ARE MULTIPLE SHARKS DANGEROUS? THE IMPACT OF MULTIPLE CORPORATE INVESTORS ON VENTURES' INNOVATIVE OUTCOME

When they are familiar - the impact of prior ties, and when swimming in their waters - the impact of industry relatedness

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RESUMÉ

Trods den voksende videnskabelige interesse for virksomheders venture kapitalinvesteringer skelnes der i størstedelen af litteraturen ikke mellem tilstedeværelsen af én eller flere virksomhedsinvestorer, samt hvorvidt, og hvordan disse påvirker ventures innovative performance. Denne afhandling fokuserer på, hvorledes ventures påvirkes af at have flere virksomhedsinvestorer (”hajer”) på samme tid samt specifikt hvordan tidligere relationer mellem virksomhedsinvestorer og graden af industri sammenlignelighed mellem virksomhedsinvestorer og ventures påvirker venturen’s innovative performance. Undersøgelsen er baseret på et datasæt med 14.048 ventures fra USA indenfor life science og informations- og telekommunikationsindustrien, der har modtaget investering mellem 2003 og 2020 fra uafhængige venturekapitalister (IVCs) og virksomhedsinvestorer (CVCs). Vores resultater viser, at ventures som har modtaget investering af flere virksomhedsinvestorer, udviser højere innovationsperformance (målt på patentansøgninger) sammenlignet med ventures, der udelukkende er finansieret af én virksomhedsinvestor og/eller uafhængige venturekapitalister (IVCs). Resultaterne viser samtidigt, at givet der er flere virksomhedsinvestorer, samt at de nogen grad tidligere har investeret sammen, så påvirker dette venturen’s innovations performance positivt. Ydermere finder vi, at givet tilstedeværelsen virksomhedsinvestorer, så er stigende industri sammenlignelighed mellem virksomhedsinvestorerne og venturen forbundet med negativ innovativ performance for venturen, dog i mindre grad når der er flere virksomhedsinvestorer til stede. En robusthedskontrol viser, at resultaterne er følsomme over for ændringer i modelspecifikationer, og konklusionen ændres afhængig af graden af tidligere relationer mellem virksomhedsinvestorerne. Vores afhandling bidrager både til områder inden for virksomheders venture kapitalinvesteringer, iværksætterfinansiering samt innovation forskning.

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1. INTRODUCTION

The phenomenon of Corporate Venture Capital (CVC) is growing and becoming more prolific. In the second quarter of 2020, CVC participated in 24% of all deals in VC-backed ventures globally (PwC & CB Insight, 2020). CVC deals are on average larger in terms of value compared to traditional venture capital (VC), and in 2020, the annual CVC financing hit yet another milestone by soaring to an all-time high of USD 73 billion, increasing 13% annually since 2013 (CB Insight, 2021).

Corporates are increasingly engaging in CVC activities (CB Insights, 2018) which underscores that it has become a popular tool within the corporate innovation toolbox (Dushnitsky, 2012). Accordingly, CVC has attracted the attention of researchers, and the field has witnessed an increasing number of research articles that delve into multiple avenues such as when CVC creates value for the corporation (see for example Dushnitsky and Lenox, 2006; Wadhwa and Basu, 2006), how it creates value for the ventures (see for example Alvarez-Garrido and Dushnitsky, 2016; Park and Steensma, 2012) and many other essential aspects (for a comprehensive overview of relevant literature, see for example Wadhwa et al., 2016).

Besides CVC being an interesting field, the motivation behind this thesis can best be conveyed via an illustrative example: In 2018, the five-year old US biopharmaceutical venture Alector Inc. announced the closing of its latest funding round. The company that is pioneering the immune-neurology therapeutic area raised around USD 130 million from a diversified investment syndicate. Among others were well-established corporations including Amgen Inc., Abbott Laboratories, Eli Lilly and Co. and Alphabet Inc., and other independent venture capital firms such as Foresite Capital, SV Health Investors and OrbiMed (Crunchbase, 2020). This example portrays a situation we may see more often as more corporates begin to pursue CVC activities, and a natural question arises: are the ventures' innovative performance *positively* affected by the *presence* of multiple corporate investors? Attempting to answer this question is the main motivation behind this thesis.

This study is particularly prevalent in current times. While there is a consensus among scholars that CVC investors increase ventures' innovative performance (e.g., Chemmanur et al., 2014; Park and Steensma, 2013), scholars in recent years have turned their focus towards unraveling the underlying mechanisms that influence the CVC-backed ventures innovative performance (e.g., Alvarez-Garrido and Dushnitsky, 2016; Pahnke et al., 2015; Kim and Park, 2017). Yet, most of this research focus on a dyadic corporate-venture investment relationship (i.e., one corporate investor and one venture).

And, so far, researchers have neglected to explore the performance (implications) for ventures backed by multiple corporate investors. Some research on independent venture capital (IVC) syndication has been undertaken where for instance Tian (2012) find that VC-syndicates increase ventures' innovative performance and Das et al. (2011) find a higher likelihood of a successful exit (i.e., an IPO or acquisition). However, CVCs and IVCs differ on many levels. Besides both contributing financial resources, CVCs can provide access to a wide set of resources to ventures that IVCs typically lack (Gompers and Lerner, 2000a). In addition, CVCs are primarily interested in maximizing the total value of their parent organization (Hellmann, 2002) and mainly pursues a strategic objective (Dushnitsky and Lenox, 2006) rather than investing solely for a financial return (Chesbrough, 2002). In contrast, IVCs primarily focus on generating a financial return on their investments and maximizing the value of their portfolio companies (Hochberg et al., 2007) to return capital gains to their investors (Gompers and Lerner, 2004). This underscores the heterogeneity between the two investor types, and can inherently give rise to various performance implications for ventures backed by multiple corporate investors.

Central to the discussion is, *when* should a venture accept CVC investments, considering the tension that ventures face between the need for resources from investors due to their liability of newness and the potentially damaging misappropriation of their own resources (e.g., knowledge, interventions, discoveries) by corporate investors ("sharks") (Katila et al., 2008; Wadhwa and Basu, 2013; Hallen et al., 2014). As corporates invest for strategic reasons, such as to realize innovative benefits (Dushnitsky and Lenox, 2006; Wadhwa and Kota, 2006), they are inclined to take advantage of ventures by exploiting their information and imitate their invention, potentially leaving the venture empty-handed (Dushnitsky and Shaver, 2009). This is especially profound when the venture and CVCs' parent company operate within the same industry (Dushnitsky and Shaver, 2009). Essentially, this leads to decisional trade-off for the venture, as the same industry-corporate investors are deemed the best partners (Gompers and Lerner, 2000a) due to their ability to provide complementary assets (Alvarez-Garrido and Dushnitsky, 2016), unique insights into industry trends and evolution (Hendricks, 2002; Henderson and Leleux, 2002), and deep technical knowledge (Maula et al., 2006; Chemmanur et al., 2014). However, they are also considered the most dangerous partners due to their greater ability and motivation to misappropriate the ventures' resources to limit the chances of creating a new competitor and potentially taking a share of the profit pool in the same industry (Colombo and Shafi, 2016). In the context of multiple corporate investors, several important questions arise: how are the ventures' innovative performance affected by corporate investors familiarity and ability to coordinate their effort and behavior given they previously have invested together? And how are ventures' innovative performance affected by the corporate investors and the venture operating in related industries?

