roadshows and investment professionals like underwriters and banks (Röell, 1996). The most severe impact, however, are the problems of reduced entrepreneurial freedom, long-run underperformance and especially underpricing (Ritter & Welch, 2002; Röell, 1996). Underpricing describes the phenomenon that shares at IPOs are regularly priced below their market value. This underpricing is necessary, however, as prices must be sufficiently discounted that even uninformed investor invests (Schwienbacher, 2009)[68]. Both the process of an IPO and the operation as a public company come with costs. For the IPO, underwriting, consulting and legal fees will occur and marketing activities (e.g. prospects, trade shows) need to be paid for. For example, the commission for investment bankers often ranges between six to eight percent of the IPO value (Zider, 1998). In addition, an IPO requires a high attention of senior management (Christofidis & Debande, 2001). Once the company is public, additional disclosure requirements are mandatory, e.g. regarding financial accounting or business risks, which are often published in annual or and quarterly reports (e.g. 10Ks and 10Qs in the US). Lastly, IPOs are a complex endeavor that is influenced by several external environmental factors. IPOs are heavily dependent on the overall market sentiment and business cycles (Tirole, 2005, p. 92). IPOs occur more during economic upswings, e.g. during the Dotcom boom (Daily, Certo, Dalton, & Roengpitya, 2003). Additionally, the legal environment, availability of underwriter and (institutional) investors as well as exchange rules lead to differences in IPOs across countries. For example, IPOs are

[68] See Ibbotson and Ritter (1995) for more detailed explanations about IPO in general, especially regarding costs and benefits

more frequent in countries like US, UK or Netherlands and less frequent in Germany, Japan, Italy or Portugal (Röell, 1996). Moreover, IPO success is influenced by the background of the CEO, the board composition and reputation as well as the reputation of auditors and underwriters (Beatty, 1989; Certo, Covin, Daily, & Dalton, 2001; Reuer & Ragozzino, 2012).

Besides IPOs, full acquisitions of ventures occur. In this case, a new – often strategic – investor acquires 100% of the venture, assumes full control and often integrates the venture in its own operations (Cumming & MacIntosh, 2003b). Normally, such investors are competitors, suppliers or customers of the venture that are active in the same industry or work with similar technologies. Therefore, the investor has a reduced information asymmetry and can realize synergies from the integration, both leading to a higher acquisition price. The realization of synergies strongly depends on complementarity of the two firm, degree of interaction and coordiation between the two merging units and a reduction of employee resistance to the acquisiton (Larsson & Finkelstein, 1999). An acquisition has a strong signaling effects as it demonstrates how well the previous investor developed the venture (Reuer & Ragozzino, 2012). On first sight, an acquisition seems beneficial for all involved parties. However, disadvantage and hurdles exist. Although most acquisitions are friendly, some are not supported by the venture and are therefore hostile (Tirole, 2005, p. 43)[69]. The integration occurs normally along production, marketing, sales, product development or human resources management and is not beneficial in all cases (Karabag, Borah, & Berggren, 2018), especially as ventures loose their entrepreneurial freedom. Through cultural hurdles, key employees may leave the combined firm (Angwin, 2001). Employee behavior and emotions can be influenced by the way how the acquisition is communicated, in other words

[69] See Tirole (2005, p. 45) for a discussion of the acquisition process and ways to defend hostile ones

the suitability of change management activities (Zagelmeyer, Sinkovics, Sinkovics, & Kusstatscher, 2018). Moreover, R&D intensity is often reduced post-acquisition, leading to less innovations (Haucap, Rasch, & Stiebale, 2019). In short, acquisitons create financial, social and market risks, e.g. from coordination and control, impact on social climate, cultural aspects and costs of reorganizations (Michalski et al., 2019, p. 453).

Instead of a full acquisition of a venture, a trade sale of share is possible. One investor sells its share to another third party investor that is familiar with the industry and technology of the venture (Cumming & MacIntosh, 2003b). The buyer can be either a financial purchaser (e.g. a bank or a fund) or a strategic investor (e.g. an industrial company) (Christofidis & Debande, 2001). In a trade sale, other investors and the founder keep their share. Often such buyers have a better portfolio fit with the venture and invest in close alignment with the incumbent management. The main reason why a sale of share is performed instead of a full acquisition is a low bargaining power of the buyer (Cumming & MacIntosh, 2003b). Unfortunately, hardly any empirical research is available on sale of shares due to difficulties of getting data (Schwienbacher, 2009).

Buybacks, especially LBOs and MBOs, often occur if the venture misses performance indicators or if going public did not prove successful (Cumming & MacIntosh, 2003b). In such cases, the management, founder or other investors buy back shares from the investor. The shares are then concentrated at few investors which take the firm private (Tirole, 2005, p. 47). As insiders are often involved in buybacks, access to all kind of venture information is available. The difficulty, however, lies in making sense of the information, requiring the input of LBO and MBO experts (Cumming & MacIntosh, 2003b). Buying back shares is a costly endeavor, which is often financed by a high debt leverage, for example up

to 20:1 in the 1980s and 5:1 in the 1990s (Tirole, 2005, p. 47). Due to high leverage, LBOs require high cash-flows for interest payments and are therefore rather seen in mature industries, not necessarily start-ups. Nonetheless, they serve as a strong monetary performance incentive, lead to heavy monitoring through banks and demand sufficient efficiency improvements to fulfill cash-flow obligations (Tirole, 2005, p. 48). LBOs are much more prominent in the US, whereas their image is rather negative in Europe and Japan (Tirole, 2005, p. 43).

The last form of a venture exit is its liquidation, which happens if the venture fails to perform well. In such a case, the venture ceases existence and its assets are re-distributed to the respective owners and investors (Cumming & MacIntosh, 2003b). The investor loses much of its investment and normally has to accept a negative financial return. Such liquidations can be compulsory, e.g. in the case of financial bankruptcy, or voluntary, if no future success is expected.

All in all, the exit of an investor is characterized by information asymmetries and agency problems. Each and every form of exit comes with benefits and drawbacks, which need to be balanced accordingly. In the next section, the different forms are discussed specifically in a CVC setting.

II.2.6.2 Exits in the CVC context

The following section discusses exits of CVC-managed start-ups. The exit describes a severe and drastic event in the CVC-venture collaboration. Start-ups rarely generate profits and even more seldomly pay dividends. Additionally, their shares are highly illiquid, making a successful exit the only way how investors can generate a financial return from their investments (Schwienbacher, 2009). The general observations from above and the forms of

exit discussed in theory are applied to a CVC setting. Similar to theory, information asymmetries and agency problems are key issues to consider. Due to the high uncertainty, exits are heavily discussed ex-ante investment in the due diligence phase and play a crucial role in CVC investment decisions. In many regards, exits from CVC do not substantially differ from exits from other venture capitals investors. Therefore, the broader literature is consulted. However, CVC-specific exit considerations need to be taken into account, especially for acquisitions of the start-up and a subsequent integration in corporate business units. The next section is structured as follows: first, the goals and objectives of CVC exits are discussed. The control, timing and influencing factors of exits are elaborated on. Next, performance implications of various exit forms are differentiated. Differences between CVC and other VC forms are specifically highlighted in the last part[70].

Goals of exit

The goals and objectives of the involved parties, especially corporate investors on the one hand and start-ups on the other, differ. In general terms, investors perform exits if "the projected marginal value added as a result of its efforts, at any given measurement interval, is less than the projected marginal cost of these efforts" (Cumming & MacIntosh, 2003b, p. 516). As an exit is often the only way for VCs to generate a financial return (Schwienbacher, 2009), VCs focus on financial aspects. Although CVCs pursue strategic goals in addition to their financial interests (Hellmann, 2002), they prioritize financial aspects during exits as well, especially as strategic objectives, like getting a window on technology or learning from a more agile start-up culture, are achieved during the collaboration phase. If CVCs divest, they normally aim at selling the start-up for cash which can immediately be used for further

[70] See Cumming and MacIntosh (2003b) for a detailed discussion on VC exits

investments (Cumming & MacIntosh, 2003b). Nonetheless, instead of getting cash, a sale of a start-up might also be done through getting shares of the acquirer. CVCs rarely prefer that option, as they have no inclination of holding shares of a competitive corporation. Both VCs and CVCs might face a fire-sale problem (Cumming & MacIntosh, 2003b). VCs sell start-ups at the end of their funds lifecycle in order to generate returns that can be distributed to investors. CVCs, in contrast, perform fire-sales when the corporate strategy shifts and start-ups are not of corporate interest anymore. In both cases the investors favor a quick exit over achieving the highest possible return. Besides financial goals, a VCs aim at building their reputation through successful exits (Fairchild, 2004). Start-ups also purse financial and strategic goals during an exit. They aim at raising enough capital such that they can meet their future capital requirements and fund further growth (Cumming & MacIntosh, 2003b). They aim at non-monetary private benefits (Bienz & Walz, 2006), e.g. less dependency on few investors, less interference from corporations and a strong reputation. A start-up that completed an IPO is perceived more successful than a start-up still under the management of a CVC. One goal that both parties have in common is to reduce information asymmetries to potential investors in order to increase the purchase price (Cumming & MacIntosh, 2003a, 2003b). Besides that conflicts of interests between the parties emerge (Bienz & Walz, 2006). Although most exits occur in mutual interest, exits might also be one-sided due to "conflicts and unethical behaviors among venture partners" (Fassin & Drover, 2017, p. 650). Such ethical conflicts stem from unbalanced contracts, lack of corporate governance and minority shareholder protection, fraud, threat, insider trading or abuse of power. Disagreement often evolves around the form and timing of an exit, the split of financial proceeds or the valuation of the start-up (Bascha & Walz, 2001). To reduce the impact of such conflicts, clear decision rights need to be determined in advance.

Determinants of exits

Several factors influence the timing, form and success of CVC exits. Independently of the form, all exit options take several months or even years to be properly executed and therefore need sufficient preparation time (Christofidis & Debande, 2001; Cumming & MacIntosh, 2003b). Clear control over exits is ensured through staged financing, respective equity instruments and further contractual stipulations. Staging of investments is heavily used in start-up financing (Gompers, 1995). Thereby, investors have the opportunity to retract from the investment at multiple stages. Additionally, staging serves as incentive for start-ups to perform. CVCs can obtain control over the exit if convertible securities are applied from the beginning (Bascha & Walz, 2001). Often these convertibles include an automatic conversion at IPOs (Hellmann, 2006). Through convertibles with conversion, investors obtain preferred instruments in the case of acquisitions and common stock for IPOs. According to Hellmann (2006) this is the optimal solution as CVCs contractually agree ex-ante an more cash-flow rights for acquisitions than for IPOs. Thirdly, CVCs secure exit control rights contractually, especially in the case of early stage seed financing (D. G. Smith, 2005). Such contractual rights include registration rights, drag- and tag-along rights and call and put options (Chemla, Habib, & Ljungqvist, 2007). The control rights include board control, the right to replace the founder, a forced exit after a specified time (e.g. if no IPO after 5 years occurred) or drag-along covenants (Cumming, 2008; Kaplan & Strömberg, 2003; D. G. Smith, 2005). Control over exits in the hand of investors has positive implications. In such cases, an exit through an acquisition or IPO occurs and write-offs are 30% less likely (Cumming, 2008).

For most of the exit options, apart from a liquidation, one or multiple third-party players are needed as counterpart for a transaction. Therefore, not only the intention of the CVC and the start-up, but also the availability of future potential start-up owners impact the exit (Christofidis & Debande, 2001). Exits will be less successful if cultural and institutional differences between these parties are large (Li, Vertinsky, & Li, 2014). Moreover, exits – especially IPOs – are heavily influenced by the overall economic sentiment, stock market developments, business cycles and market liquidity (B. S. Black & Gilson, 1998; Cumming, Fleming, & Schwienbacher, 2005). For example, due to the unfavorable market conditions, divestments were especially high in the early 2000's (Schwienbacher, 2009). Additionally, exits are influenced by start-up characteristics, like the tangibility of their assets (Cumming & MacIntosh, 2001). Moreover, the value of the start-up plays a role. Start-ups with higher expected value pursue IPOs, start-ups with lower expected value are rather acquired and start-ups with negative expected value liquidated (Bascha & Walz, 2001; Guo, Lou, & Pérez-Castrillo, 2015). The older start-ups grow, the more probable an IPO gets, until a specific point, where too old ventures turn less attractive for IPOs again (Giot & Schwienbacher, 2007). Additionally, country and industry differences evolve. Cumming and MacIntosh (2003a) detect differences between the US and Canada and conclude that they are due to regulation and market factors that influence risk and therefore return. Contrary to expectations, exits are, however, are not impacted by taxation (Cumming & MacIntosh, 2003b). Similarly, the VC market is more developed in the US than in Germany and Japan due to more favorable stock markets (B. S. Black & Gilson, 1998). Accordingly, trade sales are more frequent in Europe than IPOs (Schwienbacher, 2009). With regards to industries, especially biotech and internet firms go public even without generating any profit (Christofidis & Debande, 2001). Lastly, exits are influenced by the reputation of the CVC.

Gompers (1996), for example finds that VCs with a low reputation exit their investments also in unfavorable market conditions, whereas Nahata (2008) detects that more reputable VCs lead to higher exit proceeds. Successful exits via IPOs or acquisitions are more probable under prominent investors (Ragozzino & Blevins, 2016). Clearly all the factors discussed also drive the price, i.e. market valuation of a start-up in the case of an exit to a third party. In addition, longer investment durations, strong monitoring skills of buyers, low information asymmetries and low agency costs generally increase the purchase price, whereas synergies play a role especially for acquisitions and subsequent integrations through third parties (Cumming & MacIntosh, 2003b).

Performance of exit forms

Exits can be differentiated in full and partial exits. At a full exit, an investor completely leaves the investment and ceases any relationship with the start-up. In a partial exit, a start-up uses one of the exit forms, but keeps the CVC on board. A partial exit can be, for example, an IPO where the CVC keeps holding shares, an acquisition not in cash but where the CVC obtains shares of the acquiring party or a partial buyback. During an IPO, CVCs often keep stakes in start-ups, even if it is public (Schwienbacher, 2009). However, through new equity investors, the CVC's share will be diminished (Christofidis & Debande, 2001). A CVC keeping a share in a public start-up, signals start-up quality and ensures an ongoing monitoring (Cumming & MacIntosh, 2003b). In some cases, or after some time, the corporation might take the opportunity to fully exit the venture to have the funds available for investment in other start-ups. The degree of exit influences the risk and return independently of the exit form used. According to Cumming and MacIntosh (2003a), a partial

exit comes with higher risk and return and is a common way to signal the quality of the venture.

All forms of exit discussed above, namely IPOs, full acquisitions, share sales, buybacks and liquidations, are used by CVC. Nonetheless, especially IPOs and acquisitions are primarily discussed in literature (Guo et al., 2015). The form of exit is especially influenced by investors (Cumming & MacIntosh, 2003b). The selection of a specific form of exit has an impact on the return, governance and control and private benefits on both the corporate and start-up side. Scholars broadly agree that an exit via an IPO yields the highest financial return for any form of venture capital (B. S. Black & Gilson, 1998; Cumming & MacIntosh, 2003b, 2003a; Gompers, 1995; Schwienbacher, 2009). IPOs generate a 59.5% average annual return, acquisitions only a return of 15.4% annually and liquidations a loss of 80% of the investment (Gompers, 1995). Intriguingly, Christofidis and Debande (2001) argue that share buybacks are mainly performed if the investment proved unsuccessful. In this case, the investor receives back some or all of the funding invested and the borrowing company has to find other sources of funding. For the German VC market 30% of the exits are expected to be IPOs, 25% trade sales and 25% buybacks, with the remaining being liquidations (Bascha & Walz, 2002). Surprisingly, the findings of Christofidis and Debande (2001) differ, stating that trade sales are more frequent than IPOs for all types of VC funding in Europe, especially as they are considered faster and cheaper ways of exit. Although CVCs are well aware of differences in financial returns, they prefer other exit strategies. For them, IPOs are the most attractive exit form, followed by trade sales and buyouts. Surprisingly, only few CVCs consider an acquisition and subsequent integration of a portfolio firm in a corporate business unit a viable exit option (Ernst et al., 2005). A possible, yet unsatisfying, explanation offered by the authors is a strong short-term financial, instead of a long-term strategic,

orientation of corporations. A further explanation could be a founder's animosity with an acquisition as they lose control and entrepreneurial freedom.

Bienz and Walz (2006) find that start-ups prefer IPOs over any other form, especially trade sales and acquisitions, as an IPO allows them to stay in control of their venture. In more general terms, the post-exit governance of the various forms differs substantially (Cumming & MacIntosh, 2003b). Full acquisitions come with the best governance, as one party fully controls the venture. For trade sales, a new (majority) owner has to learn about the start-up and establish sufficient monitoring and control capabilities. Buybacks experience a positive governance effect from debt incentives, however a negative effect from management ownership.

In addition to control, entrepreneurs and CVCs chose exit forms based on private benefits. Many scholars hypothesize that private benefits for entrepreneurs are especially high in the case of IPOs (Bascha & Walz, 2001; de Bettignies, 2008; Hellmann, 2006). In an acquisition, entrepreneurs are often removed from their firm. Therefore, "even when an acquisition is financially superior to an IPO, an entrepreneur might prefer the IPO because of the private benefit" (Cumming, 2008, p. 1947). In contrast, the CVC obtains private benefits, like reputation and public image, especially from a successful IPO (Bienz & Walz, 2006; Cumming & MacIntosh, 2003b). Clearly, conflicts of interests arise between start-ups and CVCs with regards to private benefits, especially as such benefits are not necessarily transparent to other parties.

It becomes obvious that especially the case of an acquisition and subsequent integration into a corporate business unit requires specific attention in the CVC context. A corporation has the opportunity to fully acquire and integrate a start-up. This is especially

useful if synergies emerge from the combination of buyer and target (Cumming & MacIntosh, 2003b). Some corporations acquire multiple start-ups and combine them to one strategic platform (Christofidis & Debande, 2001). Reality shows, however, that acquisitions are also performed if no strategic fit exists (Cumming & MacIntosh, 2003b; Gompers & Lerner, 1998, p. 19). Nonetheless, 17% of start-ups acquired by corporations are previously CVC-managed (Benson & Ziedonis, 2010). Corporations tend to acquire and integrate CVC-backed start-ups if the innovativeness of the corporation is low, if multiple CVCs co-invested in a start-up and if the innovation outcome of the venture is clear (Dimitrova, 2015). VCs often use syndicates with CVCs in order to open up an acquisition as potential exit form, thereby accepting negative implications from leaving a syndication early (Zhelyazkov & Gulati, 2015). Despite arguments for an acquisition of a previously CVC-backed start-up, empirical research finds that acquisitions of CVC-backed start-ups are value destroying with an almost 1% negative return (Benson & Ziedonis, 2010). This negative reaction is neither owed to overpaying due to owner's curse, nor governance problems, or managerial hubris but rather to the negative impact acquisitions and integrations have on future innovations. Corporations can try to mitigate the negative effects through organizing CVCs autonomously and through improving their experience (Benson & Ziedonis, 2009; Dimitrova, 2015). Moreover, if the ratio of CVC investments to R&D expenditure increases, performance of acquisitions increases at a diminishing rate (Benson & Ziedonis, 2009). For these reasons, start-ups are often hesitant to be fully acquired by a corporation, as this raises the threat of losing independence through getting financially and operationally integrated (Christofidis & Debande, 2001). Thereby, the management of the start-up loses room to maneuver and power over the future of the start-up.

Above, differences between VC in general and CVC were pointed out selectively. In the following, existing research that specifically compares exits from the two forms is discussed. CVC investments (1,937 days in average) have a longer duration than IVC investments (1,642 days), leading to higher investment amounts (Guo et al., 2015). Whereas longer investments rather result in acquisitions, larger investment amounts favor IPOs. Taking both effects into account, no statistically significant differences in the probability of IPOs between CVC (35% IPO probability) and IVC (33% IPO probability) can be detected (Guo et al., 2015). However, CVCs outperform IVCs during IPOs, both with regards to the excess-of-market return of the start-ups going public (Chemmanur et al., 2014; Lerner, 2013) and mere announcement returns (Masulis & Nahata, 2010). The positive signal also becomes apparent in less underpricing for CVC than IVC-backed start-ups (X. A. Wang & Wan, 2013)[71]. CVC generate an IPO premium through their value-adding activities during collaboration, especially if a strategic fit between the corporation and the start-up exists (Ivanov & Xie, 2010). Start-ups in uncertain environment benefit from a CVC's asset complementarity, leading to higher IPO and lower failure rates (H. D. Park & Steensma, 2012). Due to the positive effects of CVC-backing, IVCs often enter syndicates with CVCs when they plan to leave the investment soon, especially at the end of an IVC fund's lifetime. Despite the positive effects, start-ups, however, often disfavor CVC investments due to difficulties in exiting such relationships, especially as corporations have no incentive to sell start-ups to their competitors[72] (Shane, 2010).

In summary, CVCs and start-ups reach a point where their investment relationship comes to an end. Either the two parties separate completely or the way of collaborating changes,

[71] IVCs also reduce IPO underpricing compared to non-VC-backed start-ups (Schwienbacher, 2009)
[72] Often these competitors are, however, the most likely and most promising bidder for a start-up

e.g. through fully acquiring and integrating the start-up into a corporate business unit. An exit of an investor is a drastic event that requires careful consideration as exits face typical agency problems, like asymmetric information, (double-sided) moral hazard or misleading incentives. Exits are performed for three reasons, namely a declining value-add of the investor over time, a shift in value-add and costs of a collaboration and an overhauled assessment of the investment opportunity. During the exit, investors aim at realizing a financial return from their initial investment. Moreover, exits send a strong signal regarding the investee's performance to the market. The costs of exits are high, especially regarding transaction costs, including marketing of sale, identification of potential buyers, negotiations, lawyers, contract writing, brokers and other professional services. Moreover, exits often have a disrupting impact on the monitoring of the investee. Many exits require a third party as new investor, making functional capital markets indispensable. In the CVC context IPOs, full acquisitions, trade sale of shares, buybacks in form of leveraged buy-outs or management buy-outs and liquidation of the venture are applied exit forms. The selection of a specific form of exit has an impact on the return, post-exit governance and control and private benefits on both the corporate and start-up side. Although CVC purses financial and strategic goals, exits are largely influenced by financial considerations[73]. For corporations, IPOs are the most attractive exit form, followed by trade sales and buyouts. Start-ups prefer IPOs over any other form, especially trade sales and acquisitions, as an IPO allows them to stay in control of their venture.