While the majority of CVC research is centered around a relationship, the example of Alector Inc. paints a different picture. In this example, the venture received investments from several corporations including some of the leading

pharmaceutical companies, Eli Lilly and Co. and Amgen Inc, leading medical instrument company, Abbott Laboratories, and leading software company, Alphabet Inc. Each of these companies presumably have their own strategic agenda. Accordingly, scholars have found a nontrivial number of their sample ventures being funded by multiple corporate investors (some even being competitors as in the case of Alector Inc.) and additionally called for research to understand how this influences the performance of such ventures (e.g., Park and Steensma, 2013; Dushnitsky and Shapira, 2010). We therefore respond to this call and address the research gap in the literature as well as follow the recent literature stream to uncover potential underlying dynamics in a (multiple) corporate venture capital setting.

Research questions

As innovation is at the heart of the many new ventures, the purpose of this thesis is to examine the impact of multiple corporate investors on ventures' innovative performance. Specifically, we intend to unfold if presence of multiple corporate investors positively impact the ventures' innovative performance compared to other investors. We do this by distinguishing between ventures funded by: 1) purely IVCs; 2) the *presence* of one corporate investor; and 3) the *presence* multiple corporate investors. In most cases IVCs are present in the investment syndicate and will, therefore, be included when examining the *presence* of one corporate investor and multiple corporate investors. As each corporate investor typically has their own agenda, we seek to uncover how inter-firm trust and the apparent ability to work together, based on previously having invested together in a venture, impacts ventures' innovative performance. Additionally, we aim to investigate how industry relatedness between the venture and the corporate investors impacts the ventures' innovative performance. To operationalize this aim, we explore the following research questions:

1) *Does multiple corporate investors impact ventures' innovative performance?*
2) *How does multiple corporate investors with prior ties impact ventures' innovative performance?*
3) *How does multiple corporate investors in related industries to the venture impact ventures' innovative performance?*

To address the research questions, we draw on the existing body of CVC literature and provide in-depth reviews of articles related to the research questions. We further draw on existing IVC-literature to distinguish between IVCs and CVCs, and as the largest body of literature on venture investment syndicates is concentrated within this field. In addition, we draw on the strategic alliance literature to assist in explaining the dynamics of when multiple corporate investors engage in a syndicate together and how prior inter-firm relationships may impact their behavior towards the venture. Accordingly, the strategic alliance literature has previously been used to explain aspects of

the CVC literature (e.g., Hallen et al., 2014; Maula, 2001). Lastly, we draw on game theory as a theoretical concept to help guide the understanding of how prior ties can impact ventures' innovative performance. Game theory is not intended to be used extensively throughout the thesis but is used to contextualize certain behaviors in a multiple corporate venture capital setting.

This thesis aims at contributing to both practitioners and academia. Given that a nontrivial number of ventures are funded by multiple corporate investors and scholars have called for research in this area (Park and Steensma, 2013; Dushnitsky and Shapira, 2010), we aim to help bridge the gap in literature, and contribute to the corporate venture capital, innovation, and entrepreneurial finance literature. The conclusions of this thesis will furthermore have several implications for practitioners (e.g., entrepreneurs and CVC managers) to make better informed decision when choosing its (co-)investors and understanding some of the underlying dynamics in the multiple corporate venture capital situation.

Delimitation

While there are many interesting research areas within corporate venture capital, and underlying dynamics in a multiple corporate investor situation, this thesis will solely focus on the research questions mentioned.

This thesis aims to investigate the impact of multiple corporate investors on ventures' innovative performance and selected underlying dynamics that may impact the ventures' innovative performance through an empirical investigation across a large sample of ventures, i.e., the "broader picture". Accordingly, this thesis does not aim to develop a particular reason of *how* multiple corporate investors impact the ventures' innovative performance. Neither does this thesis uncover all the relationships in the syndicate that can cause performance implications, and how each investor would gain from engaging in such syndicates.

Our data consists of 14,048 US-based ventures in the life science and information and communication technology (ITC) industry that received venture capital funding between 2003 and 2020. Therefore, our analysis is limited to ventures that have received investments within this time frame. To measure the ventures' innovative performance, we collect patent data from 1976 and 2021 to capture all the patenting activity for each venture. Although the time periods are up to date, we do not draw any conclusions about the future. It is neither our intention to generalize our results to other populations and settings. As such, the empirical findings of the main analysis are not necessarily applicable to other industries or geographical regions.