[73] The strategic objectives, e.g. gaining a window on technology, are satisfied during the collaboration phase

II.2.6.3 Example: Exit of CVC-managed start-ups

The following three examples of previously CVC-managed start-ups give more insights on the variety of exit forms. First, CVC-backed start-ups might exit through an IPO, as demonstrated by the example of Snap Inc. In 2012, Lightspeed Ventures invested 485k$ as first VC, followed by multiple syndicated financing rounds till 2016, valuing the start-up at up to 800mn$ in June 2013 (Crunchbase, 2018). In November 2013, the exit of VCs was close, when Facebook offered 3bn$ for acquiring the, still not monetized, app. However, the founder Evan Spiegel refused the offer. Around three years after being founded, the company finally hired an experienced Facebook veteran to work as vice president of monetization. In 2014, the company received more funding, which was used for its expansion, more precisely for acquiring some smaller companies, for example in the QR code business. In summer 2015, the monetization strategy finally picked up, earning the company the first revenue from McDonald's branded geofilters (Crook & Escher, 2015). Nonetheless, the company did not earn any profit, having an operating margin of less than -400% in 2017 (Morningstar, 2017a). In March 2017, Snap Inc. finally went public through an IPO, gaining large media coverage.

Second, start-ups might be integrated in a corporation that previously invested in them, as in the case of Nest Labs discussed above. As of today, Nest still exists as brand but is fully integrated in Google's organization and operations. The integrated collaboration resulted in the successful combination of the Nest and the Google world. Nowadays, for example, the Nest products are linked to Google Assistant, improving them from smart-home products to voice-commanded smart-home solutions. Nonetheless, difficulties with the integration emerged. Cultural differences were the main reason why the Nest Founder Tony Fadell had to leave Google in 2016.

The third example describes an acquisition through a third party. The artificial intelligence company Lattice Data was founded in 2015. Among others, it was backed by GV (a venture capital arm of Google) and received around 20m$ in Series A funding. In early 2017 the start-up was acquired by Apple with a valuation of 200m$ (CBInsights, 2017a). Rumors have it that both Amazon and Samsung were similarly interested in an acquisition of the company. As a consequence of the purchase, around 20 engineers joined the Apple team. Intriguingly, however, one of the four founders did not join Apple, yet started a new corporate position at Google[74].

All in all, exits from investments are specific to CVC, VC and PE funds. Therefore, the existing economic literature is already closely aligned to these areas. Especially, regarding IPOs, no remarkable difference between various forms of VC exists. With regards to full acquisitions and integration to existing business units, a lack of research occurs. Being on the one hand specific to few cases in CVC and on the other hand difficult to measure, empirical studies lack and are therefore demanded from future research.

[74] See https://techcrunch.com/2017/05/13/apple-acquires-ai-company-lattice-data-a-specialist-in-unstructured-dark-data/

II.3 Discussion and contribution

The main contribution of this chapter II lies in an enhanced understanding of CVC investments with regards to underlying economic theories. Readers gain a broad understanding of what CVC is, how it works and what research exists about it. Explanations for CVC-specific findings are offered, inconsistencies with economic theories detected and white spots identified. In addition, benefits and challenges of CVC investments are worked out. Thereby, a more detailed understanding of what makes CVC investments specific is gained, which is an indispensable prerequisite for conducting further work on CVC. For example, funding of start-ups is often used as variable for financial start-up performance. Such funding is closely related to the valuation of start-ups. Therefore, without understanding how start-ups are valued and what pitfalls exist, financial performance of start-ups cannot be understood completely. Similarly, property-rights theory ought to be known in order to grasp the full effect of equity investments.

Economic concepts like information asymmetries, moral hazard, principal-agent relationships, contract design and property-rights theory are introduced and discussed in light of CVC investments. Several economic theories, like a pecking order for funding sources, the need for property rights in case of imperfect contracts, market signaling or investment exits are confirmed by CVC applications. Others, like broadly-accepted valuation approaches find limited applicability for CVC and start-ups. Moreover, especially the collaboration between corporations, CVCs and start-ups seems to be an underdeveloped research field. The synthesis of existing CVC research helps to identify white spots. Some of these white spots are filled throughout this work, especially regarding the performance implications of collaborations between corporations, CVCs and start-ups. Other topics, like new forms of

venture financing using initial coin offerings (ICOs) or crowdfunding are increasingly tackled by many other scholars.

Through comparing well-established theories with CVC-specific applications and empirical analyses, this work contributes to the fields of economics, business and management, entrepreneurship, strategy and innovation. Methodologically, this work contributes through applying a life-cycle perspective, thereby covering all steps relevant for a CVC-start-up relationship. Scholars can use this work to derive research questions, whereas practitioners from both corporations and start-ups can improve their understanding of the CVC phenomenon.

Status of current research

Established sources of venture financing, like VC in general, are broadly discussed in literature. However, practitioners develop new forms of start-up financing, like ICOs or crowdfunding. Although initial studies already exist on this topic, more ought to be done.

A large body of literature ensures a good understanding of corporate innovation and topics around make-or-buy, economies of scale and scope, inefficiencies or transaction costs are well covered. However, demands on firms are constantly evolving, requiring novel approaches to and sources of innovation. Therefore, future work needs to consider well-established and novel research findings and discuss new forms of corporate venturing.

With regards to the selection process, both theoretical and practical insights on matching, valuation and negotiation allow for a good understanding. Future work, however, should not only consider financial numbers or firm-level similarities but take into account individual traits of the people involved. For example, personal links between a CVC and a

start-up will accelerate the selection process, simplify negotiations and potentially even reduce the importance of valuations.

The literature on contracting is well developed, especially as CVC contracts are largely similar to VC contracts and are based on the property-rights theory. CVCs not only invest in start-ups for financial reasons, but as they aim at strategic benefits. Therefore, the collaboration between the two parties emerges as the most important step in the CVC-venture lifecycle. Whereas IVC is especially focused on successful exits, the true value of CVC lies in a successful start-up collaboration. Such collaborations come with advantages and disadvantages for both parties. Nonetheless, the literature remains underdeveloped in this area. Studies consider what influences collaboration, but not necessarily how the strategic direction and organizational design of a CVC supports performance of both the start-up and the corporation. Research exists on portfolio size or the existence of CVC seats on the board of management of start-ups but misses informal links or the level of individuals. Only a limited number of CVC studies discusses performance implications of CVC governance (Röhm, 2018) and "we know little about how CVC may be facilitating or hindering the start-up's development" (Corredoira & Di Lorenzo, 2016, p. 2) or "how different CVC units finetune their structure to meet their overall financial and strategic goals" (Asel et al., 2015, p. 70). Moreover, scholars discuss the trade-offs between mutual learning through proximity and a loss of entrepreneurial freedom through closeness, without presenting empirical rigor.

Lastly, work on exits focus on IPOs in general, especially due to a high availability of data. More research might be done on CVC-specific exits, especially the integration of start-ups into the corporate organization. For example, scholars could evaluate whether an acquisition is value destroying per se or whether integrational problems lead to the negative

effect. Moreover, more focus should be given to personal and cultural differences, especially as one often sees the founder of a start-up leave the company shortly after the start-up was fully integrated in the corporation[75]. No conclusive picture on which exit form is most suitable in what context arises. Therefore, it would be helpful for both scholars and practitioners if an exit decision framework, considering firm and start-up characteristics and capabilities, as well as environmental circumstances, would be developed and empirically tested. Lastly, more research is needed on the frequency of CVC fire-sales and their implications on start-up and corporate success. In short, CVC research is not conclusive yet, especially regarding the performance of investments, the way of collaboration and a differentiation to new forms of corporate venturing or start-up support. Especially the strategic performance is essential for CVC investments, although difficulties in measuring the strategic effect remain in most studies.

Limitations

Although this work contributes to a better understanding of how CVC investments work and what influences the performance outcomes of such investments, it comes not without limitations. The elaboration on well-known economic theories and their application to the CVC context is not without flaws. "Theory is necessarily an abstraction and simplification of reality" (Makadok, Burton, & Barney, 2018, p. 1531). This is also true for all theories discussed within this work. Although the theories are reflected as conclusively as possible, some of the discussions might be oversimplifying and short. For example, property-rights theory helps to better understand CVC investments, nonetheless, it makes simplifications that do not fully represent the reality of CVC investments. Despite applying

[75] For example, the WhatsApp founders left Facebook shortly after Facebook's acquisition of WhatsApp

a broad lifecycle approach on the theoretical part, this work is far from being complete and not all potentially relevant theories can be covered. Moreover, not everything covered in economic theories is tested in the CVC context. For example, CVC investments might be influenced by individual personal traits of the involved parties, going far beyond the used experience of a CVC lead. Literature in the field of CVC is urged to add the individuum, like the founder or top management, as research object to future work and further develop the behavioral entrepreneurship literature. As CVC acts as mediator between a corporation and a start-up, CVC personnel must be able to balance both worlds and relate to both parties simultaneously. In addition, some of the theories and applications to CVC are of advanced age. The entrepreneurship world is constantly changing. Therefore, some of the historically gained evidence might not hold true for future CVC investments. Lastly, some discussions and insights are borrowed from VC literature. Although this is only done in areas where CVC and VC are highly comparable, future research might challenge and skeptically scrutinize existing wisdom to further add to a theoretical understanding of CVC.

II.4 Summary and conclusion

CVC is a well-established phenomenon with a long history, a large number of vehicles and existing theoretical and empirical research (Röhm, 2018). This work adds to the understanding of CVC investments through taking a lifecycle approach in order to detect how well-established economic theories are applied in the CVC context. Thereby, the understanding of CVC investments is enhanced, potential deviations of CVC behavior from broader economic theories detected and white spots for future research identified. CVC investment is not a straightforward endeavor. Therefore, every scholar and practitioner interested in this field is urged to gain a fundamental understanding of why CVC investments occur and how they are performed. This work modestly contributes to the understanding through detecting that CVCs largely follow broad economic concepts and theories. More precisely, CVC relationships are typical principal-agent relationships suffering from information asymmetries, which lead to moral hazard and adverse selection effects. This work demonstrates that CVC investment occurs in line with the pecking order hypothesis, having a preference for equity over debt due to liquidity and control reasons. The hurdles of finding suitable partners are explained by search and matching theories, where a heterogeneous set of CVCs needs to find a suitable partner out of a large number of different start-ups. Therefore, CVC and start-up matching follows the theory for matching indivisible non-standardized goods in markets with search frictions. Once a matching is achieved, contracts are used to reduce information asymmetries and steer the principle and agent behavior in an overall beneficial way. However, CVCs acknowledge that contracts are imperfect and follow the property-rights theory requiring control over start-ups. The collaboration between a corporation and a start-up is challenging, yet essential for a successful investment. Therefore, CVCs act as middle man and balance the needs of different

involved parties. Lastly, exits from CVC investments follow broadly researched forms, especially IPOs and trade sales. However, corporate acquisitions and subsequent integrations of start-ups constitute an exit form particular to CVC. Following this work, future research on CVC should focus on the collaboration between a CVC and start-ups, as well as CVC-specific exit possibilities. Moreover, taking the different individuals involved in CVC investments in consideration is beneficial for future research.

III. Empirical analyses of CVC performance

Several observations and conclusions drawn from the theory part in chapter II build the basis for the following empirical analyses. Through building the empirical work on an intense literature review, it is ensured that the quantitative work is based on existing theories and fills gaps in existing CVC literature.

In short, CVC research is not conclusive yet, especially regarding the performance of investments, the way of collaboration and a differentiation to new forms of corporate venturing or start-up support. Especially the strategic performance is essential for CVC investments, although difficulties in measuring the strategic effect remain in most studies. Additionally, the literature review unveils that more work needs to be done on organizational issues. Currently, cultural aspects of the people involved and personal traits are often not considered. As CVC is a mediator between a corporation and start-ups, CVC personnel must be able to balance both worlds and relate to both parties simultaneously. Taking all this into account, the following empirical work is focused on the performance of CVC and what can be done organizationally to further improve start-up performance.

Chapter III of this dissertation aims to fill these gaps in literature in multiple ways. First, section III.1 discusses the research setting and applied variables of the underlying data sample in more detail. This is necessary as all empirical work is based on a novel and unique hand-collected dataset on German CVC and CA units. In section III.2 the effect of a CVC's strategic direction and organizational design on start-up performance is analyzed. Finally, section III.3 compares CVC to the recent and similar yet distinct phenomenon of corporate accelerators. All in all, the next section therefore allows to better understand performance implication of CVC.

III.1 Overarching research setting and applied dataset

III.1.1 Research setting and sample

The research study is based on a novel hand-collected dataset covering 21 CVCs with 210 start-ups and 15 CAs with 132 start-ups under management. The 36 CVCs and CAs are owned by 29 different corporations, like BMW, Siemens, ProSiebenSat.1, Commerzbank or Klingel Group. A multi-level dataset is required to estimate the impact of (i) CVCs on (ii) start-ups while controlling for specific characteristics of the (iii) corporation. With regards to performance implications, researchers either take the perspective of the corporation, i.e. evaluate how collaborating with start-ups increases the innovativeness of the corporation itself (e.g. Dushnitsky & Lenox, 2005; Siegel et al., 1988; S. W. Smith & Shah, 2013; Wadhwa & Kotha, 2006), or researchers look at the start-up, i.e. review how working together with a large institution helps the start-up to become more innovative (Alvarez-Garrido & Dushnitsky, 2016; Chemmanur et al., 2014; Howard et al., 2017; Paik & Woo, 2017). As the effect of few small start-ups on the performance of a large corporation is difficult to separate from other influencing factors, this work focuses on the effect of CVC and CA on start-up performance.

To the best knowledge, no dataset is readily available to answer the specific research questions on hand. Therefore, a hand-collecting of data was necessary. Data was obtained and combined from various sources in early 2018. After identifying CVCs and CAs in Germany, information on them and their parent corporation was sourced from annual reports, corporate websites and providers of business data, especially CrunchBase. The background of identified leads is extracted from career websites, especially LinkedIn, whereas social

media, like Twitter and Facebook, is used to obtain information on a CV[76] unit's popularity. All information on start-ups was exceptionally sourced from Pitchbook, a provider of private capital market data, including scrapping-based start-up information. Due to the tedious data-collection approach, for the ease of comparability and the reduction of country-specific effects, the dataset purely covers CVCs and CAs located in Germany, whereas both the corporate parent and the start-ups might have their headquarters in any other country.

III.1.2 Variables and measures

All deployed variables, including their sources, are listed and described in Table 5:

[76] Going forward, the term corporate venturing vehicle (CV) is used to only describe CVCs and CAs without referring to other forms of corporate venturing, like corporate incubators

Table 5: Variable description and sources (author's dataset)

Variable	Description	Source
Financial performance (Capital raised)	Total dollar amount raised by a start-up, all the money injected from different investors	Pitchbook
Strategic performance (Market access)	Number of unique referring domains, i.e. redirections to another site, a start-up website hosts	Pitchbook
CVC vs CA dummy (VD)	Dummy variable for whether corporate venturing unit is a CVC or CA	CV website
Portfolio size (PS)	Number of start-ups currently part of corporate venturing program	Pitchbook
Portfolio concentration (PC)	Herfindahl-Hirschman Index for start-up industry concentration, industry based on two-digit SIC code	Pitchbook
Industry fit (corp. and start-up) (IF)	Dummy variable for corporation and start-up being active in same industry, industry based on two-digit SIC code	Corporate annual report, Pitchbook
CV experience (CE)	Age of the corporate venturing unit in 2018 in years	Pitchbook
Lead background (LB)	Founding experience of CV management team in years relative to industry experience	LinkedIn
Employees per start-up (VE)	Number of CV employees per start-up currently part of accelerator program	CV website, Pitchbook
Spatial distance (CV and corp.) (SD)	Distance between CV location and corporate headquarters in kilometers to account for spillovers	CV website, corporate annual report, Google data
Corporate partner network (CP)	Number of corporate partners per start-up currently part of CV program	CV website
Popularity (VP)	Number of LinkedIn and Twitter followers and Facebook likes of respective CV	LinkedIn, Twitter, Facebook
Financial backing (FB)	Annual revenue of corporate parent	Corporate annual report
Start-up employees (SE)	Number of employees working for start-up	Pitchbook
Start-up age (SA)	Age of the start-up in 2018 in years	Pitchbook
B2B orientation (BB)	Differentiation of whether start-up is active in the business-to-business (B2B) or business-to-consumer (B2C) space	Pitchbook
Number of active investors (AI)	Number of investors that injected money in start-up and still actively hold a stake in the start-up, does not include investors that invested earlier but already withdrew capital	Pitchbook

Dependent variables

The following empirical analyses aim at evaluating the impact of CV on the performance of start-ups. Therefore, the dependent variable is a proxy for start-up performance. As outlined by Chesbrough (2002) corporate venturing units follow both financial and strategic objectives. Previous studies highlight that both the financial and non-financial dimension matter for CVC and for CA even more (Colombo et al., 2018, p. 195). In order to account for such goal duality, this study analyzes performance based on two measures.

First, capital raised by a start-up is applied as financial indicator. This variable cumulates the funding received by a start-up and thereby reliably measures the financial success of a start-up as it incorporates the (financial) assessment of the start-up's future prospects from multiple, experienced entrepreneurial finance professionals. External funding encapsulates quality and market signals, e.g. regarding competitors, strategy and team aspects (e.g. Harding & Rouse, 2007) and thereby reflects how experienced business investors judge the future success of a start-up (Gompers & Lerner, 1998, p. 34; Röhm et al., 2018). Therefore, this measure – or a similar indicator like start-up valuations – is also applied by other scholars (e.g. Gompers & Lerner, 1998, p. 34; Röhm et al., 2018).

Strategic start-up performance is more challenging to measure. Strategic performance stems from access to corporate networks, experience or image endorsements (Alvarez-Garrido & Dushnitsky, 2016; Asel et al., 2015; Bjørgum & Sørheim, 2015; Maula, Autio, & Murray, 2006). Many scholars use innovation measures, like patents and citations (e.g. Alvarez-Garrido & Dushnitsky, 2016; Chemmanur et al., 2014; Dushnitsky & Lenox, 2005; Howard et al., 2017) or product introductions (e.g. Howard et al., 2017; S. W. Smith & Shah,

2013). However, these measures suffer from a high industry-specificity and are often not available for young early stage start-ups. As the strategic performance of start-ups is heavily impacted by network access, the experience of such networks and endorsement effects, a growing literature uses online performance and traffic measures from company websites, LinkedIn or Facebook (e.g. Gonzalez-Uribe & Leatherbee, 2018; Hallen, Bingham, & Cohen, 2017). Similarly, the work on hand uses the number of referring website domains to the start-up website as a measure for the start-up's market access.

Independent and control variables

In empirical models combining CVC and CA, a dummy variable is used to differentiate between the two, where 1 indicates CVC and 0 CA. The portfolio size is based on the number of start-ups that are under the management of the corporate venturing unit. Thereby, not only the extend of a start-up network, but also the degree of corporate supervision is approximated. The more start-ups a CV manages, the less the interaction with and inference of each individual start-up will be. The diversification of the start-up portfolio is measured as a Herfindahl-Hirschman-Index of the industry concentration among the start-ups. This measure encapsulates whether start-ups benefit from spillover and synergies among each other if some level of similarity is given. Thereby, the industry heterogeneity of start-ups under management is recorded. Being concerned about the protection of their intellectual property (Katila et al., 2008) and being afraid of sharing too much information with an external organization (see e.g. Karwatzki, Trenz, Tuunainen, & Veit, 2017), start-ups often see investments of corporations active in the same industry critically (Dushnitsky & Shaver, 2009). Therefore, a dummy variable is used to denote whether the corporation and the start-up are primarily operating in the same industry or not.

The age of the corporate venturing unit as of 2018 is used to approximate the experience the CV has in the start-up and corporate venturing world. The increased experience of a CV might help to handle challenges of corporate venturing better, however, too much experience might distance CVs from young and dynamic start-ups. In order to detect whether the management team of a corporate venturing unit has rather a start-up or corporate mindset, a ratio of the CV leads' collective industry experience in years versus their joint industry experience is built from LinkedIn data. Individual founding or start-up experience and connections to other players in the start-up ecosystem will help CV leads to offer relevant mentoring and training to start-ups. On the other hand, start-ups might also benefit from CV leads with sufficient industry and corporate experience, especially regarding market trends, the handling of corporate politics and the access to corporate resources (Howard et al., 2017). Although LinkedIn data might be subject to self-reporting biases, this measure is confidently applied as it is also used by other scholars (e.g. Garg & Furr, 2017; Hallen et al., 2017).

The count of CV employees per start-up serves as an approximation for the CV's oversight and inference with the start-up's entrepreneurial freedom. The spatial distance between the CV and corporate headquarters hints at the CV's access to corporate resources, especially as a large research body highlights the positive effect of spatial proximity on synergies and knowledge spillovers (Drover et al., 2017; Kloosterman, 2008; Li et al., 2014; Wong et al., 2009) and the finding that venture creation is not only influenced by availability of resources but also the smartness of its surroundings (Lehmann, Seitz, & Wirsching, 2017). The distance of CV and corporate headquarters is used as most CVs offer co-working spaces for their portfolio firms.

The count of corporate partners is used to describe the corporate partner network. Such a partner network allows start-ups to speed up their development through opening new avenues of market access. The popularity and reputation of a CV unit is of interest, especially as start-ups benefit from a strong endorsement effect investors (Bjørgum & Sørheim, 2015). VC research finds that a funds popularity has both a direct and an indirect impact on start-up performance (Sørensen, 2007). On the one hand, a signaling effect will lead to a self-selection of start-ups, more precisely high performing start-ups will reach out to a CV with a good reputation, whereas low performing start-ups will judge their success to gain funding too low to even apply for it. On the other hand, stories of successful start-up developments, especially exits, will tremendously impact the reputation of a VC. Similarly to Gonzalez-Uribe and Leatherbee (2018), the corporate venturing unit's LinkedIn and Twitter followers are combined with the number of Facebook likes to approximate the CV's popularity.

Lastly, it is controlled for both corporate and start-up characteristics. On the corporate side, the financial backing is used as approximated by the corporate revenue to account for the size and prominence of the corporate mother. Thereby, it is also controlled – to some degree – for self-selection effects of start-ups that might be more prone to be part of a CV program of a large and well-known corporation instead of a small niche-player. Start-ups size is controlled for through start-up employees and age. Using a web-based measure as strategic performance variable makes the use of a dummy variable controlling for whether the start-up is active in the business-to-business or business-to-consumer sphere necessary, as business-to-consumer start-ups will have websites with far more referring domains. As last variable, the number of active start-up investors is controlled for as more investors signal a higher quality of the start-up's idea, business plan and future prospects and therefore its performance.

III.2 The governance of CVC and its effect on start-up performance

III.2.1 Introduction

Broad literature exists regarding CVC, covering benefits, drawbacks and performance implications, as well as comparisons to similar forms. Although both benefits and drawbacks of CVC investments are evident, a general consensus of positive effects of CVC investments exists (e.g. Colombo & Murtinu, 2017; Dushnitsky & Lenox, 2005; S. J. Lin & Lee, 2011). Literature compares CVC-managed start-ups to ventures that are not under CVC management and find evidence of positive effects of CVC investments (e.g. J. H. Park & Bae, 2018). Moreover, CVC is differentiated from IVC funds, alliances or joint ventures to gain a better understanding on performance effects of different governance aspects (e.g. Alvarez-Garrido & Dushnitsky, 2016; Gompers & Lerner, 1998, p. 17; Hill et al., 2009; Keil et al., 2008). Some studies separate CVC in internally and externally oriented funds (Asel et al., 2015) or focus on performance effects of selected variables, like portfolio size or industry fit (Belderbos et al., 2018; Katila et al., 2008; S. J. Lin & Lee, 2011).