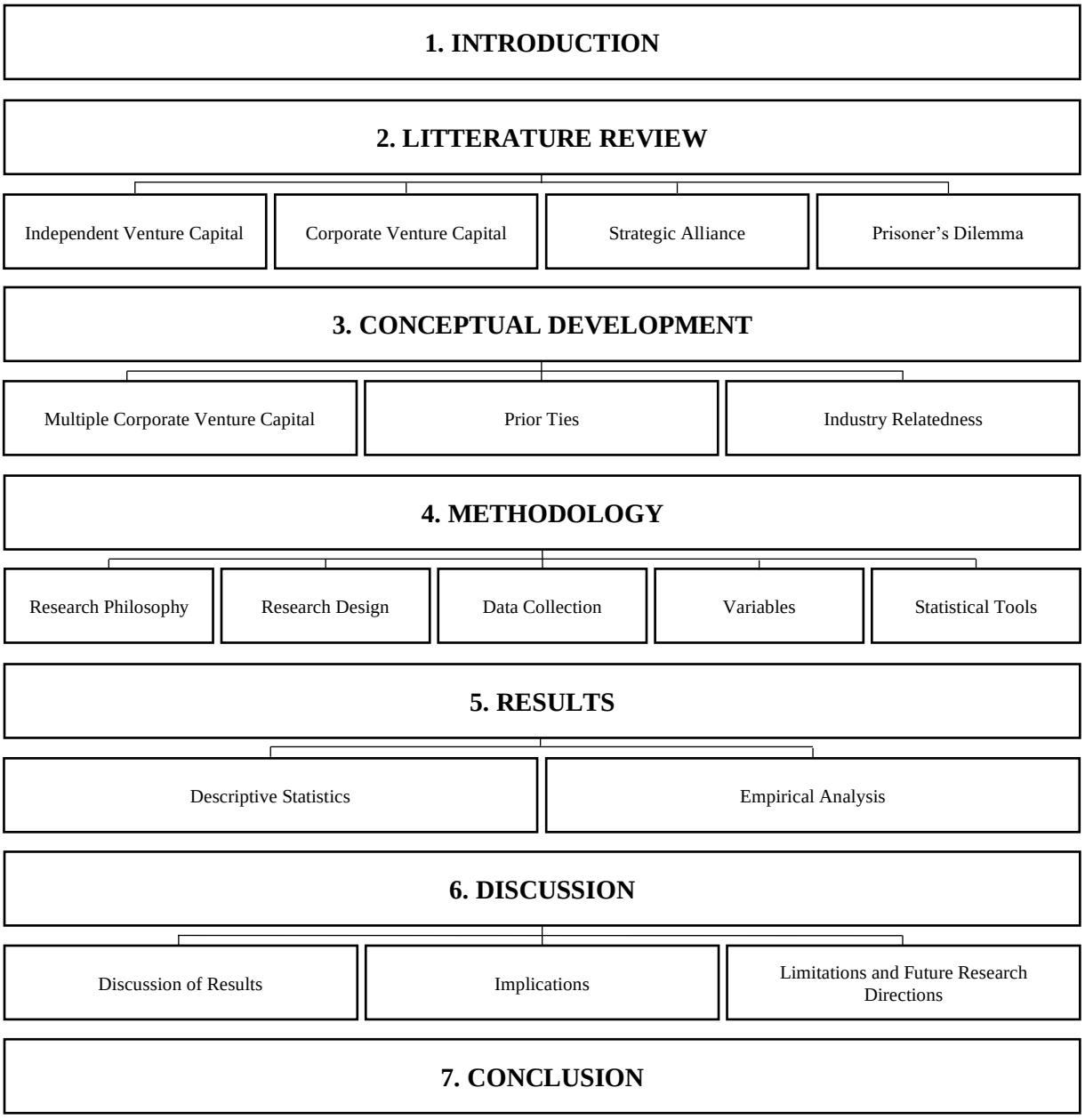
Structure

The structure of the thesis is illustrated in Figure I (see next page). After this introduction, a literature review is performed. The literature review revolves around four main areas: 1) a brief introduction to independent venture capital, venture performance when backed by IVCs, and VC-syndications; 2) a brief but comprehensive introduction to the CVC field, in-depth review of CVC-backed ventures' innovative performance and implications, and CVC-syndications; 3) a selected review of the strategic alliance literature, more specifically, the partner selection and operational stage; and 4) a brief introduction to game theory and the prisoner's dilemma.

Building on the literature review, a conceptual development follows, which guides us to our research questions and serve as the background for empirical analysis. The conceptual development unfolds the research questions that are operationalized in the analysis on the ventures' innovative performance: 1) multiple corporate investors; 2) prior ties between corporate investors; and 3) industry relatedness.

Subsequently, the methodology applied in the empirical analysis of this thesis will be described. The research philosophy and design, data collection and how we processed it, variables applied as proxies to answer the research questions and statistical tools will be discussed. After the methodology section, the results will follow. First, the data is described in the descriptive statistics section. Subsequently, the results from the main regression model are presented followed by a robustness test. Next, a discussion of the results, limitations and future research, and implications will be conducted. Lastly, we round of with the conclusion.

Figure I: Thesis Structure



2. LITTERATURE REVIEW

This literature review is divided into four sections. The first section on independent venture capital (IVC) will include a brief introduction to IVC and the impact on ventures' performance to create an understanding of the investor heterogeneity between IVCs and corporate venture capital (CVCs). Subsequently, literature on VC-syndication will be reviewed to provide an understanding behind the main motives and implications for syndicating investments as the CVC literature has been quite silent in this area. The second section will start by providing a concise overview of the CVC literature, followed by an in-depth review of academic papers focusing on ventures' innovative performance and implications behind receiving CVC-funding, and lastly, a review of articles related to syndications with CVC presence. This section will lead to the research gap this thesis aims to bridge. The third section will review the strategic alliance literature with an emphasis on the partner selection and operational stage to help explain some of the dynamics in a multiple corporate venture capital setting. Finally, the fourth section will introduce a concise summary of the game theory and prisoner's dilemma theoretical concepts that are applied in this thesis.

2.1. Independent Venture Capital

This section provides an overview of existing literature related to independent venture capital. Instead of providing an exhaustive review of the literature on independent venture capital, this section focuses on the stream of literature that is relevant to our research question (for a comprehensive review, see for example Drover et al., 2017). The review begins with a brief introduction to independent venture capital, followed by IVC-backed venture performance with a particular emphasis on innovative performance, and lastly the motives for engaging in syndications, potential conflicts and how VC-syndications impact ventures' performance.

2.1.1. A review towards understanding Independent Venture Capital

Independent Venture Capital (IVC) represents the most traditional and developed form of venture capital (VC) in the United States and abroad (Kovner and Lerner, 2015). The beginnings of IVC dates back to the 1940s when the first professional IVC investors originated in the US (Hsu and Kenney, 2005). IVCs manage several pools of capital provided by various sources (e.g., banks, pension funds, hedge funds, insurance companies, university

endowments, wealthy individuals, and family offices). Each pool is generally organized as a legally separate limited partnership (i.e., the investment fund), with a management company (e.g., *Kleiner Perkins*) serving as the general partner (GP), and capital providers serving as limited partners (LPs) (Sahlman, 1990). Although the LPs provide most of the capital to the investment fund, they do not play an active role in the management of the investments in the portfolio of companies. This is the responsibility of the GP, who looks for valuable investment opportunities and manages them throughout the investment period. In return, the GP is (generally) compensated by an annual management fee of up to 2% of the fund size and carried interest of 20%, over a specific hurdle rate, of the generated profits to the LPs (Litvak, 2009).

The main objective of IVCs is to realize the greatest possible internal rate of return (IRR), that is, a conspicuous capital gain in the shortest possible time (i.e., pure financial objective) (Gompers and Lerner, 2000b). Superior capital gains from the venture investments not only increases the wealth of the GPs but can also signal their success, enhancing subsequent fundraising efforts, leading to larger management fees, and attracting better quality ventures (Gompers and Lerner, 2004). To achieve the highest possible financial return, the IVCs aim at investing in promising entrepreneurial ventures with the goal of either selling the ventures to another firm or taking it public in an initial public offering (IPO) (Colombo and Murtinu, 2016). As IVCs need to return conspicuous capital gains in the shortest possible time and the investment funds usually being 10-12 years, the GPs are pressured to invest in entrepreneurial ventures, manage the portfolio firms to increase their value, and exit their investment within a short and limited time frame (Hochberg, Ljungqvist and Lu, 2007).