More research needs to be done regarding the set-up of CVC units and its performance implications. In this context, a more detailed consideration of CVC investments beyond aggregated performance effects is required (Anokhin, Wincent, et al., 2016). Asel et al. urge researchers to determine "how different CVC units finetune their structure to meet their overall financial and strategic goals" (2015, p. 70) and Röhm (2018) finds in a recent review of CVC literature that only few studies address the governance of CVC units and its impact on performance.

The study on hand aims to fill this literature gap through empirically studying a novel hand-collected dataset covering 21 CVCs and 210 start-ups and thereby determining how the

strategic direction and organizational design of a CVC impacts performance. Although CVCs cater to both corporations and start-ups this study focuses explicitly on the implications of CVC investments on start-up performance. Thereby, this section adds to literature primarily in three ways. First, this work presents evidence that a trade-off among financial and strategic goals exists and that there are situations where not both can be pursued simultaneously. Second, it extends the work of previous scholars that often consider only one aspect of a CVC's strategic direction and organizational design through incorporating multiple dimensions, including portfolio, experience and CVC leadership. Third, this study sheds light on the German CVC market and thereby adds a new geographic perspective to a mainly US-focused research field (J. S. Harrison & Fitza, 2014). Thereby, it is shown how the selection of a start-up portfolio and the experience and staffing of a CVC impact start-up performance. In addition, this work helps to obtain a more conclusive picture on the performance effect of portfolios, a field where disagreements between scholars exists.

Besides contributing to an existing research body, this work gives guidance to corporate practitioners and start-up founders on the design, governance and staffing of CVC units. The findings can not only be used to set up CVCs from scratch, as recently done for Alliance Venture, a 1bn$ fund by Renault, Nissan and Mitsubishi, but also to overhaul corporate venturing activities and units, as recently done by the German insurer Allianz. In addition, the findings can be used by start-ups to identify suitable CVC investors for themselves.

The remaining parts of this study are structured as follows: In section III.2.2, existing literature is discussed and hypotheses on a CVC's strategic direction and organizational design are derived. Third, descriptive statistics, the applied methodology and robustness tests

are discussed in section III.2.3. Fourth, the results are presented. Next the contribution to literature is discussed. Finally, this study concludes with a review of the limitations of this work and avenues for further research in section III.2.5.

III.2.2 Literature review and theoretical background

The size and complexity of corporations and start-ups are significantly different making direct collaborations challenging, for example, corporate inertia slows down start-up decision making. Despite the challenges of collaboration, start-ups require both financial support from the corporation and access to corporate assets, networks, capabilities and experts (Gans & Stern, 2003), especially as mutual "involvement is an important determinant of innovation and success" (Bernstein et al., 2014, p. 3). Therefore, CVCs act as a mediator and intermediary between a corporation and a start-up (Chesbrough, 2002; Dushnitsky & Lenox, 2006; Ernst et al., 2005). Within this triad, however, start-ups not only collaborate with the CVC, but also directly with corporate business units, as the relevant assets, expertise and capabilities are located there (Basu et al., 2016).

Within the trichotomy, a CVC can be closer to the corporate parent or the start-up. Therefore, governance mechanisms and a CVC's orientation matter (Solvang & Berg-Utby, 2009). Literature finds that several prerequisites support a successful CVC-venture collaboration. First, start-ups perform better if they have access to complementary corporate assets (Gans et al., 2002) and the ability to make use of and leverage those assets (Alvarez-Garrido & Dushnitsky, 2016). Second, the collaboration between the two players is only beneficial if regular and direct interactions between corporate and start-up employees allow for mutual support and learning (Maula et al., 2009; Sykes, 1990). Nonetheless, negative

effects from CVC-based collaborations evolve, especially around protection of intellectual property (e.g. Anokhin, Örtqvist, Thorgren, & Wincent, 2011), managerial complexity (e.g. Belderbos et al., 2018), conflicting objectives and strategic orientation (e.g. Gaba & Dokko, 2016), or different cultures and working styles (e.g. Pahnke et al., 2015). Despite all benefits of collaborations between corporations and start-ups, literature shows that especially intellectual property protection is key for successful open collaborations (Gans et al., 2002).

A CVC will only lead to superior performance, if both the advantages of CVC investments are leveraged and the drawbacks reduced. Therefore, the orientation of a CVC towards both the corporation and the start-up matters. A CVC's governance in terms of its strategic direction and organizational design will severely impact its performance. This is also supported by practitioners, like Matthias Lais, the COO and Co-Founder of main incubator, stating that "From our experience, it is important to create a separate, more independent unit for cooperation between start-ups and the corporation: On the one hand, it should have an eye on the market and thus recognize exciting innovations early on and in consultation with the specialist department; on the other hand, it should also moderate the initiation of cooperation between the parties" (VentureCapital Magazin, 2019, p. 7 translated from German).

In literature, two streams of CVC governance evolve. First, CVC is compared to similar forms of start-up support, especially IVC or other forms of corporate venturing, like acquisition, alliances and joint venture (e.g. Alvarez-Garrido & Dushnitsky, 2016; Gompers & Lerner, 1998, p. 17; Hill et al., 2009; Keil et al., 2008) Second, only CVC is considered and more detailed governance characteristics evaluated, like autonomy of investments or incentive schemes for CVC personnel (e.g. Asel et al., 2015; Belderbos et al., 2018; Wadhwa

& Kotha, 2006). Comparing CVC and IVC, CVC is especially beneficial if a strategic overlap between the corporate parent and the start-up exists and if start-ups have the ability to exploit complementarities (Gompers & Lerner, 1998, p. 38) as well as if corporations are accessible to start-ups and allow them to leverage corporate assets or help them with regulatory approvals, like FDA (Alvarez-Garrido & Dushnitsky, 2016). Hill et al. (2009) test what happens if CVCs use rather IVC-typical structures, like an autonomous organization, specialization, syndication, staging and high-powered incentives and find that applying IVC-like structures leads to higher CVC performance, both financially and strategically. Keil et al. (2008) compare CVC to alliances, joint ventures and acquisitions and find that relatedness between the corporation and the target has a specifically high importance for CVC.

Other scholars evaluate the governance of CVC only. Asel et al. (2015) separate CVC in internally and externally oriented funds and find that internally oriented CVCs with close links to the corporate parent are staffed with corporate personnel and invest in start-ups that are closer to the corporate core. Especially in times of economic hardship, such CVCs tend to cease start-up support more rapidly. In contrast, external CVCs are staffed with investment professionals, leading to more autonomous and return-oriented CVCs that rather invest in disruptive start-ups with less fit to the corporation. Wadhwa and Kotha (2006) specifically evaluate the effect of CVC involvement on start-up performance and find an inverted U-shape relationship between investment and start-up performance if CVC involvement in the start-up is low and a strictly positive effect of additional investments on start-up performance if CVC involvement is high. Belderbos et al. (2018) find a negative effect of an increasing number of start-ups within a CVC portfolio. Assuming that an increasing number of start-ups reduces the involvement of a CVC with each start-up, their finding suggests that an increasing start-up autonomy leads to positive performance. In contrast, Yang (2012) finds a

negative effect of autonomy on performance. Similarly, an increasing portfolio diversity and existing strategic links between a corporation and start-ups have a positive performance effect (S. J. Lin & Lee, 2011), whereas the so-called shark's dilemma states that strategic similarities between a corporation and a start-up may lead to misappropriation of start-up intellectual property through corporations (Katila et al., 2008), making a sufficient protection of start-up resources from corporate shirking necessary.

Literature shows that no conclusive picture on the effect of CVC governance on performance exists. Due to a limited number of studies and prevailing disagreement, researchers are urged to further elaborate on the effect of a CVC's structure (Anokhin, Wincent, et al., 2016; Asel et al., 2015). This work aims at adding to the literature on how strategic direction and organizational design of CVC impacts start-up performance, through considering strategic decisions specifically on portfolio composition and CVC experience and organizational topics concerning CVC leadership.

These three dimensions are chosen for multiple reasons. First, disagreement in literature exists regarding the effect of CVC portfolio composition. Second, the effect of CVC experience needs to be differentiate in a financial and a strategic perspective as the positive effect from knowing how to do things and having large networks mainly impact the financial side, whereas the negative effects of experience and age, like sluggishness, overconfidence and beaurocratic process will especially impact the strategic side. Third, literature exists on the impact of a founder on start-up success (Delmar & Shane, 2006), corporate personnel on start-up boards (Howard et al., 2017) or star-researchers (e.g. Thomas, Bliemel, Shippam-Brett, & Maine, 2016), but not on the influence of CVC leadership on start-up performance.

Portfolio composition

The composition of a CVC's start-up portfolio affects performance. Portfolio composition concerns three dimensions, namely the size of the start-up portfolio, i.e. the number of start-ups under CVC management, the concentration or diversity of the start-up portfolio and the strategic fit of portfolio start-ups to the corporate mother. Literature focuses on the effect of portfolio size on corporate performance. Lee and Kang (2015) find an inverted U-shape relationship between portfolio size and knowledge transfer from start-ups to the corporation. Wadhwa and Kotha (2006) differentiate by the involvement of the investor in the start-ups and find an inverted U-shape relationship between the number of CVC investments and corporate innovation performance for investors with limited involvement and a positive relationship for investors with high involvement.

In contrast to these scholars, this thesis focuses on the effect of portfolio size on start-up performance and argue that an increasing portfolio size has a positive effect on both financial and strategic start-up performance. A larger portfolio allows every individual start-up to access other start-ups in a similar stage. Thereby, economies of scale can be realized. Additionally, more portfolio start-ups have an increased joint power towards the corporation and might negotiate more start-up friendly policies or reduce moral hazard issues. For example, if corporations face a strong start-up portfolio, their inclination to engage in adverse actions, like theft of intellectual property, is reduced. Additionally, many start-ups in the portfolio signal the importance of corporate venturing to every individual corporate employee. On the one hand, corporate personnel will take their responsibility of giving advice to start-ups more seriously. On the other hand, a larger portfolio of start-ups will reduce the oversight and inference each start-up obtains from CVC personnel, allowing for

more entrepreneurial freedom. Having many start-ups under management also allows for knowledge spillover and direct learning among the start-ups.

The magnitude of spillover also dependents on the diversity of the start-up portfolio. A highly concentrated portfolio with similar start-ups will lead to heavy competition among the start-ups, reducing knowledge and experience sharing to a bare minimum. For example, Dushnitsky and Shaver (2009) detect a reduction in the likelihood of CVC investments if competition between start-ups leads to a high risk of imitation. Therefore, the competition with others about ciritical resources will hamper both financial and strategic start-up performance. If the portfolio shows higher diversity, economies of scope emerge. Start-ups stop competing and instead complement each other. In such a case, knowledge spillover and mutual learning from diverse portfolio fimrs lead to a superior start-up performance.

Third, the strategic fit between a corporation and a start-up matters. Katila et al. (2008) find that CVC investments are like ‘swimming with sharks’, especially if an overlap between a powerful corporation and a vulnerable start-up leads to a high potential of misappropriation. Companies might absorb the technology or idea of a start-up and stop supporting the venture, whereas the venture is afraid of the negative effects of sharing too much information with an external party (see e.g. Karwatzki et al., 2017). Moreover, redundancy in the knowledge of the involved parties negatively affects performance (Belderbos et al., 2018; Dushnitsky & Lavie, 2010). Working with a corporation of the same industry, might send adverse signals to the market, thereby limiting the access to other potential partners (H. D. Park & Steensma, 2012). For example, a start-up active in the automotive industry and under the management of Alliance Ventures, the CVC arm of Renault, Nissan and Mitsubishi might have difficulties to collaborate with another

automotive corporation, like BMW. Therefore, Maula et al. (2006, p. 25) find that start-ups are more likely to accept CVC funding if their work is complementary, not competing with the corporate parent. Similarly, Masulis and Nahata (2009) show evidence for moral hazard concerns and detect that start-ups require higher valuations from competitive than from complementary CVCs, thereby financially balancing out the risk of misappropriation. Moreover, they find that competitive CVCs have lower start-up involvement, as measured through board seat representation. Taking the arguments from above into consideration, it is hypothesized that

H1: Large portfolios enhance the performance of start-ups under CVC management, whereas both portfolio concentration and industry fit have a negative relationship with start-up performance.

CVC experience

Literature discusses how the experience or strategic renewal of an organization influence its performance. Whereas Stinchcombe (1965, p. 148) finds that older firms perform better as they are more experienced, enjoyed more learning and do not face a liability of newness, Marshall (1920, p. 254) detects that older firms face inertia and are bureaucratic, slow and inflexible, leading to low performance. Coad, Segarra and Teruel (2013) look at the effect of age on sales, profitability and firm performance and find that age has both positive and negative effects. The effect of age is not only observable for firm performance, but also for the performance of specific firm activities, like acquisitions. Haleblian and Finkelstein (1999) find a U-shaped relationship between acquisition experience and performance. According to Bengtsson and Wang (2010) a venture capital's historical track record is a key indicator of their ability to add value to their ventures under management.

From broader literature, no conclusive argumentation regarding the impact of CVC renewal and experience on performance is possible. Hill and Birkinshaw (2014) recommend CVCs to be ambidexterious[77] to survive in the long-run. Therefore, and in line with a CVC's duality in objectives, including a financial and a strategic dimension (Chesbrough, 2002), it is argued that age and experience of a CVC impact the financial and strategic performance of start-ups under CVC management disparately.

Financially, CVC-backed start-ups achieve higher subsequent valuations (Ivanov & Xie, 2010) due to three effects linked to CVC age. First, experience leads to a superior selection capability of CVCs. Although investing in start-ups is a risky endevor, more experienced CVCs will rather select start-ups with high financial success and returns. Second, CVC investments serve as signaling effect and endorse start-ups towards subsequent investors (X. A. Wang & Wan, 2013). A CVC's track record of successfully developing ventures will help start-ups to attract valuations. In contrast, other investors will be more hesitant to invest in start-ups that are supported by CVCs without a proven track record. The third advantage from older CVCs comes from treatment effects. Focusing on financial performance, more experienced CVCs will give better guidance during the application for follow up funding, like better pitch presentations and storytelling or some degree of window dressing. Additionally, experienced CVCs will better understand the investor market, leading to superior timing of when start-ups reach out to investors for additional funding. Due to the three effects of selection, signaling and treatment, start-ups benefit financially from older and more experienced CVCs.

[77] To be able to use existing capabilities and resources while also developing new ones

In contrast, start-ups benefit strategically from younger CVCs, due to higher entrepreneurial freedom, more agility and less overconfidence. Older firms suffer from organizational rigidities, bureaucracy and inferior governance leading to slower processes, obsolet assets and more rent-seeking behavior (Loderer & Waelchli, 2010). The senescence of CVCs leads to a loss of entrepreneurial freedom for start-ups. With age comes an increasing number of bureaucratic processes and policies, which distract both CVC and start-up personnel from their core activities. Second, start-ups are active in new fast-changing markets, where both technology and consumer expectations alter rapidly. As large corporations, like other investors, can not keep up the pace, start-ups suffer strategically from outdated advice and experience. In other words, CVCs fail to understand that what worked well for start-ups yesterday, might be obsolet today. Third, older and experienced CVCs suffer from overconfidence. After only few acquisitions, corporations tend to overestimate their experience, leading to inferior performance (Haleblian & Finkelstein, 1999). Keeping in mind the selection, signaling and treatment effects on financial start-up performance and the impact of bureaucracy, missing agility and overconfidence, it is hypothesized that

H2: More established CVCs support financial, yet impede strategic start-up performance.

CVC leadership

CVC units act as an intermediary between corporations and start-ups (Chesbrough, 2002). Although objectives, structures, processes and policies heavily influence the way CVC acts towards the corporation and the start-up, the personnel plays an essential role as shown in other settings. Literature discusses how the founder of a start-up influences the success of a venture (Delmar & Shane, 2006) or how corporate personnel on start-up boards impact performance (Howard et al., 2017). As the focus of this study is the organization of

the CVC, the focus lies on CVC personnel. Paik and Woo (2017) find that similarities between founder and CVC management leads to beneficial goal congruence and knowledge spillovers. However, more heterogenous teams generally increase the ventures success (Beckman & Burton, 2008). Di Lorenzo and van de Vrande (2019) find that not the knowledge of the investor, but the mobility of inventors matters for ventures to get access to corporate resources, whereas Thomas et al. (2016) detect a tremendous impact of star scientists on venture performance.

This study elaborates on the impact of previous experience of CVC leads before joining a CVC. Due to the CVC's role as intermediary, CVC managers need to balance entrepreneurial mind-set from start-ups with politics inside the corporation (Basu et al., 2016). On the spectrum between corporations and start-ups, CVC leads can either bring previous corporate industry experience or knowledge as start-up founder. Coming from either an industry role or bringing in start-up experience differentiates CVC leads along their mindset and culture, network and capabilities.

It is argued that industry experienced CVC leads are more congruent with corporate goals and culture and therefore act rather conservative and are more number and results driven. In contrast, previous start-up founders are more risk-taking and are driven by a strong believe and good cause, gaining experience and having fun at what they are doing.

Personnel with a start-up background is less driven by monetary aims and job security and more by creating an impact and acting independently and responsibly, leading to a higher innovativeness[78] compared to corporate personnel (Sauermann, 2018). The network of the two different types of CVC leads also differs. Whereas the lead with previous industry

[78] Measured as patent output

experience provides start-ups with a much better access to corporate resources as well as industry customers and suppliers, a CVC lead that was previously a founder grants access to other start-ups, influencers and a broader entrepreneurship ecosystem (Asel et al., 2015). Moreover, the leads' capabilities differ. Asel et al. (2015) state that internal personnel has a better understanding of corporate strategy and organization. In addition, they bring good technical and commercial knowledge and resources needed for start-ups (Pahnke et al., 2015). Thereby, industry experienced CVC leads offer, for example, support regarding IP protection through patents or FDA approval processes and production or commercialization capabilities. Founder experienced CVC leads have stronger capabilities in setting up and organizing small teams, developing functioning processes and assigning roles and responsibilities. Due to their specific knowledge regarding early stage start-ups, founders often leave management when firms grow and the required skill-set changes (Boeker & Karichalil, 2002). Additionally, previous founders are more experienced in decision-making under incomplete information. Through their cultural background, results-orientation, customer and supplier networks and commercialization capabilities, CVC leads with previous industry experience better cater to financial start-up performance. In contrast, CVC personnel with previous founding experience is more risk taking and rather looks at a cause instead of striving for short-term financial success and consequently is more beneficial for a start-up's strategic performance. In short, it is hypothesized that

H3: Previous industry experience of CVC personnel leads to financial start-up performance, whereas previous founder experience of CVC personnel strengthens strategic start-up performance.

III.2.3 Empirical analysis and methodology

III.2.3.1 Descriptive statistics and correlations

Descriptive statistics and pairwise correlations for the main variables are presented in the following Table 6:

Table 6: Descriptive statistics and correlations for CVC (author's dataset)

Variable	Obs	Mean	Std. Dev.	Min	Max	1.	2.	3.	4.	5.	6.
1. Capital raised	210	59.1	122.5	0.0	1,008.0	1					
2. Market access	210	757.6	1,857.1	1	14,355	0.176*	1				
3. Portfolio size	210	46.4	29.1	2	87	0.0302	0.239***	1			
4. Portfolio concentration	210	0.5	0.2	0.3	1.0	0.0182	0.0954	0.106	1		
5. Industry fit (corp. and start-up)	210	0.4	0.5	0	1	0.104	0.0931	0.400***	0.382***	1	
6. CVC experience	210	6.4	4.3	1	17	-0.0271	-0.128	-0.492***	-0.308***	0.0275	1
7. Lead background	210	0.1	0.2	0	1	-0.0368	-0.0300	-0.0454	-0.374***	0.0628	0.548***
8. Employees per start-up	210	0.8	0.6	0	2	-0.0347	-0.0903	-0.170*	-0.215**	-0.396***	-0.314***
9. Spatial distance (CVC and corp.)	210	429.4	1,314.8	0	6,229	-0.0577	-0.0330	-0.0109	0.400***	0.206**	0.0871
10. Corporate partner network	210	0.1	0.1	0	1	-0.00975	0.135	0.276***	0.442***	0.304***	-0.366***
11. Popularity	210	111.8	156.8	0	520	-0.0865	-0.0295	-0.256***	-0.264***	-0.367***	0.224**
12. Financial backing	210	62,955.1	28,869.6	2,812	98,678	-0.0216	0.0259	0.533***	-0.496***	-0.0953	-0.130
13. Start-up employees	210	405.7	3,535.0	2	50,000	0.0205	-0.0119	-0.0295	0.143*	-0.0605	0.0344
14. Start-up age	210	9.4	5.5	1	33	0.235***	0.109	0.144*	-0.0303	0.0517	-0.0243
15. B2B orientation	210	0.8	0.4	0	1	0.0781	-0.0173	0.112	0.0219	0.224**	-0.00199
16. Number of active investors	210	9.8	7.1	1	46	0.366***	0.270***	-0.0120	-0.0590	-0.00821	-0.0222

Variable	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
7. Lead background	1									
8. Employees per start-up	0.0918	1								
9. Spatial distance (CVC and corp.)	-0.157*	0.00833	1							
10. Corporate partner network	-0.187**	-0.233***	-0.0657	1						
11. Popularity	-0.323***	-0.247***	-0.163*	-0.254***	1					
12. Financial backing	0.176*	-0.188**	-0.343***	-0.158*	0.0547	1				
13. Start-up employees	-0.0519	0.00446	0.292***	-0.0370	-0.0533	-0.126	1			
14. Start-up age	0.129	0.00320	-0.0318	-0.000378	-0.139*	0.102	-0.0148	1		
15. B2B orientation	0.204**	-0.0956	0.00152	0.102	-0.171*	0.148*	0.0446	0.159*	1	
16. Number of active investors	-0.0134	-0.0588	-0.130	-0.0399	-0.0187	0.117	-0.0380	-0.0574	0.0104	1

*** p<0.001, ** p<0.01, * p<0.05

The table shows that both financial performance, i.e. capital raised, and strategic performance, i.e. market access, widely differ among start-ups. In average, a start-up raised almost 60m$ and the average website has over 750 referring domains. Both numbers are higher than expected. From the large standard deviation and the high maximum values, one can infer that outliers on the upside have a large impact. Six start-ups in the dataset raised more than 400m$. Only Scout24, a well-known online transaction platform, raised more than 1bn$[79]. Only six start-ups reported more than 5,000 referring domains. Interestingly, five out of these six are under the management of Deutsche Telekom Capital Partners. The two start-ups with the largest market access are ShareThis, a consumer engagement and sharing tool, and AppNexus, a platform that enables real-time trading of digital advertising.