2.1.2. Venture Performance

Entrepreneurial ventures typically face substantial technology, business model and operational risks (Alvarez-Garrido and Dushnitsky, 2016). Accordingly, as the IVCs select the venture on behalf of institutional investors and try to guide the entrepreneurs to exit with positive returns (Hellmann and Puri, 2000), they have incentives to become actively involved in the venture to enhance the value (Pahnke et al., 2015). To accomplish this objective, IVCs provide financial resources to the new ventures for them to invest in value generating activities such as R&D, production, marketing etc. (e.g., Park and Steensma, 2013), but also provide value-adding activities (Sørensen, 2007; Sapienza et. al, 1996). These value-adding activities include strategic and operational guidance, coaching, and mentoring to the entrepreneurs (MacMillan et al., 1989) through active monitoring and participation on the ventures' board (Megginson and Weiss, 1991). Moreover, IVC-backed ventures benefit from drawing on the

network of contacts that may be provided by well-connected IVCs such as potential customers, suppliers, and managers (Hellmann and Puri, 2002; Hochberg Ljungqvist and Lu, 2007).

In the extant literature there is however an ongoing discussion about the causality of the IVCs impact on the ventures' performance (e.g., Gompers and Lerner, 2001; Balboa et al., 2011). Specifically, it is difficult to detangle if IVCs have a superior ability to identify and invest in inherently *more* successful ventures (i.e., selection effect) or whether they have a superior ability to add value to the ventures (i.e., nurturing effect). After controlling for the selection effect, Croce et al. (2013) find that European VC-backed ventures perform better (in term of productivity growth) in the first few years through the impact of IVCs value-added activities (i.e., nurturing effect). In contrast, Chemmanur et al. (2011) provide evidence from the US manufacturing industry that the higher performance of VC-backed ventures (in terms of sales and productivity) is primarily a result of better screening abilities (i.e., selection effect). Sørensen (2007) likewise support the selecting effect but also the nurturing effect (yet noting that the former is almost twice as important as the latter), especially for experienced VCs, in terms of ventures' likelihood to go to public. Further arguing, that the contrasting findings may be associated to the institutional context, i.e., that the US VC market is more developed than the European VC market in terms of entrepreneurial venture financing (e.g., Hege et al., 2003), the discussion is yet inconclusive. To enrich the discussion and due to the high relevancy to this thesis, this section will proceed to focus on papers that research IVC-backed ventures' innovative performance.

Innovative Performance

Early scholars provide evidence that ventures backed by IVCs exhibit higher innovation output (compared to ventures without IVC-backing), primarily due their ability to draw on the IVCs network (Timmons and Bygrave, 1986) such as universities, larger corporations, and other entrepreneurial ventures (Florida and Kenney, 1988). In a later study, Kortum and Lerner (2000) support the evidence that IVC-backed ventures have higher innovative performance (by measuring patenting output) by studying a large sample across twenty industries between 1965 and 1992. A follow-up study undertaking by Hirukawa and Ueda (2008) confirms that this effect continued throughout the 1990's. Recent studies similarly show that IVC-backed ventures exhibit higher innovative performance primarily due to the IVCs' higher tolerance for failure (Tian and Wang, 2014), deep engagement with entrepreneurs (e.g., coaching and mentoring), and practices such as staged financing (e.g., milestone payments) and board seats (Pahnke et al., 2015). In contrast, other recent studies find that IVCs impact on venture patenting output is insignificant or negative, and show that IVCs instead follow patent signals to invest in ventures with

commercially viable know-how that they are likely to rationalize, rather than increase future patenting output (innovation) (e.g., Engel and Keilbach, 2007; Lahr and Mina, 2016).

Along the same lines, scholars emphasize that IVCs tend to select ventures with existing viable innovations and promote the commercialization of these rather than foster continued innovation activities. For instance, Hellman and Puri (2000) provide empirical evidence from Silicon Valley-ventures that *innovator firms* (i.e., first to introduce new products or services for which no close substitute is yet offered in the market) are more likely to obtain IVC-funding than *imitator firms* (i.e., are not first-movers in their market and tend to compete on other aspects than innovation). The results show that *innovator firms* obtaining IVC-funding are associated with faster time to market and they suggest significant interrelation between IVC-funding and product market dimension, indicating a focus on commercial efforts over continued innovation activities. Similarly, Caselli et al. (2009) find that IVCs in the Italian market choose firms with demonstrated innovative output, and once the investment is made, continued innovation is not promoted but rather a focus to improve other economic and managerial aspects of the ventures. In the same vein, Hirukawa and Ueda (2011) draw on a large panel data study from US manufacturing industry 1968 and 2001 and find supporting evidence that IVCs tend to invest in ventures with high demonstrated innovative performance and find little to no evidence that IVC-backed ventures stimulate innovation performance (when measuring patent counts) post-investment.

Taken together, some scholars find that IVCs enhance the innovative performance of their portfolio companies meanwhile others find little to no effect on innovative performance. In general, it appears that IVCs tend to follow "patent (innovation) signals" to invest in ventures and, rather than fostering continued innovation activities, they focus on commercializing these. Accordingly, Park and Steensma (2013) suggest that IVCs may benefit less from ventures' innovative activities at the expense of other value creating activities (such as commercialization efforts) that favor capital gains, i.e., to maximize the value of their portfolio companies in the shortest possible time frame (Gompers and Lerner, 2000b).

2.1.3. Syndication

As little research on corporate venture capital syndication has been undertaken, this section will introduce syndication in a venture capital context to provide a perspective on syndications. First, we describe the VC's motivations behind engaging in syndicates and potential conflicts, and second, how VC-syndications impact the venture's performance.

In venture financing, investments are often carried out in syndicates, i.e., co-investing with other VCs (Meuleman et al., 2009). Accordingly, Tian (2012) find that around 70% of all VC investments are syndicated. Scholars distinguish between two definitions of syndications: 1) co-investing in the same venture in the same financing round (e.g., Dimov and Milanov, 2010); and 2) co-investing in the same venture but in different financing rounds that eventually becomes a syndicate of co-investors (e.g., Wright and Lockett, 2003). In this thesis, we subscribe to the latter definition. In most papers, scholars do not distinguish between distinct types of venture capitalists, e.g., independent venture capitalist (IVC), government-owned venture capitalist (GVC) and bank-affiliated venture capitalist (BVC). Unless explicitly noted we do neither in this section. However, most studies focus on IVCs as this is the largest and most studied category of venture financing (Kovner and Lerner, 2015). In section 2.2.3., we intentionally review the papers on syndication where CVCs are explicitly mentioned and studied.

There are primarily four motives for VCs to syndicate their investment (Manigart et al., 2006): 1) risk reduction; 2) higher quantity and quality of deal flow; 3) deal selection; and 4) value-adding activities. In this section, we will start by diving into each of these motives, and lastly explore conflicts that can arise in syndications.

Risk sharing

One of the first scholars to research the motives behind why VCs engage in syndications is Bygrave (1987, 1988). He finds that the higher uncertainty there is related to the venture, the higher the likelihood of VCs' co-investing due to the need to spread risks and increase information sharing between syndicate partners to reduce uncertainty. Based on a sample from the UK, Lockett and Wright (2001) further investigate the motives for syndication and find that the main motive is to a large extent driven by financial considerations, in particular, risk reduction and risk sharing rather than "resource sharing" (the value-add motive which will be explained below) or deal flow motive. More specifically, they find that VCs primarily co-invest to diversify the unsystematic risk of their venture investments. Similarly, Cumming (2006) finds that VCs with smaller fund sizes syndicate their investments to reduce unsystematic risks and additionally to decrease the risks of adverse selection (i.e., risk of investing in low-quality ventures). Along the same lines, by studying a cross-border sample (instead of only one country) Wang and Wang (2012) find that spreading the investments across a greater number of ventures whose performance do not covary, and by participating in syndications, enable VCs to reduce risk without lowering the expected return of the portfolio of ventures. By comparing regional differences, motives for syndication have furthermore been shown to differ between the US and the European VC market due to institutional differences. Specifically, in contrast with U.S. findings, European findings show that risk sharing, portfolio diversification, and access to larger deals are more important than selection and monitoring of deals (Lockett and Wright, 2001; Manigart et al., 2006).

Deal flow

Lerner (1994) is among the first to highlight the importance of the deal flow motive. He argues that having a strong syndication network increases the status and visibility of a VC firm, therefore, increasing its likelihood of being invited into a syndicate and subsequently leads to a better deal flow. Accordingly, Lerner (1994) finds that having a large pipeline of potential ventures increases the likelihood of selecting high-quality ventures. Similarly, Sorensen and Stuart (2001) find that participating in syndications increases the quantity and quality of the deal flow granting the VCs access to a higher quantity and quality of ventures and significantly reduces the risks of adverse selection. They further highlight that creating a geographically and industry-diverse system of trusted partners enable VCs to participate in attractive and non-local investment opportunities. An important aspect of consistently engaging in syndications is the fact that VCs create an expectation for reciprocation (VCs invite each other to syndicate together) in the future, meaning that deal flow can be maintained even when an individual VC firm may not be the originator of the deal (Lockett and Wright, 2001).

Deal selection

Lerner (1994) is additionally among the first to find evidence for the deal selection motive. He finds that participating in syndications is a way to better assess information on ventures as it serves as a mechanism to get a second opinion on the quality of the ventures from other syndicate members, which lead to a better selection of high-quality ventures. In a later study, Brander at al. (2002) find the same results and is further supported by Chemmanur and Tian (2011) who find that a second opinion significantly improves the investment selection process without any noteworthy additional costs. In fact, Chemmanur and Tian (2011) find that a second opinion from an experienced VC is more precise and thus significantly improves the investment selection process without additional costs. Interestingly, Casamatta and Haritchabalet (2007) find that inexperienced VCs benefit more from syndicating with other VCs as their own evaluation of a venture may not sufficient. On the opposite, they find that experienced VCs "suffer" from syndicating with less experienced VCs due to potential profit-sharing and are therefore more likely to syndicate with more experienced VCs due to their ability of better signaling venture quality.

Value-adding activities

During the post-investment phase, syndicating with other VCs plays a critical value-adding role towards the venture and VCs themselves. For instance, VCs can aggregate their expertise and monitoring effort to lower the chance of agency risks by influencing the leadership style of the CEO, keeping value-adding strategies on track, approving

bonuses for top management, and broadening the market focus (Bruining and Wright, 2002). A venture capitalist can also increase its "value" in the VC community by syndicating with more well-known and reputable VCs to increase its reputation and leverage the more established VCs to achieve higher legitimacy (Gompers and Lerner, 2004). Achieving high legitimacy in the VC community is viewed as being highly important to VCs since a good and sustainable track record strengthens its reputation and encourages other VC firms to syndicate with them (Lockett and Wright, 1999). Having a good reputation also proves to be important when investing cross-border. Dai et al. (2012) show that foreign VCs investing in Asian economies with high reputation have a higher likelihood of being invited into syndicates with local VCs, which is found to be an important strategy to handle asymmetric risks associated with geographic distances and cultural differences.

Conflicts

Despite the benefits of syndications, it may entail conflicts. For instance, a profound conflict of interest that may arise is the degree of involvement in the nurturing of ventures. Some VCs may exercise a "laissez faire" governance style, whereas others are "close trackers" with hands-on management (MacMillan et al., 1989). In addition, VCs often have diverse risk appetites. Some undertake a high-risk strategy with the intention to hit a "home run" by investing and focusing on a few ventures, whereas others undertake a relatively low-risk strategy by focusing on "singles" and diversifies its risks by investing in a larger number of ventures (Norton and Tenenbaum 1993). The degree of involvement is therefore lower in terms of having a higher number of venture investments in the portfolio compared to those whose VCs have a few ventures in their portfolio. Another conflict that may arise from syndication stems from the fact that individual VCs can leverage its information advantage to serve its own interest over the other VCs in the syndicate or other newcomers (Lerner, 1994). For instance, after a funding round in a venture, a VC firm may discover the real value of the investment, which it can leverage as an information advantage to serve its own interests. In the subsequent rounds, it can disguise or hold back the true value to other investors (Lerner, 1994). As the syndicate dynamics can be overly complex, Wright and Lockett (2003) examine how VC investments are structured and managed. They find that VC syndicates are comparable to interfirm alliances, where coordination and cooperation between the VC investors is required to achieve joint payoffs. Potential conflicts in terms of opportunistic behavior can for instance be mitigated through non-legal sanctions such as reputational effects over contractual arrangements. A bad reputation in the VC community may hurt a VCs opportunity to engage in other syndications or invest in ventures (Gompers and Lerner, 2004; Lockett and Wright, 1999). More recently, Zhang et al. (2017) show that a multiparty VC syndication is affected by a several group-level constructs and not only by individual dyadic relationships. These constructs may introduce various cooperation

and coordination conflicts which are suggested to be mitigated through familiarity, trust and closure provided by prior collaboration of the syndicating VCs.

Venture Performance in Syndications

As clearly shown, there are strong motives for VCs to syndicate their investments. Turning to explore how VC syndications affect venture performance, the extant literature primarily demonstrates that syndication increases the likelihood of ventures' successful exits (Jääskeläinen, 2012). The following section aims to provide an overview of this research, in which an IPO and acquisition (i.e., exits) are typically associated with a successful performance for the ventures. To the best of our knowledge there are limited studies that relate VC syndications to other performance measurements such as innovation and commercial outcomes. Prior studies have primarily investigated how syndicate characteristics affect venture performance from a resource perspective. These are: 1) syndicate network ties; 2) knowledge exchange; and 3) diversity. We will review these separately.