On average, CVCs have around 46 start-ups under management. The smallest with only two start-ups is Mobile Ventures, whereas Deutsche Telekom Capital Partners manages 87 start-ups. The Herfindahl-Hirschman index for portfolio concentration ranges from 0.3 to 1.0 and averages at 0.5. Two CVCs reported values above 0.8, i.e. are rather focused on few industries. From the dummy variable industry fit, one can infer that 40% of the start-ups are active in the same industry as their parent corporation. Given the trend of digitization through which many start-ups are active in the ICT sector and keeping in mind that the sample contains several CVCs active in multiple industries, a matching industry in less than half of the cases is not surprising.

[79] Other start-ups successful in raising money are for example CureVac (a developer of mRNA-molecules designed to fight a large range of diseases under the management of Boehringer Ingelheim that raised more than 700m$), About You (a fashion apparel and accessories platform with investments by Seven Ventures that raised a total of almost 570m$) and Advanced Power (a developer of power generation infrastructure projects with 930m$ capital raised by – among others – Next47).

With regards to CVC experience, the average CVC is 6.4 years old in 2018, meaning that the average CVC was set up in 2011. The oldest is BASF Venture Capital with 17 years. The share of the CVC leads founding experience ranges from 0 to 0.7 and averages at a rather low value of 0.1. This demonstrates that CVC leaders rather have a background in the industry, instead of having founder experience themselves. CVCs operate with 0.3 to 2.0 employees per start-up under management, averaging at 0.8. The spatial distance between the CVC and its parent corporation ranges from 0 to more than 6,000 kilometers. The largest distance is reported by from Merck Ventures, which is located in Darmstadt whereas the Merck headquarters are in New Jersey, USA. A large share of the other CVCs is even in the same city as their corporate parent. On average, a CVC has less than 0.1 external corporate partners per start-up. Several CVCs even have no corporate partner at all, whereas the maximum is at 0.5 corporate partners per start-up. These low numbers hint that corporations do not use CVCs as a networking tool, but rather for bilateral corporation and start-up investments. Similarly, the popularity is rather small ranging from zero to 520 connections per employee. The financial backing of CVC as measured by corporate revenue has an average of 62bn€ and ranges from almost 3bn€ (Drillisch AG) to almost 100bn€ (BMW). Start-ups range from two to 50,000 employees with an average larger than 400. The average number is much higher than expected and influenced by outliers like Alcan Systems with 50,000 employees. In this case, the median of 30 employees is a more meaningful and reasonable number. The average start-up has an age of nine years, ranging from merely one year up to 33 years in the case of Locanis. As expected based on the corporations included in the sample and in line with the German industry landscape, the majority of start-ups, more precisely 80% are active in the business-to-business sphere. Finally, start-ups have in average almost ten active investors, ranging from only one to up to 46 in the case of Life360, a

provider of a location smartphone application. With regards to correlations between the variables, especially CVC experience and financial backing show notable correlations. An older CVC is negatively correlated with portfolio size as more experienced CVCs seem to perform more targeted investments. Interestingly, a positive correlation exists with the CVC experience and the leads previous founder practice. As expected, a larger financial power is positively correlated with an increasing portfolio size and portfolio diversity. No specifically strong positive correlation between (financial and strategic) performance variables and start-up age or employees is detected.

III.2.3.2 Methodological approach and robustness

Methodology

In order to empirically analyze the hypotheses developed above, this study examines a multi-level dataset containing information on (i) the corporate venture capital fund, (ii) the start-ups in which the CVC invested and (iii) the corporate parent. Taking the performance of start-ups as outcome variable, this study elaborates on the efficacy of corporate venture capital funds and distinguishes them by several strategic and organizational dimensions, as outlined by the following regression formula:

$$y_i = \beta_0 + \beta_1 PS_j + \beta_2 PC_j + \beta_3 IF_{ij} + \beta_4 CE_j + \beta_5 LB_j + \beta_6 VE_j + \beta_7 SD_j + \beta_8 CP_j + \beta_9 VP_j + \beta_{10} FB_j + \beta_{11} SE_i + \beta_{12} SA_i + \beta_{13} BB_i + \beta_{14} AI_i + \varepsilon$$

where i describes the i-th start-up, whereas j refers to the j-th corporate venture capital. As introduced by Chesbrough (2002), performance of corporate venture capital needs to be distinguished by a financial and a strategic indicator. Therefore, two models are run where y_i is defined as financial performance, i.e. capital raised or strategic performance, i.e. market

access, respectively. Although the model is seemingly described by a large number of independent variables, four key areas emerge: First, the start-up portfolio is considered along its size (PS) concentration (PC) and strategic fit (IF). Second, the experience of the CVC (CE) and the background of the CVC leadership team (LB) is of interest. Additional variables on CVC governance, like CVC employees per start-up (VE), spatial distance (SD), corporate partners (CP) and popularity (VP) are included. In addition, the models control for corporate financial backing (FB) and the start-up characteristics number of employees (SE), age (SA), differentiation between business-to-business and business-to-consumer orientation (BB) and number of active investors (AI).

Capital raised describes the dollar amount raised by a start-up as continuous variable. All observations are larger than zero and a right-skewness with a mean of 60m$ and a median of less than 20m$ is detected. Accordingly, a Poisson, Tobit or negative binomial distribution can be applied. Market access is described by a right-skewed count variable with a minimum of 1. In line with Nichols' (2010) finding that Poisson is generally preferable for nonnegative skewed dependent variables and can not only be applied for count but also continuous variables, Poisson regressions are preferably used to model both the financial and the strategic performance of start-ups. As presented in Appendix A Table 17, multiple other approaches, like ordinary-least square on logarithms, Tobit and negative binomial regressions were tested, with Poisson regressions yielding the highest explanatory power.

Robustness

Multiple tests are performed to ensure the robustness of the models presented. The main results are robust and inconspicuous to tests regarding multicollinearity or outlier exclusion. A variance inflation factor (VIF) analysis is performed on ordinary-least square

models to test for multicollinearity. Finding a maximum VIF of 7.2 and 7.7 for the financial and strategic model respectively, and keeping in mind that "a maximum VIF value in excess of 10 is frequently taken as an indication that multicollinearity" (Kutner, Nachtsheim, Neter, & Li, 2004, p. 409) exists, the models presented do not suffer from multicollinearity.

Specific attention is given to the number of observations included in the empirical analysis. A complete case analysis is performed first, based on N=210 observations. As discussed in the descriptive statistics section, outliers influence the reported averages. Therefore, a note of caution is required. On the one hand outliers are excluded as specifically requested by Drover et al. (2017). On the other hand, models with all available information beyond complete case analysis need to be checked. Outliers are detected for the three start-up variables age, number of employees and active investors. Using graphical methods, outliers are visually identified from boxplots. In addition, outliers are defined statistically as observations that are more than three times the standard deviation around the mean. Robustness tests are based on statistical methods as this approach proved more rigid in all cases, labeling more observations as outliers. Table 18 in Appendix A compares the models including all available observations with those of the complete case analysis and those excluding outliers. Only minor differences in the results are detected. Most importantly, the significance of the effect of both the corporation and the start-up being active in the same industry is reduced when considering financial start-up performance. Similar effects are detected for the number of CVC employees per start-up.

Being aware of the effects of excluding outliers, a further robustness check is performed. The dataset on hand suffers – as regularly observed for start-up data – from missing values. For example, some start-ups do not report their number of employees and

some CVC leads are hesitant to publicly share their previous experience. Therefore, multiple imputations are performed as initially proposed by Rubin (1978). Congenial multiple imputations are conducted for variables with missing data[80]: lead background (2 imputed observations), CVC employees per start-up (7 imputed observations), popularity (7 imputed observations), financial backing (28 imputed observations), start-up employees (27 imputed observations) and start-up age (1 imputed observation). Only variables also included in the final regression models are used to impute missing observations. Moreover, variable-specific regression techniques are applied, for example Poisson for the non-negative count variable start-up employees. As multiple dependent variables suffer from missing data and are imputed, chained imputations are required. Although the dataset on hand also suffers from missing values for the two variables capital raised and market access, no imputations are performed for these dependent variables as "multiple imputation of the dependent variable, however, tends to gain you little or nothing" (Williams, 2015, p. 7). As a consequence, a dataset with N=267 observations emerges[81]. Table 19 in Appendix A reports the Poisson regressions including the imputed data and a complete case imputation, where some variables show some limited robustness. However, there are shortcomings and explanatory uncertainty of imputed estimates. As the regressions including all possible observations and those excluding outliers yield similar results to the complete case analysis, especially for the variables of interest, the statistical models are robust and inconspicuous. Therefore, the complete case model is discussed in the following results section.

[80] The number of imputed observations refers to the complete case imputations
[81] If a non-complete-case analysis would be performed for each of the two dependent variables independently, N=325 for the financial dependent variable and N=336 for the strategic dependent variable

III.2.4 Results

The results of the empirical analysis are presented in Table 7:

Table 7: Complete case Poisson regression results (author's dataset)

Dependent variables Independent variables	**Poisson Financial** Capital raised	**Poisson Strategic** Market access
Portfolio size	0.017***	0.044***
	(0.001)	(0.000)
Portfolio concentration	-0.910***	-0.469***
	(0.095)	(0.046)
Industry fit (corp. and start-up)	0.005	-0.495***
	(0.029)	(0.007)
CVC experience	0.067***	-0.112***
	(0.008)	(0.002)
Lead background	-2.083***	3.716***
	(0.127)	(0.034)
Employees per start-up	-0.200***	-0.635***
	(0.047)	(0.014)
Spatial distance (CVC and corp.)	-0.000***	-0.000***
	(0.000)	(0.000)
Corporate partner network	-6.653***	-2.764***
	(0.511)	(0.159)
Popularity	-0.002***	0.003***
	(0.000)	(0.000)
Financial backing	-0.000***	-0.000***
	(0.000)	(0.000)
Start-up employees	0.000***	-0.000***
	(0.000)	(0.000)
Start-up age	0.073***	0.042***
	(0.002)	(0.000)
B2B orientation	0.669***	-0.154***
	(0.036)	(0.008)
Number of active investors	0.066***	0.082***
	(0.001)	(0.000)
Constant	3.227***	6.481***
	(0.178)	(0.061)
Observations	210	210
Pseudo R^2	0.384	0.438

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05

The efficacy of corporate venture capital is assessed through the performance of start-ups under management of a CVC. Two distinct measures of start-up performance are applied. The first model presents the financial performance through measuring its ability to raise external funding. The second model uses a start-up's market access to determine its strategic success. The results demonstrate that multiple dimensions of both strategic direction and organizational design impact the financial and strategic performance of start-ups. Whereas some, especially an increase in portfolio size, support both financial and strategic performances, others, like an increasing number of CVC employees per start-up or larger corporate partner network, negatively impact a start-ups ability to raise capital or gain market access. Some variables show a differing impact on financial and strategic start-up performance, respectively, like CVC experience or the background of the CVC lead.

The results support hypothesis 1) that large portfolios enhance the financial and strategic performance of start-ups, whereas portfolio concentration and industry fit have a negative relationship with financial and strategic start-up performance. An increasing portfolio size improves the ability to raise money and the access to market. Moreover, portfolio concentration has a negative relation with start-up performance. Start-ups benefit most from a broad portfolio as they thereby enjoy the advantage of not being one of many similar portfolio firms in a harsh competitive environment, but benefiting from complementary instead, leading to economies of scope. Moreover, negative effects are observed, especially on strategic performance, if the start-up portfolio is similar to the corporation, i.e. if the start-ups are active in the same industry as the corporate parent.

For both the CVC's experience and the CVC lead's background trade-offs between financial and strategic start-up performance emerge. A younger CVC led by a CVC manager

with previous founding experience enhances a start-up's strategic performance. In contrast, an older CVC headed by an industry focused management team triggers financial performance. Therefore, both hypothesis 2) and 3) are supported.

In addition, the empirical results offer further intriguing insights. First, an increasing oversight of start-ups through CVC, modelled through the number of CVC employees per start-up reduces financial and strategic start-up performance. The empirical analyses indicate that spatial distance between the corporation and the CVC does not matter. In other words, no effect on start-up performance emerges. Therefore, it seems indifferent whether CVCs are physically located at corporate headquarters or somewhere else, for example in start-up hubs. The results of both models indicate that start-ups benefit both financially and strategically from more focused CVCs. Too many corporate partners lead to unclear and potentially contradicting guidance. The results show that popularity of the CVC in social networks hardly matters for start-up performance. As expected, existing social networks support the market access of start-ups. However, the magnitude is small. In contrast, the effect of popularity on financial start-up performance is small, yet significantly negative.

Moreover, several further aspects are controlled for. First, the financial backing of the CVC has a significant yet small impact on start-up performance. Second, it is controlled for several start-up characteristics. As expected, start-up age, start-up employees and the number of active investors influences a start-up's performance. The control for a start-up being active in either the business-to-business or business-to-consumer space is specifically used for the strategic performance variable. Being active in the consumer space increases, as expected, the market access. For reasons of completeness, marginal effects are presented in Appendix A Table 20.

III.2.5 Discussion

III.2.5.1 Contribution and implications

The empirical analysis finds support that CVC programs need to trade off positive and negative effects they have on start-up performance, requiring a careful determination of a CVC's strategy and organization. This work detects that trade-offs are especially present for the CVC experience and the background of CVC leads as CVC experience enhances financial yet reduces strategic start-up performance and CVC leads with previous start-up experience have a negative effect on financial and a positive effect on strategic start-up performance. Clear recommendations can also be derived, especially regarding the start-up portfolio. The empirical analysis finds support that start-ups benefit from a diverse portfolio and a limited strategic fit between a corporation and a start-up, whereas negative effects are detected for CVC investments of corporations of the same industry, impeding especially strategic performance through misappropriation of start-up technologies and ideas. In contrast to Belderbos et al. (2018) who find a negative effect of portfolio size and Lee et al. (2015) who find an inverted U-shape relationship for number of investments and level of knowledge transfer, the study on hand detects a positive relationship between portfolio size and start-up performance. Therefore, the results are similar to the findings of Benson and Ziedonis (2009) who argue that a large portfolio size increases the CVC's experience and thereby has a positive effect on start-up performance. Moreover, the so-called shark's dilemma which describes the risk of misappropriation of a start-ups technology and capabilities through corporations (Katila et al., 2008) finds support. Too much similarity between a start-up and a corporation promotes dependency, leading to a hold-up problem and threatening start-up performance. Strategically, potential start-up customers – which are

often active in similar markets as the start-up's parent corporation – are reluctant to collaborate with a start-up that is closely related to their direct competitor.

The rationale for the findings is manifold. First, an increase in portfolio size reduces the intensity of interference of the CVC with the start-up. Therefore, start-ups gain access to needed corporate resources, but still can 'do their own thing'. Interestingly, this finding is supported by the negative sign for employees per start-up. The less CVC employees oversee one start-up, the more entrepreneurial freedom for the venture team remains. Second, a large portfolio of start-ups allows for network and spillover effects among the start-ups. Not only can they learn from each other's experiences, but they also share a stronger negotiation power towards the CVC and the corporation. For example, a large group of start-ups might have more influence on overarching CVC guidelines than only a handful of start-ups would have. In a similar vein, a large portfolio of start-ups will help the CVC to position itself more prominently within the corporation, e.g. towards other innovation units like the R&D department. For example, CVCs can get additional funding for trainings or infrastructure that benefits all start-ups.

The results contribute to existing literature in multiple ways. The main contribution is to empirically explain how the strategic direction and organizational design of CVC funds support start-up performance. This work contributes through challenging and extending the work of previous studies. Thereby, a more holistic picture of how the strategic direction and organizational design of CVCs impact start-up performance emerges, deepening the understanding of a phenomenon relevant for many corporations. The study on hand contributes through extending existing literature that compares CVC-managed start-ups with start-ups under the management of independent or governmental venture capital funds

(Bertoni, Colombo, & Grilli, 2013; Colombo & Murtinu, 2017; Drover et al., 2017) or start-ups without any venture capital investment (Allen & Hevert, 2007; Alvarez-Garrido & Dushnitsky, 2016). Moreover, literature on specific areas of CVC investments, like industry overlaps (e.g. Dushnitsky & Shaver, 2009), venture board representation (e.g. Howard et al., 2017), or portfolio size (e.g. Belderbos et al., 2018) is extended. Also, the findings on the background of CVC leads amend existing literature. Weber and Weber (2002) argue that company-internal experience and networks enable sufficient corporate support for start-ups and help to ensure that start-ups act in the interest of the corporation. Dokko and Gaba (2012) find a positive effect of previous venture capital experience for financial and a negative effect for strategic orientations and the opposite effect for previous engineering experience. This study largely agrees with these scholars and asks what kind of previous experience of CVC personnel is specifically beneficial for start-ups. Generally, previous founding experience can be easily replicated (Shane & Khurana, 2003), explaining the positive effect of previous founder experience on strategic start-up performance. However, founding experience needs to be balanced with corporate and industry experience, such that the CVC lead understands both the start-up and the corporate politics (Basu et al., 2016). Comparing previous founding experience with previous industry experience, the study on hand finds contradicting results based on whether financial or strategic start-up performance is pursued, namely a negative (positive) impact of a larger share of founder experience over industry experience for financial (strategic) start-up performance.

The second contribution is the extension of regional discussions. Light is specifically shed on CVC activities in Germany, which is – besides selected studies on CVCs (Ernst et al., 2005; Maxin, 2018; Weber & Weber, 2003) – an under-researched country. Thereby, this

study contributes to the existing CVC literature through giving insights on a previously under-researched country, whereas most studies are US-focused.

Third, the results offer useful insights for practitioners from both corporations and start-ups. As policy implication, practitioners are recommended to consult this work when setting up or re-organizing corporate venture capital vehicles. Superior organizational design can be ensured and staffing decisions made when the findings detected in this section are followed. Moreover, practitioners can make educated decisions in case of trade-offs, knowing the implications on both financial and strategic start-up performance. Start-ups can review potential CVC investors more critically, taking into account implications from CVC characteristics. For example, start-ups aiming at high financial proceeds can deliberately choose more established CVCs led by industry-experienced personnel.

III.2.5.2 Limitations and further research

Despite the new insights gained through this study, this work does not come without limitations and avenues for future research. First, limitations regarding geographical diversity and cyclical nature of CVC investments that are widely spread in research occur (Röhm, 2018). Critical to the generalizability of this study's findings is the geographical focus on Germany. Although this helps to mitigate country-specific effects, e.g. from cultural and regulatory differences (Block, Colombo, Cumming, & Vismara, 2018), it remains unclear, whether the governance of CVC in different countries has the same effect on start-up performance. Therefore, it is recommended to replicate this study on a larger cross-country dataset including countries with prospering venture capital and start-up environments, especially the US. CVCs often operate offices in different countries. For example, Siemens' Next47 has representations in Beijing, Boston, Israel, London, Munich, Palo Alto, Paris and

Stockholm. The differentiation between office-specific CVC governance and start-up portfolios will help to gain further insights on geographical implications. CVC investments are of cyclical nature (Bielesch et al., 2012). During different times, various governance designs of CVCs might be beneficial. For example, the raise of digital communication tools significantly changed the way of how corporates and start-ups collaborate. Therefore, the findings of this study are limited to the current wave, without any possible derivations for previous or future waves. A further limitation in the field of venture capital research is the separation of selection (CVC selection of start-ups, as well as start-up acceptance of CVCs) and nurturing effects.

Second, study-specific limitations emerge, opening avenues for future research. Although the number of observations is sufficient for meticulous empirical research, a larger dataset would be beneficial, as it will enhance the robustness of results. Additionally, the choice of empirical variables needs to be critically reviewed, as no satisfying variable for strategic performance exists in literature so far. For future work, combining quantitative and qualitative research is recommended. Through performing surveys and interviews with corporate, CVC and start-up personnel, the dataset can be enriched. For example, the priority of a CVC compared to other corporate innovation vehicles, the financial budget of a CVC, the remuneration and incentive scheme of CVC personnel and the existence of formal and informal ties between the corporation and the CVC, the CVC and the start-up as well as corporate experts and the start-up can be taken into consideration. Additionally, future research should incorporate the firm's perspective (Drover et al., 2017). First, scholars should elaborate on the implications of CVC governance on corporate performance, considering corporate objectives like financial return, innovation benefits and image effects. Secondly, a CVC governance that sufficiently balances the needs of the corporation and the start-up

should be detected. Moreover, deep-dives on specific aspects of CVC governance are recommended, especially regarding personnel and human resources (Drover et al., 2017). Finally, comparing the governance of CVC with the design of other corporate venturing units, like corporate incubators or the new phenomenon of corporate accelerators, will help to further deepen the understanding of how CVC governance impacts performance.

III.2.6 Summary and conclusion

The analysis reveals that the strategic direction and organizational design of CVC impacts start-up performance, both financially and strategically. This work adds to the existing, yet contradicting and limited literature on CVC governance. A dataset of 210 start-ups under the management of 21 different CVCs is used, investigating specifically the effects of a CVC's portfolio, including its size, diversity and fit, a CVC's experience and age and the background of a CVC's leadership team. The results corroborate that start-ups benefit both financially and strategically from large and diverse CVC portfolios. A large portfolio reduces the interference of the CVC with an individual start-up and allows for network and spillover effects among start-ups. A high diversity is beneficial for start-ups as it reduces direct competition but allows for mutual learning and creative input from peers. This work finds that a CVC's experience has a positive effect on financial, yet a negative effect on strategic start-up performance. Other investors value a long track record of the CVC and start-ups might get access to previously CVC-managed start-ups that successfully completed an IPO and act as informal mentor. Strategically, however, start-ups suffer from bureaucratic and rigid CVC structures or unsupportive mindsets. Similar results are obtained for the CVC leads' background. Whereas leads with industry background support financial start-up

performance through their industry and technology expertise and a deep understanding of market requirements, leads with start-up experience help young ventures strategically through addressing general start-up issues, for example through mentoring in business plan or pitch deck preparations, and through offering access to a broader start-up ecosystem. These trade-offs need to be considered when setting up CVC programs or when start-ups must decide on a collaboration with two heterogenous CVC funds.

III.3 An empirical differentiation of CVC and corporate accelerator

III.3.1 Introduction

As outlined before, CVC is an established form of corporate venturing and corporate start-up collaboration. Historically, the investment of DuPont in General Motors in 1914 can be seen as first CVC investment, although the raise of CVC began in the 1960s (Chesbrough, 2000; Dushnitsky, 2011). Corporations across industries and geographies set up CVC units, with Google, Intel, Salesforce and Baidu running the most active ones in 2018, leading to prominent examples of CVC and start-up collaborations including Google and AirBnB, GlaxoSmithKline and Amgen Biotech, Coca-Cola and Spotify or In-Q-Tel[82] and Facebook.

Corporate accelerators (CA), in contrast, are a rather new yet vastly growing form of corporate venturing. Citrix Accelerator, the oldest corporate accelerator was only founded in 2010. Nowadays, notable firms like AT&T, Microsoft or Walt Disney operate CAs (Colombo et al., 2018, p. 191; Shepherd & Shankar, 2017).