Network ties

VCs tend to syndicate their investments with other VCs rather than investing alone (Lerner, 1994). Through past and current investments, they are connected into webs of relationships with other VCs. Once they have invested in a company, VCs are found to draw on their networks of former investment partners and service providers, e.g., headhunters, patent lawyers, investment bankers, etc., to help the venture succeed (Gorman and Sahlman, 1989; Sahlman, 1990). Based on a sample of VCs in the UK and Continental Europe, Abell and Nisar (2007) find that highly networked VCs experience significantly better performance measured by the proportion of ventures that are successfully exited through an IPO or a sale to another company. They note that VC firms need to pay close attention to their relational strategies as networking is likely to add value to their venture investments' operations. In a similar study of US-based VCs, Hochberg et al. (2007) find that better networked VCs enjoy significantly better fund performance (in terms of portfolio exits). They further find that portfolio ventures of better-networked VCs are significantly more likely to survive and likely to obtain financing in succeeding funding rounds. Accordingly, Hochberg et al., (2007) find that the most important influences on venture performance (i.e., IPO or sale to another company) were found to be the size of the VC firm's networks, the tendency to be invited into other VCs syndicates, and access to the best networked VCs. In a similar study, Nahata (2008) find that VCs with a substantial network are more likely to lead its portfolio firms to successful exits, especially when the VCs are very reputable (measured by the aggregate investment amount in ventures).

Knowledge exchange

Based on a sample of Canadian VC firms, Brander et al. (2002) investigate whether VCs engage in syndications to obtain a "second opinion" on the ventures' future performance prospects (because VCs may not trust their own judgements) or whether to increase the "value-add" to the venture (i.e., to leverage a larger pool of resources). Their study clearly favors the "value-added"-hypothesis and shows that ventures backed by a syndicate, on average, provide investors with higher rates of return compared to ventures backed by a single VC. The underlying argument behind the value-add hypothesis is that VCs possess heterogeneous skills and expertise that they can leverage to increase the ventures' performance. For instance, some VCs may have extensive knowledge about production management while others in managing commercial activities, thereby supplementing each other's knowledge to enhance value creation to the venture. In the same vein, Tian (2012) find that syndicates are better at nurturing ventures which increases both the ventures' innovative performance (both in terms of patent output and quality, i.e., higher number of patents and forward citations) and financial performance (higher likelihood of successful exists in terms of IPO or acquisition). De Clercq and Dimov (2008) investigates how industry-specific knowledge affect the ventures' performance by whether the venture went public, was acquired, failed, or remained private. They find that VCs investing in industries in which a VC firm has more knowledge and investing with more or familiar partners increases the performance of the ventures. Yet, they note that if the syndicate becomes too large, it has a diminishing marginal effect in terms of performance due to potential conflicts such as misaligned goals and less efficient decision-making processes, and coordination issues. In other words, it may be more difficult for ventures to leverage the marginal knowledge contribution by increasing number of syndicate partners.

Diversity

VCs generally prefer to syndicate with similar partners (e.g., partners with same experience) as it likely reduces transaction costs, however heterogeneous syndicates show to have a larger impact on the ventures' performance (Du, 2016). Based on a sample of US-based VC investments, Du (2016) examines the short-term performance of VC syndicates (IPO or acquisition) and finds that given the high risks inherent in early-stage ventures, even experienced VCs have limited capabilities to gather and process all relevant information to make decisions. She therefore finds that it is beneficial for VCs to syndicate with partners that contribute different perspectives on the technology, market, and industry prospects to increase the performance of their venture investments. Complementing these findings, Chahine et al. (2019) investigate the effect of foreign VC participation in US VC-backed IPOs. They find that a VC syndicate composed of both domestic (US) and foreign (non-US) VC firms have a better ability to certify the quality of its portfolio companies which lead to higher IPO premiums. In addition, they argue

that while domestic VCs have extensive knowledge about the US business environment, foreign VCs can provide advice on foreign business activities to enhance value creation to the ventures.

Summing up, research on the performance of ventures backed by VC syndicates primarily suggests two types of performance mechanisms: post-investment management and the exit process. First, due to pooling of diverse resources, syndication is likely to enhance performance of ventures as it provides access to a broader range of opportunities, resources, and partners. Second, syndications provide better quality pricing in the exit process and a higher likelihood of a successful exit.

2.2. Corporate Venture Capital

The concept of CVC has attracted considerable attention from researchers. This section gives an overview of existing literature. It starts with the definition, followed by the corporates' objectives to engage in CVC, the historical evolution and the current state of the CVC landscape. Subsequently, program governance and the management of CVC investments are briefly presented. These are presented to provide a broader understanding of CVC and how it differs relative to IVC. Lastly, this section will include an in-depth review of the recent surge in academic papers related to CVC-backed ventures' innovative performance followed by a review of articles related to syndications with presence of corporate investors.

2.2.1. A review towards understanding Corporate Venture Capital

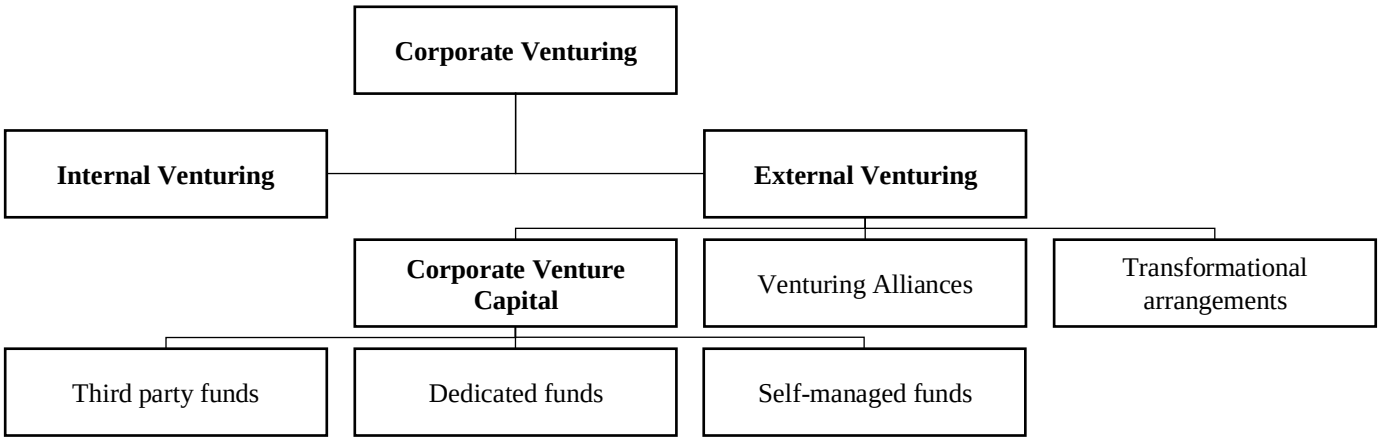
Definition

There are many ways to define CVC which can cause some term confusion. In this paper the definition proposed by Dushnitsky (2008) will be applied: "A minority equity investment by an established corporation in a privately-held entrepreneurial venture" (p. 2). Dushnitsky (2008) outlines three common factors to all CVC investments: 1) investments are often based on strategic objectives rather than merely financial returns; 2) the venture is privately held and independent from the investing corporation; and 3) venture investments are minority equity stakes.