Practical examples show that firms differ in their application of the two corporate venturing forms. Whereas some firms, like BASF, only operate CVCs, other firms, including GE and Microsoft operate both a CVC and a CA, or, as in the case of Google's parent holding Alphabet or IBM, even multiple CVCs and CAs[83]. Moreover, start-ups might be, often with a timely delay, supported by both a CA and a CVC of the same corporation. For example, Zizoo, a provider of boat rental services, was under the management of both Axel Springer Digital Ventures (CVC) and Axel Springer Plug and Play Accelerator (CA).

[82] In-Q-Tel is the CVC arm of the US Central Intelligence Agency (CIA)
[83] Google: CVCs (GV, CapitalG, Gradient Ventures), CAs (Launchpad Accelerator); IBM: CVCs (IBM Venture Capital Group), CAs (IBM Alpha Zone, IBM Blockchain Accelerator)

Being aware of the two forms of corporate venturing the question occurs whether, and if so how, the two forms differ or whether the new phenomenon of CA is merely old wine in new bottles. Additionally, one might ask whether CVC will be completely replaced by CA. From literature, it becomes obvious that both similarities and differences between CVC and CA exist. However, due to the newness of the CA phenomenon no empirical comparison of the two forms exists so far. Therefore, this work aims at shedding more light on the differences between CVC and CA, the start-ups under management and the implications of the two forms on start-up performance.

The empirical work of this section is based on a dataset covering 21 CVCs with 210 start-ups and 15 CAs with 132 start-ups. The results suggest that the two forms differ regarding their key characteristics, start-ups under management and performance effects. More precisely, CVCs collaborate with older and more established start-ups with strategic proximity, whereas CAs engage with young start-ups across industries. CVCs have larger effects on start-up performance than CAs, even when controlling for the development stage of the start-up.

This study is structured as follows: In section III.3.2, corporate venturing (CV) vehicles, especially CVCs and CAs are described and literature comparing different forms of CV vehicles is reviewed. Third, theoretical arguments for the differences of CVCs and CAs and their respective implications on start-up performance are derived in section III.3.3. Fourth, the applied multi-step methodology is explained. The results of the empirical models are presented in section III.3.5 and their implications and contributions are discussed. Lastly, the limitations of this study and avenues for future research are summarized.

III.3.2 Literature review and theoretical background

Nowadays, corporations operate in a fast-paced highly competitive environment. One predestined way for firms to stay ahead of competition is innovation. Already Schumpeter (1934, p. 133, 1943, p. 83), found that innovation is a prerequisite for firms to generate profits. This finding is supported by empirical work, detecting a return premium of innovative firms above their competitors of 6.7% in Americas or even 14% in Asia (Brigl et al., 2014). Multiple sources of innovation exist, including firm-internal innovation, innovation initiated by market and industry changes, process needs, incongruities or even unexpected events, or externally stimulated innovation from the broader social environment, initiated by demographic change, perceptional changes or new technologies and knowledge (Drucker, 2002). In literature, the collaboration of corporations with external organizations for innovation purposes is described as open innovation (Gallouj & Djellal, 2018, p. 4). Firms partner with organizations along the entire value chain, including suppliers, universities, research institutes, competitors, customers and consumers. Moreover, established corporations use start-ups as source of innovation (Schildt et al., 2005), aiming at getting access to new ideas and technologies, a large talent pool and learning from a more agile and risk-taking culture.

Such start-ups are young entrepreneurial enterprises that often have an idea or technological advancement, but lack resources to detail out the idea, build a prototype or enter a market. Therefore, they require funding, mentoring, talent, production assets or R&D facilities, a network of suppliers, customers and experts and above all financing (Dushnitsky & Lenox, 2005; Radcliffe & Lehot, 2018).

A collaboration between a corporation and a start-up helps both parties to pursue their objectives and satisfy their needs (e.g. Alvarez-Garrido & Dushnitsky, 2016; Anokhin, Wincent, et al., 2016; Chemmanur et al., 2014; Hallen et al., 2017). In literature, such collaborations are summarized under the umbrella of corporate venturing, describing "investments that facilitate the founding and/ or growth of external businesses" (Covin & Miles, 2007, p. 183) and including alliances, joint ventures, merger and acquisitions and collaborations between corporations and start-ups (e.g. Dushnitsky & Lavie, 2010; Fenwick & Vermeulen, 2016; Keil, 2000; Keil et al., 2008; Van De Vrande & Vanhaverbeke, 2013). Each form of corporate venturing comes with specific advantages and disadvantages. Therefore, corporations need to ask themselves "how and why should they organize their corporate venturing activities?" (Drover et al., 2017, p. 1841). Once a collaboration with start-ups is chosen as preferred way, executives must determine what vehicle to use for start-up collaborations. Corporations can choose from different forms including corporate venture capital (CVC), corporate accelerator (CA) and corporate incubator (CI). In addition, less formal and structured forms of interaction are applied. The key characteristics of these corporate venturing vehicles are summarized in Table 8:

Table 8: CV vehicles for start-up collaborations (author's compilation)

	Objective	Description	Examples
Corporate Venture Capital	Financial return, strategic advantage (e.g. technology)	• Equity investment (up to 20%) over several years (5-7) and often multiple funding rounds • Investment in established fast-growing existing small companies with high potential • Often close collaboration with business units, assumptions of board seats, sharing of patents and complementary assets	• BMW iVentures • Renault, Nissan, Mitsubishi Alliance Venture • Alphabet GV
Corporate Accelerator	Rapid screening of large number of start-ups and search for highly qualified personnel and innovative ideas	• Structured 3-4 months accelerating program for larger batches of early stage start-ups • Small founding of around 25k$ for small (<10%) or no equity stake • Often mentoring, network access, office space, public relations • Limited interaction with business units • Also support of ideas unrelated to core business of the corporation • Ownership up to 25%, timeframe 1-3 years	• Microsoft Ventures Accelerator • Telekom hub:raum • Axel Springers Plug'n'Play
Corporate Incubator	Development and support of (internal) innovative ideas	• Offer mentoring, coaching, network access, office space, hardware and infrastructure • Often, yet not always external experts/ team are used to execute on internal ideas • Support of ideas related to core business	• Merck Innovation Center • ATT Foundry • LinkedIn [in]cubator
Other less structured forms	Access to early stage start-ups, bringing together of innovative entrepreneurs, creation of positive image for corporation in start-up sphere	• Pure sharing of resources, e.g. co-working spaces • Internal/ external hackathons • Challenges/ contests for specific problem-statements • Scouting missions, innovation platforms or venture clients, digital labs	• Facebook Hackathon • AT&T Developer Summit Hackathon • Unilever Foundry

In recent studies, Drover et al. (2017) urge for a comparison of CVC, IVC and angel investments with the more recent phenomena of crowdfunding and accelerators, whereas Colombo et al. (2018, p. 192) recommend CVC and CA as unit for empirical comparison. Following these authors, the work on hand is limited to a comparison of CVC and CA[84].

[84] For the interested reader Sarwono and Trisetyarso (2017) offer a systematic literature review of incubators and among others Cohen (2013) and Drover et al. (2017) for a comparison of incubators and accelerators

The phenomenon of corporate venture capital

Historically, four waves of CVC investments are observed, namely from 1960 to 1977, from 1978 to 1994, from 1995 to 2001 and since 2002 (Bielesch et al., 2012; CBInsights, 2017c; Chesbrough, 2000; Dushnitsky, 2011). Within the four waves, CVCs differ by their objective[85], strategic direction and motivation. Nonetheless, the waves have in common that they are started by economic and technological enhancements and ended by exogeneous market shocks (Gompers & Lerner, 2000). The first wave was driven by corporate diversification attempts, trying to circumvent antitrust litigations and a high availability of cash and came to an end through the 1973 stock market crash and an introduction of a capital gains tax in the US (CBInsights, 2017c). The second wave was motivated by the emergence of the personal computer and an increase in entrepreneurial activities, especially in the Silicon Valley. During that time, the phenomenon of CVC started spreading internationally, especially in Japan. The fact that corporations failed to take into account start-up objectives and the stock market crash in 1987 brought the wave to an end (CBInsights, 2017c). The third wave of CVC was heavily fueled by the Dotcom bubble and was initiated by the 1995IPO of Netscape. This wave was subject to high expectations but came to a sudden end with the Dotcom bubble bursting. In consequence, many companies suffered from immense write-downs of CVC investments (CBInsights, 2017c)[86]. The most recent wave started in 2002 with a large uptick from 2011 to 2014, strongly driven by digital and mobile technologies and solutions (Bielesch et al., 2012) in almost every industry, changing the way of corporate innovation and venturing fundamentally (Christofidis &

[85] Whereas 83% of CVCs pursued only strategic goals in 1996, only 42% did so beginning of this century (Weber & Weber, 2002)

[86] For example, Microsoft had write-downs on its start-ups under management of 5.7bn$ in 2001

Debande, 2001) and a high availability of cash at low interest rates since the financial crisis (CBInsights, 2017c).

Due to a large interest from practitioners and its long history, the phenomenon of CVC is well defined in literature. Most scholars follow the definition of Gompers and Lerner (1998, p. 21) describing CVC as minority equity investments by established firms in private entrepreneurial ventures (e.g. Benson & Ziedonis, 2009; Dushnitsky & Lenox, 2005, 2006; Dushnitsky & Shapira, 2010; Pahnke et al., 2015; H. D. Park & Steensma, 2012; J. H. Park & Bae, 2018; S. W. Smith & Shah, 2013; Souitaris & Zerbinati, 2014; Wadhwa & Kotha, 2006; Wadhwa et al., 2016; Yang et al., 2014). Moreover, it is broadly established that corporations use CVC for financial and strategic reasons (Chesbrough, 2002; Dushnitsky & Lenox, 2006; Siegel et al., 1988). Financially, corporations expect a high return on investment, whereas the strategic goal is to amend internal R&D attempts through external innovation (Siegel et al., 1988). Through investing in start-ups, CVC opens a window on technology (Benson & Ziedonis, 2009; Dushnitsky & Lenox, 2006) and get access to external experts and ideas (Dushnitsky & Lenox, 2005; Ernst et al., 2005; Siegel et al., 1988). Collaborating with start-ups allows for operating synergies (Hellmann, 2002), opens up new markets for corporate products (Anokhin, Wincent, et al., 2016) and thereby supports the overall corporate business (Sykes, 1990). Lastly, corporate personnel adapts a more entrepreneurial mindset and culture from start-ups (Ernst et al., 2005). Clearly, CVCs pursue both financial and strategic goals in parallel. Whereas some researchers stress the dominance of financial objectives (Siegel et al., 1988), others argue that the financial performance of CVC investments is limited, whereas the strategic effects are predominant (Dushnitsky & Lenox, 2006).

The phenomenon of corporate accelerators

Accelerators in general are a recent yet increasingly occurring phenomenon. For example, Y Combinator, the first accelerator was only founded in 2005 and accelerators are the most rapidly growing institution in entrepreneurial ecosystems (Drori & Wright, 2018, p. 2). The latest Global Accelerator Report estimates a total number of 3,000 accelerators worldwide, of which 52% are expected to be owned or funded by corporations (Gust, 2016).

Corporate accelerators are – as indicated by the name – accelerators that are owned by corporations, with a structure similar to that of seed accelerators (Richter, Jackson, & Schildhauer, 2018). Historically, accelerators developed out of less successful incubators after the Dotcom burst (Ceaușu, Marquardt, Irmer, & Gotesman, 2017; Pauwels, Clarysse, Wright, & van Hove, 2016). However, especially a different use of equity financing, a shorter investment timeframe and different objectives distinct accelerators from incubators (Cohen, 2013; Drover et al., 2017). Due to the newness of the phenomenon, literature is limited with the first scientific paper on accelerators in general dating back to 2012 (Hoffman & Radojevich-Kelley, 2012) and specifically on corporate accelerators back to 2015 (Weiblen & Chesbrough, 2015)[87].

As the phenomenon is new and the literature limited, no precise and broadly accepted definition emerged yet (Colombo et al., 2018, p. 190; Pauwels et al., 2016; Richter et al., 2018). Most recently, the definition of Cohen and Hochberg that accelerators offer "a fixed-term, cohort-based program, including mentorship and educational components, that culminates in a public pitch event or demo-day" (2014, p. 4) finds broad consensus[88].

[87] The authors discuss different forms of accelerators including CAs
[88] A more extensive definition of accelerators is available from Drori and Wright (2018, p. 2)

According to Cohen (2013), accelerator programs have a duration of three months and only two cohorts or batches a year[89] consisting of early stage start-ups. Some accelerators invest up to 5% equity in start-ups, whereas the majority provides capital without assuming any equity ownership (Brigl et al., 2014). However, in order to simplify and intensify collaboration and mentoring, co-working spaces are offered in almost all cases (Fishback, Gulbranson, Litan, Mitchell, & Porzig, 2007).

Corporations use accelerators to get access to promising ideas, business models or technological advances, however, they also aim at recruiting qualified personnel and learning from a more agile start-up culture (Cohen, 2013; Dempwolf, Auer, & D'Ippolito, 2014; Hochberg, 2016; Sauermann, 2018). Corporations obtain a window on technology, future innovations and talents and thereby aim at much more than only financial return (Cohen & Hochberg, 2014).

The main contribution of accelerators for start-ups is non-financial. Accelerators play a crucial role in the education of ventures (Goswami, Mitchell, & Bhagavatula, 2018), mainly provided through (corporate) mentors (Cohen, 2013; Cohen & Hochberg, 2014), in form of guest speakers and lectures and one-on-one coaching with (corporate) experts. Especially in the case of corporate accelerators, start-ups also benefit from access to a broader network covering industry and technology experts, suppliers and potential customers (Fishback et al., 2007). Accelerators support start-ups with regards to both business optimization and technological improvements, like enhanced product development (Uhm, Sung, & Park, 2018).

[89] A cohort or batch describes a group of start-ups that jointly go through the acceleration program

So far, little empirical research on the performance of CAs is available. Although the short timeframe makes performance implications questionable (Dempwolf et al., 2014; Hochberg, 2016), “it may speed up the cycle of the venture - leading to quicker growth or quicker failure” (Cohen, 2013, p. 21).

Existing comparisons of CVC and CA with similar vehicles

Comparisons of CVC with other forms of start-up support vehicles exist in literature. Many studies compare CVC to venture capital firms with different owners, especially independent venture capitals (IVCs), government-owned venture capitals (GVCs) or venture capital funds owned by financial institutions (financial VCs). The phenomenon of CA, however, is too recent to allow for empirical literature comparing it to similar vehicles. Therefore, the following Table 9 summarizes studies that compare CVC with other forms of venture capital in alphabetical order:

Table 9: Comparisons of CVC to other forms of venture capital (author's compilation)

References	Units of comparison	Outcome variable of interest	Focus of comparison	Key findings
(Bengtsson & Wang, 2010)	CVC, IVC, GVC, financial VC	Start-up – VC preferences	Independent and dependent VCs	Start-ups favor independent VCs, start-ups can identify VCs with better track record but do not prefer them over other VCs
(Bertoni et al., 2013)	CVC, IVC	Start-up – Sales and employment growth	Investment objective and organization	IVCs with larger effect on start-up sales growth than CVCs, no difference regarding employment growth as IVCs need to signal more success to raise further funds
(Bjørgum & Sørheim, 2015)	CVC, IVC, business angels	Start-up – Value added (business and technology development, investor outreach, legitimacy)	Contribution of investor (e.g. management support, network access, technology/ business expertise)	CVCs especially increase legitimacy of start-ups
(Chemmanur et al., 2014)	CVC, IVC	Start-up – Innovation (patents) and profitability	Ownership, investment horizon, (compensation of) personnel	Technological fit with CVC boosts start-up's innovative performance
(Colombo & Murtinu, 2017)	CVC, IVC	Start-up – Economic performance (sales, fixed assets, labor costs; short- and long-term)	CVC, IVC, syndication of CVC and IVC	Both CVC and IVC improve start-up performance, no impact of syndication
(Dushnitsky & Shapira, 2010)	CVC, IVC	VC – Investment stage and syndicate size	Compensation of personnel and managerial actions	Performance differences between CVC and IVC exist and are sensitive to CVC compensation
(Hill et al., 2009)	CVC, IVC	VC – Financial and strategic performance, survival	Incentives, organization, syndication, staging, specialization	IVC elements (high incentives, autonomous organization, syndication, staging and specialization) lead to higher CVC performance
(Maula et al., 2006)	CVC, IVC	Start-ups – Value add (social capital and knowledge)	Origin and consequences of CVC and IVC investors	CVCs help building commercial credibility and developing technology; IVCs support in raising capital, hiring key employees and improving organization; both CVC and IVC value adds are complementary
(Pahnke et al., 2015)	CVC, IVC, GVC	Start-up – Innovation performance (patents)	Institutional logic (norms, structure, practices)	CVCs are less effective than IVCs due to their constraining institutional logic
(H. D. Park & Steensma, 2013)	CVC, IVC	VC – Selection of investment targets	Preferences, resources, influence in syndications	CVCs fund more innovative start-ups, CVC-backed start-ups are more innovative
(X. A. Wang & Wan, 2013)	CVC, IVC	Start-up – IPO underpricing	Ownership form, financial and strategic orientation	IVC positively associated with underpricing, CVC negatively

CVC is predominantly compared to IVC, especially regarding its effect on start-up performance (Bertoni et al., 2013; Bjørgum & Sørheim, 2015; Colombo & Murtinu, 2017), or the effects on the venture capital unit (Dushnitsky & Shapira, 2010; Hill et al., 2009; H. D. Park & Steensma, 2013). The various forms are differentiated along their strategy and objectives, their organizational form, independence or ownership and their (incentives and compensation for) personnel. Although both IVC and CVC create value (Colombo & Murtinu, 2017), the findings hint that IVC outperforms CVC in financial terms (Bertoni et al., 2013; Maula et al., 2006, p. 24), whereas CVC boosts innovative and strategic performance (Chemmanur et al., 2014; Maula et al., 2006, p. 24).

In addition, CVC is differentiated from third-party collaboration forms or "technology sourcing modes" (Van De Vrande et al., 2011, p. 483):

Table 10: Summary of studies comparing CVC to other forms of corporate third-party collaboration forms (author's compilation)

References	Units of comparison	Outcome variable of interest	Focus of comparison	Key findings
(Schildt et al., 2005)	CVC, alliances, joint ventures, acquisitions	Corporation – Inter-organizational learning	Venturing mode and technological relatedness	Significant effects on likelihood of explorative learning from venturing mode and technological relatedness
(Van De Vrande et al., 2011)	CVC, alliances, joint ventures, acquisitions	Corporation – Innovation output (patents)	Non-equity alliances, equity alliances, M&As	CVC especially beneficial for firm innovation (patent count) if used in conjunction with other forms

Schildt et al. (2005) find that the mode of corporate venturing influences the likelihood of explorative learning, whereas Van De Vrande et al. (2011) detect that CVC works complementary to the other forms. Thereby, the insights gained by such comparisons helps scholars and practitioners to better understand interactions and links between different modes used in the corporate world.

III.3.3 Hypotheses on the differentiation of CVC and CA

As no comparison of CVC and CA exists in literature yet but is requested by scholars (Colombo et al., 2018, p. 192; Drover et al., 2017) and considered beneficial for practitioners, the following section differentiates the two forms of corporate start-up engagement. Both key characteristics of the two units and the start-ups under management differ. Therefore, CA is not a copy of CVC but a new phenomenon with distinct intentions[90].

CA aims at getting access to novel ideas, for example regarding business models or technological advancements. Therefore, CA will have large and more diverse portfolios, including start-ups from industries unrelated to the corporate parent. To attract young and unknown start-ups, CAs need larger networks, like corporate partners or publicity in social media to make potential start-ups aware of the CA program. Moreover, CAs only take few months to "speed up the cycle of the venture" (Cohen, 2013, p. 21), through education, coaching and mentoring of the ventures (Cohen & Hochberg, 2014; Goswami et al., 2018). For CA-managed start-ups support with more general start-up issues, like the development of business plans or pitch presentations is of utmost value. Consequently, CA personnel will be experienced in such topics, rather than having a deep industry expertize.

CVC, in contrast, aims at a measurable financial return and a positive effect on a firms innovation output (Siegel et al., 1988). Instead of getting access to new ideas, CVCs expect operating synergies, additional revenue from selling its own product to the start-up or support for the overall business through successfully selling the start-up's offering (Anokhin, Wincent, et al., 2016; Hellmann, 2002; Sykes, 1990). Therefore, CVCs will be more selective in their collaboration with start-ups, resulting in intense due diligences. Moreover, the

[90] Going forward corporate venturing (CV) refers to CVCs and CAs only

portfolio of start-ups is more focused on closer to the corporate core, like focusing on start-ups in the same industry and having CVC personnel with a previous corporate background.

To pursue their objectives, CAs focus on early stage start-ups that often only have an idea. In contrast, CVCs invest in more established start-ups that often already developed a prototype or generate small revenues. Thereby, the start-ups under management of the two forms will differ from each other, e.g. by size, age or their exposure to the capital market. Moreover, CVC-backed start-ups are further developed in their lifecycle, leading to a higher financial and strategic performance. Taking into account the different objectives, intentions and timeframes of CVC and CA, it is hypothesized that

H1: CVC and CA differ from each other regarding key characteristics and start-ups under management.

Given that CVC and CA differ, both scholars and practitioners are interested in learning about heterogeneous performance implications of the two forms. It is argued that the performance of CVC and CA differs due to their different objectives, their different intensity of support and their different level of control.

First, the objectives and strategic intentions of CVCs and CAs differ in a way that results in superior CVC performance. As mentioned by Cohen (2013), CAs aim at accelerating start-up ideas. Therefore, both speeding up the development of a successful start-up and terminating a start-up in case of an unsuccessful idea are considered a success for the CA. CAs thereby serve as a vehicle to identify promising start-ups and quickly dissolve unsuccessful ones. In contrast, CVCs are used to support proven start-up in making the step into a successful commercialization or development of an innovation. In a profit-oriented world, investing money in a start-up that ceases existence shortly after is value-destroying.

Second, the intensity of start-up support is higher for CVC than CA. CVCs invest more money in start-ups than CAs do. Assuming rationale profit maximizing corporations, a higher investment in the case of CVCs comes with additional risk and therefore requires a superior return compared to CA investments. Additionally, CVCs also conduct higher non-financial investments than CAs. Whereas CAs offer standardized programs for large batches of start-ups, CVCs have individual offering for each and every start-up. All CA-backed start-ups listen to the same guest speaker or have access to identical office infrastructure. In contrast, one CVC-backed start-up might get access to resources, like marketing experts, whereas another CVC-backed start-up might use a corporation's factory and production equipment. Additionally, CVCs have a longer timeframe of influencing start-ups than the limited three-month CA programs. Through the specificity of CVC investments, backing a start-up through a CVC comes with higher investments and a more sophisticated selection, support and exit process[91]. Both corporations and start-ups are only willing to make this large effort, if the proceeds are appropriately high.

Third and most importantly, the level of control differs between CVC- and CA-managed start-ups. Whereas CAs hardly assume any ownership in the start-ups, CVCs always perform (minority) equity investments (Brigl et al., 2014; Gompers & Lerner, 1998, p. 21). Based on property-right theory (Grossman & Hart, 1986; Hart & Moore, 1990), the equity ownership of CVCs has a particular effect on the performance of CVC versus the performance of CA. Both CA and CVC operate in a setting of relationship-specific investments with some non-contractible dimension like the success of a new technology, making it impossible to contractually cover all eventualities and determining an ex-ante split

[91] Including e.g. due diligences, writing individualized contracts with elaborate term-sheets and preparing start-ups for exits, like IPOs

of future profits. In addition, the assumption of information asymmetry leading to imperfect information, uncertainty and moral hazard between two parties holds. Whereas CAs tend to obtain hardly any voting equity in the start-ups they manage, CVCs assume start-up control through considerable equity investments. Therefore, CVC investments serve, through their ownership component, as a typical example for contracts discussed in property-rights theory (Grossman & Hart, 1986; Hart & Moore, 1990). According to theory, opportunistic behavior and the hold-up problem are reduced through increased integration from asset ownership (Hart & Moore, 1990), thereby leading to more relationship-specific non-contractible investments and increased contract efficiency (Hart, 2013). Although integration has also downsides like reduced incentives for the previously independent start-ups (Grossman & Hart, 1986), the higher efficiency of CVC contracts leads to a superior collaboration between corporations and CVC-backed start-ups, which is reflected in higher (financial and strategic) start-up performance. To foster collaboration among start-ups and business units and increase control, CVC managers or corporate personnel often assume seats on start-up boards or obtain board observation rights (Dushnitsky & Lenox, 2005; MacMillan et al., 2008, p. 17).

Taking the arguments above into consideration, the implications on start-up performance of CVC are higher than those of CA. Therefore, it is hypothesized that

H2: The effect on start-up performance is larger for CVC than it is for CA.

III.3.4 Empirical analysis and methodology

III.3.4.1 Descriptive statistics and correlations

Table 11 shows descriptive statistics and pairwise correlations for the entire dataset:

Table 11: Descriptive statistics and correlations for CVC and CA combined (author's dataset)

Variable	Obs	Mean	Std. Dev.	Min	Max	1.	2.	3.	4.	5.	6.
1. Capital raised	342	37.7	99.9	0.0	1,008.0	1					
2. Market access	342	512.7	1,502.6	1	14,355	0.222***	1				
3. CVC dummy	342	0.6	0.5	0	1	0.270***	0.206***	1			
4. Portfolio size	342	49.3	27.7	2.0	87.0	-0.0223	0.142**	-0.133*	1		
5. Portfolio concentration	342	0.5	0.2	0	1	0.0114	0.0776	-0.0345	0.106	1	
6. Industry fit (corp. and start-up)	342	0.3	0.5	0	1	0.141**	0.134*	0.192***	0.157**	0.271***	1
7. CV experience	342	5.8	3.7	1	17	0.0348	-0.0505	0.190***	-0.367***	-0.277***	0.0327
8. Lead background	342	0.2	0.2	0	1	-0.117*	-0.0918	-0.331***	-0.0178	-0.0815	-0.0217
9. Employees per start-up	342	0.8	1.3	0	16	-0.0156	-0.0335	-0.0271	-0.271***	0.0450	-0.114*
10. Spatial distance (CV and corp.)	342	352.5	1,048.6	0	6,229	-0.0314	-0.0164	0.0926	0.0108	0.310***	0.173**
11. Corporate partner network	342	0.1	0.2	0	2	-0.0965	-0.0466	-0.360***	-0.178***	0.0542	0.0913
12. Popularity	342	491.4	816.0	0	2,635	-0.180***	-0.133*	-0.588***	0.133*	-0.107*	-0.257***
13. Financial backing	342	57,645.4	39,708.2	2,812	164,330	0.0536	0.0620	0.169**	0.182***	-0.173**	0.191***
14. Start-up employees	342	254.3	2,774.2	2	50,000	0.0385	0.00284	0.0689	-0.0337	0.125*	-0.0367
15. Start-up age	342	7.6	5.1	1	33	0.322***	0.203***	0.452***	0.00697	-0.0277	0.130*
16. B2B orientation	342	0.8	0.4	0	1	0.102	0.00632	0.168**	0.0173	-0.00826	0.175**
17. Number of active investors	342	7.8	6.6	1	46	0.415***	0.315***	0.391***	-0.134*	-0.0322	0.0960

Variable	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
7. CV experience	1										
8. Lead background	0.162**	1									
9. Employees per start-up	-0.165**	0.0500	1								
10. Spatial distance (CV and corp.)	0.107*	-0.190***	-0.0325	1							
11. Corporate partner network	-0.264***	0.198***	0.237***	-0.0402	1						
12. Popularity	-0.0128	-0.0531	-0.206***	-0.0174	0.101	1					
13. Financial backing	-0.0949	-0.200***	-0.0196	-0.152**	0.100	-0.121*	1				
14. Start-up employees	0.0444	-0.0554	-0.000337	0.292***	-0.0326	-0.0486	-0.0587	1			
15. Start-up age	0.125*	-0.106	-0.0399	0.00897	-0.177***	-0.258***	0.169**	0.0190	1		
16. B2B orientation	0.0220	-0.119*	-0.0629	0.0418	-0.0271	-0.0854	0.254***	0.0434	0.176**	1	
17. Number of active investors	0.0695	-0.158**	-0.0114	-0.0794	-0.115*	-0.224***	0.202***	-0.00449	0.171**	0.0774	1

*** p<0.001, ** p<0.01, * p<0.05

The average start-up raised 37.7m$ by all investors so far. The number is highly right-skewed and impacted by CVC-sponsored start-ups. As shown by the maximum value, the dataset contains one unicorn, namely Scout24, a now stock-listed platform for online transactions[92]. The average website of the start-ups in the dataset has 513 referring domains, i.e. links to other websites. All reported start-up averages are slightly skewed to CVCs as 60% of the dataset are comprised of CVC-managed start-ups. The CV units have on average a total of 50 start-ups under management. Given the large range from only 2 to up to 87 start-ups hints that different CV units pursue different strategies with regards to the size of their portfolio. The diversity of start-ups in a portfolio is balanced, with an average Herfindahl-Hirschman index of 0.5. The minimum and maximum values of 0 and 1 respectively show, however, that some CVs support start-ups with heterogeneous backgrounds, whereas others focus on one industry only. Moreover, 30% of start-ups are active in the same industry as their corporate parent, whereas the remaining are from different industries. This might be explained by the needs of digitization through which corporation need access to ICT capabilities, independently from their own industry-background.

The experience of both the CV unit and the unit's lead matter. The experience of the CV is measured through its age and ranges from 1 to 17 years in the case of Dieter von Holtzbrink Ventures. The average CV unit is almost 4 years old and the youngest units in the sample were established in 2017 only. The lead background reports an average value of 0.2 with a minimum of 0 and a maximum of 1. Therefore, the average lead has five times as much corporate experience than founding experience, no CV lead has more start-up than industry experience and some leads spend their entire career in the corporate world. On

[92] See Lehmann, Schenkenhofer and Wirsching (2019) for an explanation why the number of unicorns is limited in Germany

average, one start-up is supervised by 0.8 CV employees. The minimum of 0 is due to rounding, as especially in the case of some accelerators, few employees manage a large number of start-ups. On average, CV units are more than 300 kilometers away from the headquarters of their corporate parent. The distance between the CV unit and the corporation is rather high for CAs, as they are often located in start-up hubs, like Berlin or Munich. The maximum value of more than 6,000 kilometers is the case of Merck Accelerator located in Darmstadt, Germany, whereas the Merck headquarters are based in the United States. Corporations run their CV units jointly with between 0 and 2 corporate partners. The average value of 0.1 shows that corporations mainly operate CV units by themselves instead of co-partnering with other corporations. The popularity of CV units is a combination of its followers on multiple social media platforms. The rather small average of less than 500 followers is influenced by CVCs that are partially not active on any of these platforms at all. In contrast, CAs tends to more popular. The model controls for financial backing through the corporate parent by using its revenue. The range of less than 3bn€ to more than 160bn€ shows, that CV units are a phenomenon across different firm sizes.

The size and age of start-ups are important measures to control for. On average, start-ups employ 250 people and are more than 7 years old. The small minimum values of 2 employees and 1 year represent a typical young start-up with merely an idea, whereas the maximum value of 50,000 employees demonstrates that even some well-developed start-ups can still be under the management of a CV unit, especially a CVC. Moreover, it is controlled for the B2B orientation of start-ups as this might influence their website links and financing needs. 80% of start-ups are active in the B2B business. Lastly, the average start-up has almost 8 active investors, with a large range from 1 to 46.

As expected, the CVC dummy is significantly correlated with several other variables. CVC units are led by managers with less start-up experience, have smaller corporate partner networks and tend to be less popular. In contrast, a positive correlation between the CVC dummy and both start-up age and number of active investors hints that CVC-managed start-up are further developed than CA-managed ones. Moreover, a positive correlation exists between the number of active investors or start-up age and capital raised or market access. Surprisingly, no such correlation is evident for the number of start-up employees and the two performance measures. Intriguingly, a negative correlation between CV experience and portfolio size indicates that older CV units are more focused, which is especially the case when only considering CVC units.

As evident from a differentiation of Appendix B Table 21 and Table 22, selected differences between CVC and CA emerge. Whereas no correlation between market access and start-up characteristics can be found for CVCs, a positive correlation is found for start-up employees and age in the case of CAs. Moreover, market access is positively correlated with portfolio size for CVCs and negatively for CAs, indicating that difference performance effects of portfolio sizes result. Similarly, opposite correlations are evident for portfolio concentration and industry fit, CV experience, lead background, CV employees per start-up and spatial distance, thereby indicating that portfolio compositions between CVCs and CAs differ.

III.3.4.2 Methodological approach and robustness

Multi-step methodology

A multi-level dataset is considered, including information on start-ups, the corporate venturing unit and corporations as well as the dyadic level. In order to detect differences between CVC and CA in sufficient detail and empirically test the hypotheses, a multi-step approach, as outlined in Figure 22 is applied:

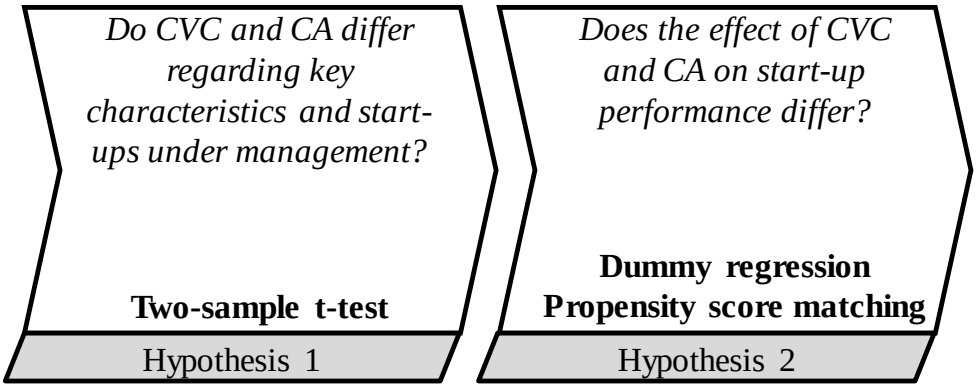

Figure 22: Multi-step methodology (author's approach)

First, a two-sample t-test as introduced by Snedecor and Cochran (1989) is performed. Thereby, differences in the means of variables concerning CVC and CA set-up and organization and variables describing start-ups under the management of a respective corporate venturing vehicle are described and statistical significances of the means detected.

In the second step the impact of CVCs and CAs respectively on start-up performance is evaluated. In doing so, regression models with the following form are applied:

$$y_i = \beta_0 + \beta_1 VD_j + \beta_2 SE_i + \beta_3 SA_i + \beta_4 BB_i + \beta_5 AI_i + \beta_6 FB_j + \varepsilon$$

where i is used to describe start-ups and j to refer to corporate venturing vehicles. As corporate venturing pursues both financial and strategic goals (Chesbrough, 2002), y_i is

measured using both capital raised and market access. VD describes a dummy variable of whether the corporate venturing unit of interest is a CVC or a CA. Thereby, performance differences between the two forms are detected. The variables SE, SA, BB, AI and FB are controls on the start-up and corporate level and are explained in more detail in Table 5. The variable capital raised is a continuous variable with a strong right-skewness and only positive values. Market access is a right-skewed count variable. As Poisson distributions are generally preferred over Tobit or negative binomial distributions for nonnegative skewed dependent variables (Nichols, 2010, p. 19), Poisson is used as preferred regression.

More importantly, however, propensity score matching (PSM) is performed as originally developed by Rosenbaum and Rubin (1983) as it helps to present a causation (Suh, 2016) and mimic some specific characteristics of experiments (Austin, 2011), thereby, circumventing a limited comparability of CVC- and CA-managed start-ups. As outlined above, CVCs and CAs pursue different goals and invest in start-ups at different stages. Clearly younger and smaller start-ups will show less performance than older and more established ones. Therefore, only comparing CVC- and CA-managed start-ups will not sufficiently separate the various effects of the two corporate venturing forms. Propensity score matching based on start-up characteristics, in contrast, allows to identify the differences between CVCs and CAs with regards to the performance effect of otherwise 'same' start-ups. Accordingly, scholars apply propensity score matching in similar settings, e.g. to compare CVC with IVC (e.g. Chemmanur et al., 2014).

Start-ups are matched based on their age, the number of employees, their B2B orientation and the number of active investors. Similar start-ups are grouped and the effect of being either under the management of a CVC or a CA is isolated. Due to trivial reasons of

the availability of observations, being under CA management is chosen as the treatment group, whereas start-ups under CVC management are applied as control group. Based on the discussion of propensity score matching provided by Grotta and Bellocco (2014), matching with ten nearest neighbors is applied. The caliper is deliberately chosen to be small at 0.005 to matching sufficiently similar start-ups. After the matching is performed, the effect of CVC and CA, respectively on the performance of start-ups results.

Robustness

The robustness of models is checked specifically for the dummy regression and for the propensity score matching. For the dummy regression, the variance inflation factor is computed based on a regular ordinary-least square regression. As in both models the highest factor is below 1.5, multicollinearity is not a problem. To test the validity and robustness of the regression results, OLS, Tobit and negative binomial regressions are performed in addition to the favored Poisson regression and presented in Appendix B Table 23. The key finding that CVC leads to higher financial and strategic start-up performance than CA is confirmed by using linear regressions on logarithmized dependent variables and negative binomial regressions. Besides the different complete case regressions, models with all available observations and models excluding outliers are estimated. Outliers are excluded based on a statistical threshold and all observations outside of range of three times the standard deviation around the mean are excluded for start-up employees, star-up age and the number of active investors. The results of the regressions demonstrate the robustness of the empirical result as shown in Appendix B Table 24.

In addition, post-matching tests are performed for the propensity score model. First, matching start-ups helps to reduce the difference between the number of employees, start-up

age, B2B orientation and active investors. As shown by the high p-values, no significant differences remain after matching in all three dimensions, thereby demonstrating the validity of the matchings performed. Additional further test statistics, especially Rubin's B and Rubin's R are reported in Table 12:

Table 12: Test statistics and observations for propensity score matching (author's dataset)

	Pseudo R^2	LR chi^2	p>chi^2	Mean Bias	Median Bias	Rubin's B	Rubin's R	%Var
Unmatched	0.38	170.91	0.00	63.4	63.2	20.6	0.00	100
Matched	0.00	0.49	0.98	2.3	1.9	10.6	2.00	0

	Off support	On support	Total
Untreated	0	210	210
Treated	49	83	132
Total	49	293	342

As attempted both the mean and median bias were reduced through the matching. Of specific interest are the values of Rubin's B and Rubin's R. Rubin's B reports the absolute standardized mean differences and is recommended to be less than 25, whereas Rubin's R sets the treated and non-treated variances in a ratio and is recommended to be between 0.5 and 2 (Rubin, 2001). As shown by Table 12, the Rubin's B is in line with the recommended values. For Rubin's R, it would be advantageous if the unmatched value would be slightly higher. As the matched test statistics are within the recommended thresholds the propensity score matching results are robust. Thereby the results for hypothesis 2) are largely robust and inconspicuous for both the dummy regression and the propensity score matching.

III.3.5 Results

In line with the hypotheses developed, the results section is split in three parts, namely a differentiation of CVC and CA, an evaluation of CVC and CA effects on start-up performance and an assessment of how strategic direction and organizational design of CVCs and CAs differently impact start-up performance.

Differences between CVC and CA

Table 13 presents differences between CVC and CA regarding key characteristics and start-ups under management:

Table 13: Two-sample t-test for differences between CVC and CA (author's dataset)

Variable	Mean CVC	N CVC	Mean CA	N CA	Difference in means	
Capital raised	59.08	210	3.71	132	55.37	***
Market access	757.63	210	123.17	132	634.46	***
Portfolio size	46.36	210	53.89	132	-7.54	*
Portfolio concentration	0.48	210	0.49	132	-0.01	
Industry fit (corp. and start-up)	0.35	210	0.17	132	0.18	***
CV experience	6.37	210	4.92	132	1.45	***
Lead background	0.11	210	0.27	132	-0.16	***
Employees per start-up	0.80	210	0.87	132	-0.07	
Spatial distance (CV and corp.)	429.42	210	230.19	132	199.23	
Corporate partner network	0.07	210	0.24	132	-0.17	***
Popularity	111.76	210	1,095.31	132	-983.55	***
Financial backing	62,955.12	210	49,198.09	132	13,757.03	**
Start-up employees	405.68	210	13.45	132	392.23	
Start-up age	9.41	210	4.68	132	4.73	***
B2B orientation	0.81	210	0.67	132	0.15	**
Number of active investors	9.80	210	4.53	132	5.26	***

*** p<0.001, ** p<0.01, * p<0.05

The table shows that statistically significant differences between CVC and CA exist. The first section of the table gives an insight on start-up performance, the second part discusses CV variables and the bottom part refers to the start-ups under management. First, start-ups under CVC management show a significantly higher financial and strategic performance than their CA counterparts. As many different effects might lead to this observation, the performance differences are discussed in more detail later. Second strategic and organizational dimension of CVCs and CAs are compared. As expected, CAs have significantly more start-ups under management, as they aim at detecting promising ideas and technologies from a large pool of start-ups. In contrast, CVCs perform more focused investments and offer more specialized, intense and individual coaching. Therefore, the number of start-ups under management is smaller. Both CVCs and CAs report a Herfindahl-Hirschman index of portfolio concentration of almost 0.5, meaning that the portfolios are similarly dispersed and no significant differences between the two corporate venturing forms exist. CVCs tend to invest more in start-ups that are active in the same industry as the corporate parent, whereas CAs have a broader industry orientation. Corporations staff CVCs with personnel having sufficient industry experience. Thereby, they ensure a deep understanding of the market drivers and innovative needs. CVC-managed start-ups rather require input regarding individual target customers, industry-specifics or technological intricacies. CA leads, in contrast, offer more founder experience as they need to support start-ups regarding more basic 'founder topics', like how to create business plans from scratch. Surprisingly, CVCs tend to be geographically further away from the corporate headquarters. This finding is misleading and heavily influenced by the case of Merck Ventures[93]. A more

[93] The CVC Merck Ventures is located in Darmstadt, Germany, whereas the corporate headquarter of Merck is located in Kenilworth, NJ, USA

detailed analysis of the location of CVCs and CAs reveals that CAs are more frequently located in start-up hubs whereas CVCs are in many cases located at the corporate headquarter. Finally, CAs have a much higher popularity on social media, like Facebook, Twitter and LinkedIn as they require a large network to attract applicants for their batches and promote what they are doing. In contrast, CVCs tend to focus mainly on LinkedIn making more targeted information sharing with a more professional audience possible.

In summary, CVC and CA differ in their set-up. CAs tend to have larger portfolios with start-ups from different industries, thereby gaining access to many different ideas. CAs are more popular on social media to gain attention of start-ups. For example, most CAs have online registration forms where any start-up can apply for being part of an accelerator batch. Additionally, the staffing of CAs and the location in start-up hubs shows that CAs are closer to the start-up world. In contrast, CVCs seem to narrow down the portfolio of start-ups and move closer towards the corporation. The portfolio of CVCs is smaller and more start-ups are from the same industry as the corporation. Furthermore, CVCs are in closer proximity to the corporation, both geographically and with regards to the lead's previous experience.

Third, start-ups are under the management of CVCs differ as expected from those under the management of CAs. CVC-managed start-ups are with 9.4 years twice as old as CA-managed start-ups with an average age of 4.7 years. Of course, this age difference will impact further variables. For example, start-ups under CVC management are more established and larger, leading to significantly more money raised from many more different investors. Accordingly, the number of active investors is much higher for CVC-backed start-ups than CA-backed ones. Although start-ups under CVC management have on average more than 400 employees and CA-managed start-ups have less than 14 employees, surprisingly

this large difference is not statistically significant due to high standard deviations. In summary, hypothesis 1) is empirically validated as the two-sample t-tests report significant differences between CVC and CA with regards to both the set-up and composition of the vehicle itself and the start-ups under management. Additionally, differences in both the financial and strategic performance of start-ups exists. As multiple reasons for this phenomenon are conceivable, the next section aims at differentiating the effect of CVC and CA on start-up performance in more detail.