The definition is not to be confused with corporate venturing which is more broadly defined. Corporate venturing is the overarching term used to describe any venturing investment a firm undertakes including investing in internal

entrepreneurial initiatives (Dushnitsky & Lenox, 2006). CVC can be subcategorized as part of a corporate's external venturing activities outside a firm's existing boundaries (Keil, 2002). This is illustrated in Figure II.

FIGURE II: CORPORATE VENTURING MODES



Note: External venturing modes adopted from Keil (2002)

Corporate venture capital resembles the operations of traditional venture capital firms in referring to programs residing at various levels of corporations where investments are made in independent external companies (Keil, 2002). In this thesis, only the corporate venture capital mode of corporate venturing will be covered.

Objective

The objective(s) behind corporates pursuing CVC activities has been discussed extensively in the literature. Although corporates may be motivated by the potential financial returns, common for all researchers within corporate venture capital is that the strategic objective is the most important for the corporates' engagements in corporate venture capital. Early research identifies numerous strategic benefits from CVC investments, such as exposure to new markets and technologies, identification of acquisition targets and market extension possibilities (Siegel et al., 1988; Sykes, 1990). Recent research has, however, emphasized the role of CVC investments as conduits for knowledge spillovers from innovative ventures to the corporate. For instance, Dushnitsky and Lenox (2006) find that CVC investments create greater firm value when firms explicitly pursue CVC to harness novel technology to realize innovative benefits such as to supplement a corporates' internal R&D effort. This learning opportunity enable corporates to combine ventures' innovative capabilities with their own to create higher firm value

(Dushnitsky and Lenox, 2006; Wadhwa and Kotha, 2006). Specifically, from use of new information gathered from the ventures, corporations can support, complement, or augment their internal R&D capabilities, exploit it to enter new markets or introduce new products earlier than competitors (Chesbrough and Tucci, 2003; Maula et al., 2003), and improve existing products by adding new features and functionality (Keil et al., 2004). Moreover, the products and innovations developed by ventures may stimulate demand for complementary products produced by the corporate investor which can add value for the corporation (Kann, 2000; Chesbrough, 2002).

Historical evolution

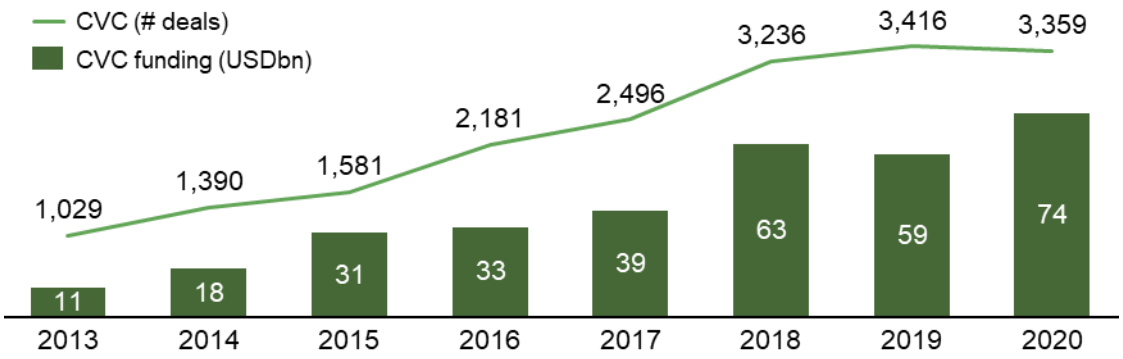
Historically, CVC activities have been highly cyclical. There have been three documented waves of CVC (Dushnitsky, 2008) meanwhile the recent years resurgence in CVC activities can be characterized as the fourth wave. Common for the past waves is the emergence of novel technologies that are an important precursor to CVC investments. The first wave started in the mid-1960s driven by three factors (Fast, 1978; Gompers & Lerner, 1998): 1) an overall diversification trend; 2) excess cash flows; and 3) inspiration of the financial success for independent venture capital funds. About one quarter of Fortune 500 engaged in CVC at that time. The first wave ended in early 1970s as the attractiveness of VC investments decreased drastically with the collapse of the IPO market in 1973 (Gompers and Lerner, 1998).

The second wave took place in the early 1980s due to changes in legislation, new technological commercial opportunities, and favorable market conditions. As the market crashed in 1987, it subsequently led to a sharp decline in CVC activities (Dushnitsky, 2008).

The third wave took place during the 1990s. This wave was primarily driven by technological advancements across a diverse set of industries. The number of CVCs and investment levels during this wave far exceeded previous ones (around 15% of all VC investments in 2000 were made by CVCs, equivalent to approx. USD 16 billion). As with previous waves, a crisis in the public market (see the IT-bubble crash) led to a decline in CVC activities (Dushnitsky, 2008). Yet, several leading corporations remained committed to CVC investments during the period (Chesbrough, 2002).

While it is evident that CVC activity has been highly cyclical, it is now more prolific than ever. CVC investments peaked to an all-time-high in 2020 at around USD 73 billion, up from USD 11 billion in 2013, increasing at a compound annual growth rate of 13% (CB Insights, 2021). At the same time, CVC constituted 24% of all VC deals in the second quarter of 2020 (PwC & CB Insights, 2020). In fact, this recent surge can be characterized as the fourth wave of CVC activity.

FIGURE III: GLOBAL ANNUAL DISCLOSED CVC DEALS AND FUNDING



Source: CB Insights (2021)

Programme Structure

The structure or program governance of CVC has been investigated differently in numerous studies, and due to the nature of organizational structure-related data, most studies have been based on self-reported surveys. It is often the case that studies use similar labels to describe dissimilar program structures. To avoid unnecessary term confusion, we follow the definition of Dushnitsky (2008) and differentiate between the two most common structural set-ups that invest *directly* in the venture: 1) an internal set-up with direct investments in ventures through current operating business units of the parent company (primarily R&D and business development units); and 2) an external CVC unit, which is a stand-alone, separate entity, and wholly owned by the parent company. At the same time, some firms choose to invest *indirectly* in the venture by joining existing VC funds as limited partners. We will briefly present the relevant existing literature on CVC structure and program governance.

McNally (1997) suggest that CVC investments can be categorized as either *direct* (i.e., a CVC investing directly in a venture) or *indirect* (i.e., a CVC invests through an outside VC fund). The direct investments are primarily undertaken for strategic objectives, while indirect investments for financial returns. The organizational structure (i.e., *internal* or *external*) is related to the concepts of decision-making and funding authority in the context of CVC-programme governance: internal CVC units investing directly often encounter a strict corporate approval process, while a separate subsidiary is generally associated with a higher degree of autonomy in decision-making.