Effect of CVC and CA on start-up performance

As indicated in Table 13 significant differences in the performance of start-ups under CVC and CA management exist. Similar to scholars comparing CVC with IVC (see e.g. Alvarez-Garrido & Dushnitsky, 2016; Bengtsson & Wang, 2010; Chemmanur et al., 2014), dummy regressions are used to compare CVC and CA. As the start-ups under management of the two forms differ, propensity score matching is performed first, to determine the difference in effect size when start-ups are matched based on their age, the number of employees and the number of active investors. Similar approaches are also used by scholars when comparing CVC with IVC (see e.g. Chemmanur et al., 2014; Hirsch & Walz, 2013). The following Table 14 reports the results of the matching:

Table 14: Results of propensity score matching (author's dataset)

		CVC	CA	Delta	% Bias	% Red. Bias	t	p>t
Capital raised	Unmatched	59.08	3.71	55.37				
	Matched	8.86	5.51	3.35				
Market access	Unmatched	757.63	123.17	634.46				
	Matched	216.64	163.11	53.53				
Start-up employees	Unmatched	405.68	13.46	392.23	15.7		1.27	0.204
	Matched	15.40	16.86	-1.46	0.1	99.6	-0.43	0.666
Start-up age	Unmatched	9.41	4.68	4.73	111.5		9.35	0.000
	Matched	5.43	5.31	0.12	3.0	97.3	-0.25	0.791
B2B orientation	Unmatched	0.81	0.67	0.14	34.1		3.14	0.002
	Matched	0.74	0.76	-0.02	5.2	84.8	-0.33	0.741
Nr of active investors	Unmatched	9.80	4.53	5.26	92.4		7.83	0.000
	Matched	5.44	5.40	0.04	0.8	99.2	0.08	0.939

The performance differences between CVC and CA diminish when start-ups are matched. The difference in capital raised is reduced from 55 to only 3, whereas the difference in market access diminishes from 634 to 54. Being based on a propensity score matched sample and controlling for various start-up characteristics, Table 15 reports the dummy regression to support hypothesis 2), whereas Table 16 shows marginal effects (the dummy regression and marginal effects without prior propensity score matching indicate the same results and can be found in Appendix B Table 25 and Table 26)

Table 15: Poisson regressions for effects of both CVC and CA on start-up performance, based on propensity score matched sample (author's dataset)

Dependent variables Independent variables	**Poisson Financial** Capital raised	**Poisson Strategic** Market access
CVC dummy	1.527***	0.958***
	(0.050)	(0.009)
Financial backing	-0.000***	0.000***
	(0.000)	(0.000)
Start-up employees	0.000***	-0.000***
	(0.000)	(0.000)
Start-up age	0.080***	0.060***
	(0.001)	(0.000)
B2B orientation	0.447***	-0.274***
	(0.028)	(0.006)
Number of active investors	0.071***	0.058***
	(0.001)	(0.000)
Constant	0.661***	4.574***
	(0.054)	(0.010)
Observations	293	293
Pseudo R^2	0.433	0.249

Standard errors in parentheses,
*** p<0.001, ** p<0.01, * p<0.05

Table 16: Marginal effects for Poisson regressions for effects of both CVC and CA on start-up performance, based on propensity score matched sample (author's dataset)

Dependent variables Independent variables	**Poisson Financial** Capital raised	**Poisson Strategic** Market access
CVC dummy	67.060***	564.432***
	(2.231)	(5.685)
Financial backing	-0.000***	0.000***
	(0.000)	(0.000)
Start-up employees	0.001***	-0.005***
	(0.000)	(0.001)
Start-up age	3.515***	35.498***
	(0.069)	(0.260)
B2B orientation	19.633***	-161.343***
	(1.236)	(3.582)
Number of active investors	3.119***	34.158***
	(0.045)	(0.155)
Observations	293	293

Standard errors in parentheses,
*** p<0.001, ** p<0.01, * p<0.05

As derived in hypothesis 2), being under the management of a CVC has a larger impact on start-up performance than being under the management of a CA. This is true for both financial and strategic start-up performance. Intriguingly, the dummy variable that differentiates CVC-managed start-ups with CA-managed start-ups has a larger effect size than any other control variable included. From the marginal effects one can see that being under the management of a CVC versus a CA increases the funding of a start-up by 67m$ and the number of website links by 564. CVCs invest equity in start-ups and therefore take – besides developing the technology, product or service of the start-up strategically – also financial considerations into account. In contrast, CAs offer a standardized amount of money to the start-ups and mainly focus on accelerating the start-up strategically. The included control variables are in line with expectations. Whereas the effects of financial backing and start-up employees are hardly discoverable, both start-up age and number of active investors show positive signs. As anticipated, being active in the business-to-business sphere has a positive effect on start-up funding, whereas business-to-consumer start-ups experience better market access.

All in all, CVC-managed start-ups are superior to CA-managed start-ups, thereby supporting hypothesis 2). Due to the propensity score matching, one can infer that there is an actual causation between being under CVC management (versus CA management) and a superior financial and strategic start-up performance.

III.3.6 Discussion

III.3.6.1 Contribution and implications

The results corroborate that CVC and CA differ with regards to key characteristics and start-ups under management. CVCs tend to be older and rather staffed with industry-experienced personnel. CAs in contrast tend to have more corporate partners, larger portfolios and a higher popularity in social media. Additionally, CVC-backed start-ups are further developed and show a closer strategic fit to the corporate parent industry. As anticipated, CVCs have a larger effect on start-up performance than CAs in both financial and strategic terms. Even when controlling for start-up characteristics, the results confirm that CVCs outperform CAs, which can be attributed to their longer experience, their closer interaction with start-ups, the reduction of potential adverse actions through equity investments and the longer timeframe and higher partner specificity of collaboration.

This study contributes to existing literature in multiple ways. First, it creates a better understanding of both CVC and CA through comparing the two with each other. Thereby, insights on key characteristics of the two forms and the typical start-ups under management are offered. So far, CVC is mainly compared to IVC or alliances, joint ventures and M&A transactions (e.g. Bertoni et al., 2013; Colombo & Murtinu, 2017; Drover et al., 2017), whereas CA is a too novel phenomenon to be compared to other forms yet. Therefore, this work is one of the first that adds – in line with requests by scholars like Colombo et al. (2018, p. 192) – a new perspective to literature through empirically comparing CVC with CA. The detected performance differences between CVC and CA offer support for several well-established theories, like property-rights theory. Through equity shares and more deliberate investments in same industry start-ups, CVCs have more control over their start-ups under management and can thereby influence the performance of start-ups more positively. In

addition, the longer and more intimate relationship between corporations and start-ups in a CVC setting allows for better access to complementary resources and more intense spillover effects.

CAs take a broader market oriented approach and are more open to different types of start-ups. CA-backed start-ups support corporations in learning about potential ideas that might be ‘out of the box’ on first sight. Young start-ups gain insights, network access and market information from their CA.

Moreover, the study contributes to a better understanding of the two venturing forms through indicating that the two might work well as complementaries, not competitive forms. Only because CVC outperforms CAsdoes not mean that CVC is always a better choice. Corporations must first decide what they aim at, then choose either a CVC or a CA form and finally set-up their portfolios and the interactions between start-ups, the venturing unit and the corporation accordingly. Corporations might consider having multiple different accelerators for different technologies, yet only one CVC. Thereby, corporations can use multiple CAs to identify the most successful start-ups that survive harsh competition. Later on, these successful start-ups can complement each other in CVCs thereby jointly solving large and complex technological challenges. Such behavior is seen by several firms for both CVC and CA. As example for CVC, the BASF Venture Capital has three 3D-printing related start-ups in its portfolio, where one focuses on the development of 3D-printers, one on the development of novel printing technologies and one on 3D-printing materials. IBM serves as example for a corporation operating multiple technology-specific accelerators. Future research should elaborate on the interplay of CVC and CA and the existance and collaboration of multiple venturing units within one corporation.

Lastly, a better understanding of CVC and CA for practitioners is achieved. For corporate practitioners, the results give hints on potential interplays between CVC and CA units within one corporation. Moreover, the comparison might be helpful to develop new forms of corporate venturing that bring together the best of both worlds and allow successful start-ups to seamlessly move from a CA-like support to a CVC-like support. Start-up practitioners can use the findings to decide on whether to pursue CVC or CA backing, depending on the state and requirements of their start-up. Additionally, they can obtain a feeling on the impact a specific CVC or CA will have on their start-up's success.

III.3.6.2 Limitations and further research

Although the results present promising insights on the differences between CVC and CA, this study comes with limitations and need for future research. Due to its newness, data on CAs is not available broadly. The obtained limited test results for the propensity score matching are also due to the limitation in number of observations. Although this work aims at circumventing the limited data availability through using multiple imputations, future studies will benefit from a larger dataset with more observations collected over a longer period. Through time-series and panel data, a difference-in-difference approach could be applied, leading to more robust statistical results. Additionally, the focus of the dataset on Germany only limits the generalizability of findings. Future research might replicate a similar study for further countries, thereby mitigating country specific effects, like Germany's economic structure and strong position of small and medium sized family-owned corporations. Adding qualitative information, e.g. from surveys and interviews with start-up founders and CVC and CA managers would allow for deriving further insights on the daily collaboration of corporate venturing vehicles and start-ups. Scholars might perform a case study with one of few individual start-ups that were first part of a CA program and later

moved forward to a CVC-backing to gain more understanding of the interplay of the two venturing forms within one corporation. In addition, it might be useful to add further corporate venturing vehicles, predominantly corporate incubators to the comparison.

Comparable to other studies that differentiate CVC with similar vehicles, this study suffers from a limited comparability of CVC and CA. Although both vehicles are owned by corporations and aim at supporting start-ups on the one hand and gaining access to ideas and technologies on the other hand, indispensable differences remain. CVC is a much older phenomenon which went through ups and downs, as outlined above. Accordingly, CVC is more finetuned to cater to start-up needs and more established, therefore showing a higher acceptance and reputation in the market than the newer phenomenon of CA. Empirically, the effect from being a well-developed rather than a recently established vehicle[94] can hardly be controlled for. Additionally, the comparison of CVC and CA effects on start-ups is complicated through the differences in time and depth of interference. Whereas CAs often collaborate with start-ups for a limited timeframe of few months, CVC investments often last many years. Moreover, the depth of interconnections differs. CAs loosely collaborate with start-ups through some mentors and standardized coaching sessions, whereas CVCs invest equity, hold ownership and often assume board seats. Additionally, CVC often co-invest in syndications with other players, like independent venture capitals, or invest in multiple financing rounds subsequently. Although Colombo and Murtinu (2017) find no effect of syndication, future research might take these issues in consideration, especially a collaboration between CVC and CA. Additionally, despite performing propensity score matching, the majority of CVC-backed start-up differs from CA-backed start-ups. Further

[94] The unit of interest here is not a corporation-specific unit, e.g. the CVC of BASF or the CA of Daimler, but the vehicle in general terms

research is advised to compare start-ups on further dimensions, e.g. the stage and type of their idea and technology or its position within a hype cycle[95].

Furthermore, future research should consider that CVC and CA are complements that might work in a funnel approach. In such a model of interplay and staging, CAs are responsible for sourcing many young start-ups with promising ideas. After successfully exiting CA programs, a subset of these start-ups might enter more intertwined relationships with CVCs. Future research is asked to theoretically elaborate on and empirically test such a funnel approach of corporate venturing to detect if and how CVC and CA collaborate.

In line with similar studies, this work suffers from a definite distinction of selection and treatment effects. Due to their higher age and experience, CVCs might be more successful in selecting superior start-ups into their programs than CAs are. Scholars might to attempt to mitigate such a selection bias through applying panel data or using start-ups without any form of corporate backing as control. Moreover, other variables for performance are conceivable, like survival of start-ups.

Lastly, the work on hand exclusively focuses on the effect of CVC and CA collaborations on start-up performance. As profit-oriented and non-philanthropic corporations invest resources in form of money and time from personnel, financial and strategic returns must also result for the corporation. Although it is difficult to isolate the effect of having a CVC or CA on corporate performance, scholars are asked to take a corporate perspective and rigorously analyze the efficacy of CVC and CA for corporations.

[95] For example, the Gartner hype cycle available under https://blogs.gartner.com/smarterwithgartner/files/2018/08/PR_490866_5_Trends_in_the_Emerging_Tech_Hype_Cycle_2018_Hype_Cycle.png, accessed 25 February 2019

III.3.7 Summary and conclusion

From the empirical analysis it becomes obvious that CA is not old wine in new bottles, but that clear differences between CVC and CA exist. Using a dataset of 342 start-ups managed by 21 CVC and 15 CA programs located throughout Germany, the study demonstrates that CVCs tend to have older and more established start-ups with a closer fit to the corporate parent in their portfolio, whereas CAs support younger early stage start-ups in larger portfolios. The results corroborate that the performance effects of CVC and CA differ. Support for the property rights theory that the ownership component through equity investments in the case of CVCs might allow corporations to better enable start-up performance is found. This, however, is also influenced by the fact that CAs aim at being an accelerator in both ways, i.e. accelerating either the failure or the success of their start-ups under management. Just because CVCs have higher performance effects does, however, not mean that both corporations and start-ups should only engage with CVCs and cease existence of CAs. In contrast, both involved parties must consider their objectives and intentions, as well as the stage of the start-up. All in all, the presented findings are beneficial for corporate managers deciding about CVC and CA and their governance and organization, but also for founders searching for corporate support for their start-up. Nonetheless, future research should elaborate on the interplay of the two forms within a corporation.

IV. Contributions, limitations and future research

In the following, the overall contributions of this dissertation, its limitations and avenues for future research are presented. Each of the empirical studies in section III.2 and III.3 contributes individually and faces specific limitations, which are discussed in more depth in the respective parts of this work whereas here a synthesis of the overall contributions and limitations are given.

IV.1 Contributions

This work contributes to research on CVC, both theoretically and empirically. The main contribution lies in an enhanced understanding of CVCs through a grounding in economic theories, a determination of performance implications of a CVC's strategic direction and organizational design and a differentiation from a similar corporate venturing form, namely CA. Readers gain a better understanding of what CVC is, how it works and what research exists about it. Through comparing well-established theories with CVC-specific applications and rigorous empirical analyses, this work contributes in multiple ways to the fields of economics, business and management, entrepreneurship, strategy and innovation.

First, this work helps to better understand CVC through a reconciliation of general theories and their application in the CVC context. Relevant theories are discussed and applied to CVC using a lifecycle perspective. Thereby, a more detailed understanding of what makes CVC investments specific is gained, which is an indispensable prerequisite for understanding further work on CVC and contributing to existing literature[96].

[96] For example, funding of start-ups is often used as variable for financial start-up performance. Such funding is closely related to the valuation of start-ups. Therefore, without understanding how start-ups are valued and

The synthesis of existing CVC research and its comparison to broader economic theories helps to identify white spots. The empirical part of this work contributes to filling some of the identified white spots, especially regarding the performance implications of collaboration between corporations, CVCs and start-ups as well as a differentiation to CA. Other topics, like new forms of venture financing, e.g. initial coin offerings (ICOs) or crowdfunding, or the form and intensity of day-to-day interactions between corporate and start-up personnel, are intentionally left open to be tackled by other scholars.

Second, the understanding of CVC is enhanced through presenting empirical evidence on their performance and thereby contributing to some of the white spots identified before. Light is shed on how CVCs should be organized to foster start-up performance. Trade-offs among benefits and drawbacks of CVC governance are discussed and effects on start-up performance presented, a field that is so far underdeveloped in literature. Moreover, clear recommendations are given, for example on the staffing of CVC leads. A deeper understanding of CVC is offered through an empirical comparison with the new phenomenon of CAs, as this study is one of the first to compare CVC to CA. Being based on a novel dataset, this work offers intriguing first insights on CAs and serves as a door-opener for further empirical CA research. Most existing research compares CVC to IVC, acquisitions or alliances (see e.g. Gompers & Lerner, 1998; Howard et al., 2017; H. D. Park & Steensma, 2012) and CA mainly to incubators or business angels (see e.g. S. W. Smith, Hannigan, & Gasiorowski, 2015; Stagars, 2015). Clearly, this work adds to literature and gives a better understanding of whether – and if so how – the two forms of corporate start-up engagement

what pitfalls exist, financial performance of start-ups cannot be understood completely. Similarly, property-rights theory ought to be known in order to grasp the full effect of equity investments.

differ. Moreover, hints at potential interplays of the two forms are given, opening additional avenues for new research.

The empirical part of this work makes two additional contributions to corporate venturing literature. First, as the US is the leading CVC market (Christofidis & Debande, 2001) and data on European CVC activities is hard to obtain (Colombo & Murtinu, 2017), most publications in this field are US-focused (J. S. Harrison & Fitza, 2014). Through using a dataset from Germany, this work contributes to a better understanding of CVC activities outside the US and therefore more generalizable findings and conclusions. Second, the empirical work is based on a multi-level dataset as favored by Colombo et al. (2018). Using data on the corporate parent, the corporate venturing unit (CVC or CA) and the start-up as well as dyadic links allows to develop more complex models offering new insights.

In short, this dissertation's main contribution lies in offering both scholars and practitioners a better theoretical and empirical understanding of CVC investments and their performance implications. Economic concepts like information asymmetries, moral hazard, principal-agent relationships as well as contract design and property-rights theory are introduced and discussed in light of CVC investments. White-spots in CVC research are uncovered holistically and subsequently partially filled regarding CVC organization and a differentiation to CA. Through extending the theoretical and empirical work with real-life examples, this work not only contributes to research and academia, but also allows practitioners – both on the corporate and the start-up side – to better understand CVC.

IV.2 Limitations and future research

Although this work contributes to a better understanding of how CVC investments work and what influences the performance outcomes of such investments, it comes not without limitations. Limitations specific to the empirical studies conducted are outlined within the respective sections, whereas here overarching limitations are discussed.

The elaboration on well-known economic theories and their application to the CVC context is not without flaws. First, "theory is necessarily an abstraction and simplification of reality" (Makadok et al., 2018, p. 1531) and the work of many scholars discussed throughout the CVC investment lifecycle is a simplified selection. Second, not all relevant theories are discussed. For example, a more detailed elaboration on the impact of CVC individuals or start-up founders might require diving into personality traits and psychological interrelations among individuals. Third, previous economic work and broadly accepted wisdom might be challenged in current times of digitization and growing economic pressure.

This whole work follows a pyramidal approach, through first broadly covering theoretical backgrounds and CVC applications along an investment lifecycle and then turning to the more specific impact of a CVC's strategic direction and organizational design on start-up performance and differentiating CVC with CA. Through more and more focusing on specific topics, other areas of interest for research are left out on multiple levels. Chapter II identifies many more avenues for future research than can be covered within one thesis. For example, more research is needed on the effect of corporate acquisitions of previously CVC-managed start-ups. Scholars could evaluate whether an acquisition is value destroying per se or whether integrational problems lead to the negative effect. Moreover, more focus should be given to personal and cultural differences, especially as one often sees the founder of a start-up leave the company some time after the start-up was fully integrated in the

corporation[97]. No conclusive picture on which exit form is most suitable in what context arises. Therefore, it would be helpful for both scholars and practitioners if an exit decision framework, considering firm and start-up characteristics and capabilities, as well as environmental circumstances, would be developed and empirically tested. Lastly, both VCs and CVCs might phase a fire-sale problem (Cumming & MacIntosh, 2003b). More research is needed on the frequency of CVC fire-sales and their implications on start-up and corporate success. Second, even on the more detailed level of the empirical analyses in chapter III, the work on hand is far from being complete, as for example the effect of a CVC's strategic direction and organizational design on corporate performance requires the attention of future research. In this context, future research might first conduct a study with regards to corporate performance and in a next step elaborate on how the optimal strategic direction and organizational design of CVCs should be in order to ensure best performance for both the corporation and the start-up collectively.

More limitations and need for future research emerge from the empirical work in this dissertation. As in all comparable research, a clear distinction between selection and treatment effects is challenging. Moreover, the data availability is limited, especially for the performed propensity score matching between CVC-managed and CA-managed start-ups. In addition, applied variables are – although the best available – imperfect, especially with regards to measuring true performance. Readers have to be aware of country-differences and the fact the empirical work in chapter III is focused on Germany only. Scholars are urged to replicate the study for different countries to further enhance the generalizability of findings. Furthermore, the empirical work is conducted on a corporation and start-up level, without

[97] For example, the WhatsApp founders that left Facebook shortly after Facebook's acquisition of WhatsApp

specifically considering other research objects. Future work on CVC could, for example, incorporate aspects of the political, economic, technological, social or legal environment. Furthermore, start-ups could be further differentiated by the technology they follow or the hype cycle stage of their technology. Moreover, CVC investments should be analyzed in the light of the broader entrepreneurship ecosystem and other corporate and non-corporate innovation vehicles. Although this work extensively researches existing literature on CVC, incorporates multiple data sources in the empirical work and adds practical examples, additional insights could be gained from a more qualitative research approach. The understanding of CVC and CA can be enhanced through performing interviews and surveys, thereby getting insights from the corporate and the start-ups side on topics that cannot be covered by quantitative data. Future research could also use such insights to better understand the link between CVC and CA. In addition, similar work ought to be done for CVC and other forms of corporate innovation. In short, several identified limitations of this work open multiple avenues for future research.

V. Conclusion

In literature, a fragmented discussion of CVC investments exists, which lacks, however, a structured and broad overview of the particularities of such investments and a comparison with more general economic theories. Many scholarly articles exist on specific topics of CVC investments without 'connecting the dots' and without explaining core foundations and their impact on corporations, CVC funds and start-ups. The applied lifecycle perspective helps to fill this gap, better understand the complex and manifold nature of CVC investments and allows for a structured detection of avenues for future research. Thereby, this work contributes to a wider field of research through offering insights on existing theories, concepts and assumptions, including property-rights theory or information asymmetry in principal-agent relationships.

Through the lifecycle perspective, it becomes obvious that CVC investments are more complex than often taken for granted, as especially the information asymmetry inherent in a principle-agent setting has far reaching effects on CVC contracting and the collaboration between the involved parties. Similarly, it is shown that the equity component of CVC investments is essential. Through an equity investment, corporations gain (partial) ownership of a start-up, impacting the way contracts are written and start-ups are monitored. Moreover, the work on hand identifies multiple research white spots along the investment lifecycle, e.g. the collaboration between a CVC, a corporation and a start-up, incorporating the personal level of individuals involved or an exit through a full corporate acquisition and subsequent integration into one corporate business unit. All this research should be conducted keeping the performance implications for both corporations and start-ups in mind.

The extensive literature review identifies that – among others – future work should be done on the collaboration between a CVC and a start-up. In addition, scholars also urge for research studying the organization of CVCs and the outcome of choosing different strategic and organizational options (Anokhin, Wincent, & Oghazi, 2016; Asel, Park, & Velamuri, 2015; Drover et al., 2017). This work responds to the scholars' request through discussing the effects of a CVC's strategic direction and organizational design on both financial and strategic start-up performance, finding that the benefits and drawbacks of CVC investments can be balanced through a conscious and targeted CVC governance.

The results of this thesis show that financial and strategic performance need to be considered separately, especially as trade-offs among the two are required. For example, a long CVC experience and a leadership team with industry background are financially beneficial for start-ups, yet detrimental for strategic start-up performance. In contrast, some results are uniform for financial and strategic performance: Start-ups benefit from large and diverse portfolios with a limited strategic fit with their corporate parent. In other words, start-ups rather learn from and with other and different start-ups in the portfolio of a CVC instead of benefitting from a corporation active in the same industry. Thereby, the results corroborate the argument of Tirole (2005) that start-ups require sufficient entrepreneurial freedom.

Due to the current high in entrepreneurship and start-up-driven innovations, new forms of corporate venturing emerge, preliminary CA, making a comparison and delimitation with CVC necessary (Colombo, Rossi-Lamastra, & Wright, 2018; Drover et al., 2017). The empirical distinction of CVC and CA and their effect on start-up performance brings to light considerable differences between the two forms of corporate venturing and their portfolio of start-ups under management.

The empirical analysis corroborates that the two forms of corporate venturing differ in their structure, set-up and portfolio of start-ups under management. CVCs tend to be older and more experienced and closer to the corporate parent than CAs, both with regards to the background of the leadership team and the industry of start-ups under management. The portfolio of start-ups under CVC management is smaller and start-ups are more mature and have more active investors than is the case for CAs. In contrast, the concentration of the start-up portfolio and the number of employees per start-up are similar for the two forms. Looking at CAs explicitly, it is detected that the industry fit between a corporation and a CA-managed start-up is rather low and that CAs focus on early stage young ventures, which are attracted by the high popularity and social media activity of CAs. Moreover, the results give first indications that the organization of CAs, e.g. the portfolio size or corporate fit matters for start-up performance. Furthermore, the differentiation of CVC and CA shows clear performance differences between the two forms. CVC has a higher effect on both financial and strategic start-up performance, which might be attributed to the more intense collaboration and the higher control through the equity component. The finding that the performance effect of CA is smaller than that of CVC acknowledges that CAs aim at accelerating start-up development, which might also entail the liquidation of a start-up.

Thereby, this thesis contributes to a better understanding of CVC through empirically working out the effect of CVC organization on start-up performance, finding differences to CA and presenting evidence on disparate performance effects. Moreover, this thesis contributes through a novel dataset. The existing empirical work on CVC is heavily biased towards US datasets (Harrison & Fitza, 2014). Building on a German dataset, the empirical work of this thesis fills the gap of not having enough non-US evidence on CVC investments.

In addition to the contributions to CVC and CA research, the results show support for well-known economic theories, especially property-rights theory, the challenges of principal-agent relationships, the concept of entrepreneurial freedom and the benefits of spillovers. The results indicate that multiple forms of corporate venturing co-exist for a good reason and that various ways of corporate start-up engagement are required to pursue different objectives. Moreover, the results strengthen the finding that corporate venturing activities have to differentiate between a financial and a strategic perspective.

Managerial and policy implications can be drawn, especially for individual actors, like corporate leadership, CVC managers and start-up founders. Both corporate and start-up decision-makers get a deeper understanding of CVC investments. Additionally, they can substantiate their decision whether a CVC or a CA is the right vehicle for their needs and requirements. Lastly, this thesis equips corporate personnel and entrepreneurs with theoretical and practical knowledge about the organization of CVC units and its implications on the performance of start-ups under management.

As this thesis is limited in scope, future research is encouraged to take this work as a starting point and elaborate on the white spots identified along the CVC investment lifecycle, for example regarding the integration of start-ups in corporations. In addition, the performed empirical analyses can be extended through incorporating non-empirical data on the day-to-day collaboration between corporations, CVCs and start-ups and through bringing in the perspective of individuals involved, as well as considering effects on corporate – instead of start-up – performance. Lastly, scholars are urged to further dive into the comparison of CVC and CA and ask if CAs might work as pre-selection tool for CVCs or how a beneficial collaboration between the two forms should be designed.

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Appendix

Appendix A: III.2 The governance of CVC and its effect on start-up performance

Table 17: Ordinary-least square (OLS), Tobit and negative binomial regressions for CVC (author's dataset)

	OLS Financial	**OLS Strategic**	**Tobit Financial**	**Tobit Strategic**	**Nbreg Financial**	**Nbreg Strategic**
Dependent variables	Capital raised[a]	Market access[a]	Capital raised	Market access	Capital raised	Market access
Independent variables						
Portfolio size	0.007	0.041***	0.419	26.430**	0.024***	0.035***
	(0.007)	(0.008)	(0.507)	(7.921)	(0.005)	(0.006)
Portfolio concentration	-0.718	-0.295	-64.193	-340.749	-0.729	-0.900
	(1.112)	(1.239)	(80.383)	(1,255.904)	(0.985)	(1.270)
Industry fit (corp. and start-up)	-0.312	-0.895*	15.808	-455.098	-0.481	-1.131***
	(0.340)	(0.378)	(24.561)	(383.735)	(0.280)	(0.304)
CVC experience	-0.059	-0.006	2.296	-40.819	0.096*	-0.038
	(0.066)	(0.073)	(4.744)	(74.116)	(0.049)	(0.052)
Lead background	0.489	1.618	-122.270	1,296.812	-2.592***	1.196
	(1.095)	(1.220)	(79.176)	(1,237.049)	(0.781)	(0.831)
Employees per start-up	-0.631	-0.303	-6.432	-440.103	-0.219	-0.785*
	(0.356)	(0.396)	(25.717)	(401.800)	(0.283)	(0.310)
Spatial distance (CVC and corp.)	0.000	-0.000	-0.011	-0.021	-0.000**	-0.000
	(0.000)	(0.000)	(0.008)	(0.119)	(0.000)	(0.000)
Corporate partner network	-4.409	-2.289	-185.771	378.500	-6.177**	-2.764
	(2.388)	(2.661)	(172.658)	(2,697.613)	(2.042)	(1.777)
Popularity	-0.000	0.000	-0.098	1.046	-0.002**	-0.000
	(0.001)	(0.001)	(0.074)	(1.157)	(0.001)	(0.001)
Financial backing	-0.000*	-0.000***	-0.001	-0.022*	-0.000***	-0.000***
	(0.000)	(0.000)	(0.001)	(0.008)	(0.000)	(0.000)
Start-up employees	0.000	-0.000	0.001	-0.005	-0.000	-0.000
	(0.000)	(0.000)	(0.002)	(0.035)	(0.000)	(0.000)
Start-up age	0.090***	0.028	5.637***	35.152	0.086***	0.068***
	(0.019)	(0.022)	(1.396)	(21.816)	(0.016)	(0.018)
B2B orientation	0.497	-0.177	19.539	-158.140	0.389	-0.702**
	(0.291)	(0.324)	(21.043)	(328.774)	(0.255)	(0.268)
Number of active investors	0.121***	0.026	6.484***	80.634***	0.090***	0.076***
	(0.015)	(0.016)	(1.067)	(16.665)	(0.014)	(0.014)
Constant	2.671	5.559***	18.144	553.490	3.081*	7.181***
	(1.458)	(1.625)	(105.451)	(1,647.564)	(1.221)	(1.448)
Observations	210	210	210	210	210	210
(Pseudo) R^2	0.342	0.215	0.0220	0.0119	0.0525	0.0385

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05; a = logarithm for dependent variable

Table 18: Poisson regression for all observations, complete case and excluding outliers for CVC (author's dataset)

	Poisson Financial - All observations	**Poisson Strategic - All observations**	**Poisson Financial - Complete case**	**Poisson Strategic - Complete case**	**Poisson Financial - Excl. Outliers**	**Poisson Strategic - Excl. Outliers**
Dependent variables	Capital raised	Market access	Capital raised	Market access	Capital raised	Market access
Independent variables						
Portfolio size	0.013***	0.043***	0.017***	0.044***	0.017***	0.047***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Portfolio concentration	-0.544***	-0.401***	-0.910***	-0.469***	-0.600***	-2.243***
	(0.094)	(0.046)	(0.095)	(0.046)	(0.119)	(0.049)
Industry fit (corp. and start-up)	0.166***	-0.238***	0.005	-0.495***	-0.108**	-0.684***
	(0.028)	(0.007)	(0.029)	(0.007)	(0.035)	(0.008)
CVC experience	0.024***	-0.097***	0.067***	-0.112***	0.093***	-0.087***
	(0.007)	(0.002)	(0.008)	(0.002)	(0.009)	(0.002)
Lead background	-1.429***	3.915***	-2.083***	3.716***	-2.426***	2.407***
	(0.113)	(0.032)	(0.127)	(0.034)	(0.130)	(0.036)
Employees per start-up	-0.073	-0.416***	-0.200***	-0.635***	-0.026	-0.593***
	(0.047)	(0.014)	(0.047)	(0.014)	(0.051)	(0.015)
Spatial distance (CVC and corp.)	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Corporate partner network	-7.815***	-2.566***	-6.653***	-2.764***	-6.043***	-2.854***
	(0.523)	(0.156)	(0.511)	(0.159)	(0.498)	(0.160)
Popularity	-0.001***	0.003***	-0.002***	0.003***	-0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial backing	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Start-up employees	0.000***	0.000***	0.000***	-0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Start-up age	0.085***	0.039***	0.073***	0.042***	0.094***	0.059***
	(0.001)	(0.000)	(0.002)	(0.000)	(0.002)	(0.001)
B2B orientation	0.613***	-0.456***	0.669***	-0.154***	0.317***	-0.269***
	(0.029)	(0.007)	(0.036)	(0.008)	(0.037)	(0.008)
Number of active investors	0.063***	0.080***	0.066***	0.082***	0.080***	0.115***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Constant	2.966***	6.342***	3.227***	6.481***	2.571***	7.425***
	(0.175)	(0.061)	(0.178)	(0.061)	(0.198)	(0.062)
Observations	253	238	210	210	201	201
Pseudo R^2	0.344	0.404	0.384	0.438	0.332	0.531

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05

Table 19: Poisson regression for complete case, imputed and complete case imputed for CVC (author's dataset)

	Poisson Financial - Complete case	**Poisson Strategic - Complete case**	**Poisson Financial - Imputed**	**Poisson Strategic - Imputed**	**Poisson Financial - Imputed - Complete case**	**Poisson Strategic - Imputed - Complete case**
Dependent variables	Capital	Market	Capital	Market	Capital	Market
Independent variables	raised	access	raised	access	raised	access
Portfolio size	0.017***	0.044***	0.004***	0.035***	0.003***	0.036***
	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)	(0.002)
Portfolio concentration	-0.910***	-0.469***	0.125	-0.325	0.294***	-0.329
	(0.095)	(0.046)	(0.170)	(0.797)	(0.081)	(0.321)
Industry fit (corp. and start-up)	0.005	-0.495***	0.271***	-0.096**	0.283***	-0.327***
	(0.029)	(0.007)	(0.031)	(0.033)	(0.029)	(0.070)
CVC experience	0.067***	-0.112***	-0.024***	-0.065	-0.005	-0.099***
	(0.008)	(0.002)	(0.005)	(0.055)	(0.006)	(0.013)
Lead background	-2.083***	3.716***	-0.590***	2.778**	-0.688***	3.415***
	(0.127)	(0.034)	(0.161)	(1.012)	(0.175)	(0.300)
Employees per start-up	-0.200***	-0.635***	0.053	-0.291	0.073*	-0.520***
	(0.047)	(0.014)	(0.029)	(0.332)	(0.029)	(0.070)
Spatial distance (CVC and corp.)	-0.000***	-0.000***	-0.000***	-0.000**	-0.000***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Corporate partner network	-6.653***	-2.764***	-5.436***	-1.465	-3.376***	-1.279
	(0.511)	(0.159)	(0.494)	(1.395)	(0.260)	(0.739)
Popularity	-0.002***	0.003***	-0.001**	0.003***	-0.001***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial backing	-0.000***	-0.000***	-0.000	-0.000***	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Start-up employees	0.000***	-0.000***	0.000***	0.000	0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Start-up age	0.073***	0.042***	0.068***	0.047***	0.054***	0.048***
	(0.002)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)
B2B orientation	0.669***	-0.154***	0.238***	-0.631***	0.113***	-0.375***
	(0.036)	(0.008)	(0.024)	(0.067)	(0.026)	(0.077)
Number of active investors	0.066***	0.082***	0.063***	0.077***	0.066***	0.081***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	3.227***	6.481***	2.776***	5.876***	2.649***	6.109***
	(0.178)	(0.061)	(0.227)	(1.307)	(0.123)	(0.333)
Observations	210	210	325	336	267	267

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05; A long form is used with 20 imputations. The following univariate imputation methods are used, variables in bracket denote the variables used for imputations: Popularity: linear regressions (corporate partner network, portfolio size, portfolio concentration, CVC experience), financial backing: linear regressions (corporate partner network, portfolio size, portfolio concentration, CVC experience), lead background: linear regression (corporate partner network, portfolio size, portfolio concentration, CVC experience), employees per start-up: linear regression (corporate partner network, portfolio size, portfolio concentration, CVC experience), start-up employees: Poisson (B2B orientation, number of active investors), start-up age: Poisson (B2B orientation, number of active investors).

Table 20: Marginal effects of complete case Poisson regression results (author's dataset)

Dependent variables Independent variables	**Poisson Financial** Capital raised	**Poisson Strategic** Market access
Portfolio size	0.980***	33.107***
	(0.044)	(0.193)
Portfolio concentration	-53.739***	-355.235***
	(5.646)	(35.034)
Industry fit (corp. and start-up)	0.301	-374.937***
	(1.706)	(5.641)
CVC experience	3.954***	-85.115***
	(0.451)	(1.554)
Lead background	-123.062***	2,815.210***
	(7.563)	(26.912)
Employees per start-up	-11.842***	-481.270***
	(2.805)	(10.969)
Spatial distance (CVC and corp.)	-0.014***	-0.061***
	(0.001)	(0.004)
Corporate partner network	-393.055***	-2,093.785***
	(30.397)	(120.536)
Popularity	-0.110***	2.224***
	(0.007)	(0.028)
Financial backing	-0.001***	-0.029***
	(0.000)	(0.000)
Start-up employees	0.001***	-0.014***
	(0.000)	(0.001)
Start-up age	4.334***	31.775***
	(0.097)	(0.342)
B2B orientation	39.502***	-116.634***
	(2.143)	(5.868)
Number of active investors	3.920***	62.259***
	(0.065)	(0.263)
Observations	210	210

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05

Appendix B: III.3 An empirical differentiation of CVC and corporate accelerator

Table 21: Descriptive statistics and correlations for CVC (author's dataset)

Variable	Obs	Mean	Std. Dev.	Min	Max	1.	2.	3.	4.	5.	6.
1. Capital raised	210	59.1	122.5	0.0	1,008.0	1					
2. Market access	210	757.6	1,857.1	1	14,355	0.176*	1				
3. Portfolio size	210	46.4	29.1	2	87	0.0302	0.239***	1			
4. Portfolio concentration	210	0.5	0.2	0.3	1.0	0.0182	0.0954	0.106	1		
5. Industry fit (corp. and start-up)	210	0.4	0.5	0	1	0.104	0.0931	0.400***	0.382***	1	
6. CV experience	210	6.4	4.3	1	17	-0.0271	-0.128	-0.492***	-0.308***	0.0275	1
7. Lead background	210	0.1	0.2	0	1	-0.0368	-0.0300	-0.0454	-0.374***	0.0628	0.548***
8. Employees per start-up	210	0.8	0.6	0	2	-0.0347	-0.0903	-0.170*	-0.215**	-0.396***	-0.314***
9. Spatial distance (CV and corp.)	210	429.4	1,314.8	0	6,229	-0.0577	-0.0330	-0.0109	0.400***	0.206**	0.0871
10. Corporate partner network	210	0.1	0.1	0	1	-0.00975	0.135	0.276***	0.442***	0.304***	-0.366***
11. Popularity	210	111.8	156.8	0	520	-0.0865	-0.0295	-0.256***	-0.264***	-0.367***	0.224**
12. Financial backing	210	62,955.1	28,869.6	2,812	98,678	-0.0216	0.0259	0.533***	-0.496***	-0.0953	-0.130
13. Start-up employees	210	405.7	3,535.0	2	50,000	0.0205	-0.0119	-0.0295	0.143*	-0.0605	0.0344
14. Start-up age	210	9.4	5.5	1	33	0.235***	0.109	0.144*	-0.0303	0.0517	-0.0243
15. B2B orientation	210	0.8	0.4	0	1	0.0781	-0.0173	0.112	0.0219	0.224**	-0.00199
16. Number of active investors	210	9.8	7.1	1	46	0.366***	0.270***	-0.0120	-0.0590	-0.00821	-0.0222

Variable	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
7. Lead background	1									
8. Employees per start-up	0.0918	1								
9. Spatial distance (CV and corp.)	-0.157*	0.00833	1							
10. Corporate partner network	-0.187**	-0.233***	-0.0657	1						
11. Popularity	-0.323***	-0.247***	-0.163*	-0.254***	1					
12. Financial backing	0.176*	-0.188**	-0.343***	-0.158*	0.0547	1				
13. Start-up employees	-0.0519	0.00446	0.292***	-0.0370	-0.0533	-0.126	1			
14. Start-up age	0.129	0.00320	-0.0318	-0.000378	-0.139*	0.102	-0.0148	1		
15. B2B orientation	0.204**	-0.0956	0.00152	0.102	-0.171*	0.148*	0.0446	0.159*	1	
16. Number of active investors	-0.0134	-0.0588	-0.130	-0.0399	-0.0187	0.117	-0.0380	-0.0574	0.0104	1

*** p<0.001, ** p<0.01, * p<0.05

Table 22: Descriptive statistics and correlations for CA (author's dataset)

Variable	Obs	Mean	Std. Dev.	Min	Max	1.	2.	3.	4.	5.	6.
1. Capital raised	132	3.7	10.8	0.0	70.2	1					
2. Market access	132	123.2	354.8	1	3,910	0.334***	1				
3. Portfolio size	132	53.9	24.6	3	75	-0.276**	-0.265**	1			
4. Portfolio diversity	132	0.5	0.1	0.3	0.6	0.168	0.0402	0.0930	1		
5. Industry fit (corp. and start-up)	132	0.2	0.4	0	1	0.161	0.262**	-0.318***	-0.0207	1	
6. CV experience	132	4.9	2.3	1	17	0.277**	0.410***	0.124	-0.129	-0.124	1
7. Lead background	132	0.3	0.3	0	1	-0.113	-0.0532	-0.0986	0.350***	0.0262	-0.306***
8. Employees per start-up	132	0.9	2.0	0	16	0.0551	0.0215	-0.436***	0.262**	0.0156	-0.169
9. Spatial distance (CV and corp.)	132	230.2	282.7	0	596	-0.177*	-0.168	0.347***	-0.482***	-0.143	0.182*
10. Corporate partner network	132	0.2	0.3	0	2	0.0440	0.00306	-0.544***	-0.0963	0.227**	-0.370***
11. Popularity	132	1,095.3	1,046.7	0	2,635	-0.168	-0.0699	0.197*	-0.253**	-0.237**	0.227**
12. Financial backing	132	49,198.1	51,551.2	3,563	164,330	0.365***	0.110	-0.103	0.230**	0.484***	-0.198*
13. Start-up employees	132	13.5	21.1	2	200	0.607***	0.235**	-0.100	0.139	0.0814	0.0907
14. Start-up age	132	4.7	2.5	1	17	0.501***	0.498***	-0.198*	0.0774	0.0433	0.514***
15. B2B orientation	132	0.7	0.5	0	1	0.0692	-0.163	-0.0686	-0.0525	0.0282	-0.0332
16. Number of active investors	132	4.5	3.8	1	24	0.458***	0.250**	-0.376***	0.159	0.142	0.0916

Variable	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
7. Lead background	1									
8. Employees per start-up	0.0315	1								
9. Spatial distance (CV and corp.)	-0.535***	-0.210*	1							
10. Corporate partner network	0.159	0.287***	0.0429	1						
11. Popularity	-0.385***	-0.280**	0.460***	-0.142	1					
12. Financial backing	-0.361***	0.0302	0.178*	0.246**	-0.0420	1				
13. Start-up employees	-0.131	-0.00975	-0.0219	-0.0253	-0.0283	0.247**	1			
14. Start-up age	-0.108	-0.102	-0.133	-0.0541	0.105	0.183*	0.223*	1		
15. B2B orientation	-0.314***	-0.0538	0.221*	0.0291	0.0577	0.302***	0.0658	0.0262	1	
16. Number of active investors	-0.0831	0.0504	-0.126	0.0994	0.0297	0.277**	0.406***	0.325***	0.0228	1

*** p<0.001, ** p<0.01, * p<0.05

Table 23: Ordinary-least square, Tobit and negative binomial regressions for dummy regressions (author's dataset)

	OLS Financial	**OLS Strategic**	**Tobit Financial**	**Tobit Strategic**	**Nbreg Financial**	**Nbreg Strategic**
Dependent variables Independent variables	Capital raised[a]	Market access[a]	Capital raised	Market access	Capital raised	Market access
CVC dummy	2.723***	1.025***	1.874	119.936	2.181***	1.034***
	(0.222)	(0.224)	(11.640)	(188.399)	(0.172)	(0.165)
Financial backing	0.000*	0.000	-0.000	-0.001	0.000***	0.000*
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Start-up employees	0.000	-0.000	0.001	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.002)	(0.028)	(0.000)	(0.000)
Start-up age	0.114***	0.069***	5.043***	43.599*	0.106***	0.094***
	(0.020)	(0.020)	(1.042)	(16.868)	(0.016)	(0.016)
B2B orientation	0.179	-0.456*	10.231	-154.719	-0.423*	-0.890***
	(0.218)	(0.221)	(11.470)	(185.644)	(0.194)	(0.171)
Number of active investors	0.158***	0.040**	5.776***	64.392***	0.110***	0.105***
	(0.015)	(0.015)	(0.787)	(12.730)	(0.015)	(0.013)
Constant	-2.989***	3.347***	-43.290***	-241.236	-0.458*	3.890***
	(0.235)	(0.237)	(12.328)	(199.535)	(0.210)	(0.185)
Observations	342	342	342	342	342	342
Pseudo R^2	0.675	0.218	0.0233	0.00768	0.103	0.0471

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05; a = logarithm for dependent variable

Table 24: All observations and outlier exclusion regressions for dummy regressions (author's dataset)

	Poisson Financial – All observations	**Poisson Strategic – All observations**	**Poisson Financial – Outlier exclusion**	**Poisson Strategic – Outlier exclusion**
Dependent variables Independent variables	Capital raised	Market access	Capital raised	Market access
CVC dummy	1.773***	1.362***	1.672***	0.902***
	(0.043)	(0.008)	(0.049)	(0.009)
Financial backing	-0.000***	-0.000*	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Start-up employees	0.000***	-0.000*	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Start-up age	0.089***	0.052***	0.073***	0.051***
	(0.001)	(0.000)	(0.002)	(0.001)
B2B orientation	0.504***	-0.461***	0.037	-0.749***
	(0.025)	(0.005)	(0.031)	(0.006)
Number of active investors	0.068***	0.059***	0.052***	0.100***
	(0.001)	(0.000)	(0.001)	(0.000)
Constant	0.209***	4.406***	0.734***	4.389***
	(0.047)	(0.008)	(0.052)	(0.010)
Observations	433	449	326	326
Pseudo R^2	0.469	0.325	0.606	0.513

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05

Table 25: Unmatched Poisson regressions for effects of CVC and CA on start-up performance (author's dataset)

	Poisson Financial	**Poisson Strategic**
Dependent variables Independent variables	Capital raised	Market access
CVC dummy	1.784***	1.147***
	(0.048)	(0.009)
Financial backing	-0.000***	0.000***
	(0.000)	(0.000)
Start-up employees	0.000***	-0.000***
	(0.000)	(0.000)
Start-up age	0.080***	0.061***
	(0.001)	(0.000)
B2B orientation	0.460***	-0.263***
	(0.028)	(0.006)
Number of active investors	0.071***	0.058***
	(0.001)	(0.000)
Constant	0.376***	4.347***
	(0.052)	(0.010)
Observations	342	342
Pseudo R^2	0.484	0.297

Standard errors in parentheses,
*** p<0.001, ** p<0.01, * p<0.05

Table 26: Unmatched marginal effects of Poisson regressions for effects of CVC and CA on start-up performance (author's dataset)

	Poisson Financial	**Poisson Strategic**
Dependent variables Independent variables	Capital raised	Market access
CVC dummy	67.267***	587.941***
	(1.902)	(4.750)
Financial backing	-0.000***	0.000***
	(0.000)	(0.000)
Start-up employees	0.001***	-0.004***
	(0.000)	(0.001)
Start-up age	3.031***	31.248***
	(0.060)	(0.226)
B2B orientation	17.349***	-134.705***
	(1.060)	(3.084)
Number of active investors	2.690***	29.995***
	(0.038)	(0.135)
Observations	342	342

Standard errors in parentheses,
*** p<0.001, ** p<0.01, * p<0.05