Along the same vein, Lee et al. (2018) employ the perspective of organizational learning and find that an external structure is positively related to explorative corporate innovation performance, but negatively related to exploitative innovation performance. The reason for this is that a completely separated CVC unit is structurally disconnected from its parent. The structural disconnection and higher autonomy can cause further issues in case the

ventures rely on compatible resources, as the "structural" distance can impede effective collaboration between the parent CVC company and the venture (Lee et al., 2018). Contrary, a formal separate CVC unit limit the ventures' fear of misappropriation (e.g., due to corporate control and imitation) and increases approval by the VC community as it signals higher commitment to engaging in CVC activities and a low degree of bureaucracy (Siegel et al., 1988; Winters and Murfin, 1988).

According to Miles and Covin (2002), the decision of investing directly or indirectly in ventures depends on three factors: 1) degree of control, 2) commitment of resources; and 3) risk acceptance. A direct investment increases the control over the venture, eases the transferring of resources and capabilities from the corporate to the venture, but also increases the risks. Sykes (1990) similarly find that direct investments allow the corporate to build unique, high-quality business relationship with the venture while indirect investments imply a greater effort to build a relationship with the venture. At the same time, investing directly also entails multiple disadvantages. First, a limited ability to attract experienced personal as corporates cannot offer the same incentivized compensation scheme as independent VCs. Second, difficulty to establish sufficient deal flow as motives, strategies, and time commitment often differ from independent VCs. Third, it might provoke conflicts of interest between internal stakeholders, who are concerned about the allocation of scarce resources within the corporation (Sykes, 1990; Miles and Covin, 2002). Consequently, investing directly can have implications for the quality of ventures and internal commitment to the CVC programme.

In summary, the concept of investing *directly* decreases the "structural" distance to the venture and positively impacts the degree of relationship building, resource sharing and degree of control between the corporate and the venture. However, it requires a different level of involvement from the parent corporation which lowers the internal allocation of time, resources, and increases the risks. The structural set-up of the CVC programme is mostly concerned with the autonomy and signaling to the VC community and the ventures. An external setup increases autonomy and better signaling to the community but decreases resource sharing to the ventures and exploitive innovative performance for the corporate.

Managing investment relationship

In this section we aim to provide a brief overview of how CVCs manage their investments both pre- and post-investment and touch upon how corporate managers handle venture investments internally. The intension is to provide a conceptual understanding on the management of CVC investments and less on potential performance implications.

In the pre-investment stage, CVCs generate deal flow and select appropriate ventures to invest in. These are critical to achieve the CVC program's objective (Basu et al., 2013). CVCs primarily source potential deals internally or rely on contacts within the VC industry (Rohm, 2018). In the same vein, several studies highlight the importance of syndications (i.e., co-investing) with other VCs. CVCs engagement in syndications can result in a prominent network position in the VC network which can facilitate a greater information flow regarding venture investment opportunities and improve CVCs ability to identify ventures with a strong strategic fit (e.g., Maula et al., 2013; Yang et al., 2009). In terms of sourcing deals, CVCs use several search patterns. For instance, the industry overlap and IPP (intellectual property protection) regime of a potential venture play a crucial role in the investment decision process of CVCs as the marginal return is greater in industries with a high need for complementary assets and in weaker IPP regimes (e.g., Dushnitsky and Lenox, 2005; Dushnitsky and Shaver, 2009). Similarly, Wadhwa and Basu (2013) show that the technological and market-related overlap of the corporate investor and the venture is a good predictor of the financial commitment of a CVC unit.

In the post-investment stage, CVCs seek to manage their relationship with the ventures they invest in. Since portfolio companies are not hierarchically or contractually bound to share valuable and/or proprietary knowledge, a corporate investor needs to build a collaborate relationship to access their knowledge (Basu et al., 2011). Some empirical studies have addressed how corporate investors build such relationships (e.g., Wadhwa and Kotha, 2006) such as by committing corporate resources to assist the portfolio ventures and taking a seat or obtaining observer's rights on investee boards. For one, by committing resources to the venture, especially during early stages, it signals the degree to which the corporate investor is committed to the venture's future development. Additionally, it builds cooperation and trust, which in turn facilitates knowledge transfer (Wadhwa and Kotha, 2006). Moreover, obtaining a board membership in the portfolio ventures can help transfer knowledge effectively and align the venture's action with the investor's interest. Further, it can assist the venture in accessing the parents' firm-specific resources, which helps building the relationship between the CVC unit and the venture (Wadhwa and Kotha, 2006).

From a corporate perspective, it is important to gain legitimacy and support from the mainstream units (e.g., business units) (Basu et al., 2008). Especially as it enhances the CVC managers ability to mobilize and leverage the parent companies' resources which is needed to nurture the portfolio ventures and diffuse knowledge. Yet, the literature stream emphasizes that hostility from mainstream personnel may arise when they view CVC activity as a threat (e.g., Basu et al., 2008; Souitaris et al., 2012). Research therefore suggests that building effective teams, fostering communication, and avoiding direct competition can help CVCs obtain internal support and resources (Keil, 2004; Hill and Birkinshaw, 2014; Basu et al., 2008).

2.2.2. Venture Performance and Implications

Historically, the extant literature has primarily focused on the performance implications of the corporate investors by engaging in CVC activities, and less on how it impacts the ventures' performance (e.g., Wadhwa et al., 2016). However, in recent years scholars have increasingly turned to investigate *if* and *how* corporate investors impact the ventures' performance. As this is highly relevant in relation to our research questions, we aim to provide an in-depth review of the academic literature on the performance implications of CVC-backed ventures especially in relation to innovative performance.

An entrepreneurial invention is a product of an entrepreneur's insight and ability to recombine existing assets in new ways (Schumpeter, 1942). Innovation is at the heart of the performance of many new ventures, and the ability to create technical breakthroughs and turn them into commercial products is central to their survival and success (Pahnke et al., 2015). Yet, ventures are usually resource constrained (Wadhwa and Basu, 2013) due to their liability of newness (Katila et al., 2008). Therefore, corporate investors are becoming an important alternative to VCs (Dushnitsky, 2012) as corporate investors have access to a wide set of resources that independent VCs lack (Gompers and Lerner, 2000a). At the same time, corporate investors may provide access to corporate customer and supplier networks, and distribution channels (Teece, 1986; Acs et al., 1997). Accordingly, prior studies have acknowledged the importance of CVC investments for the development, growth, and success of ventures (e.g., Hallen et al., 2014; Katila et al., 2008; Souitaris and Zerbinati, 2014), as ventures benefit from corporates investors' financial resources, firm-specific resources, and endorsement benefits (Maula, 2001; Katila et al., 2008; Chesbrough, 2002).

Unlike IVCs who focus on maximizing their capital gains by increasing the market value of their venture investments, corporate investors are interested in maximizing the overall value of their corporate parent (Hellmann, 2002) by such as providing a new window on novel technologies, promoting complementary products, and creating potential acquisition targets (Dushnitsky and Lenox, 2006; Kann, 2000; Sykes, 1990). Therefore, corporate investors often pursue broader strategic objectives when investing in ventures. Given these aims, corporate investors have incentives to encourage their venture partners to achieve innovation (Pahnke et al., 2015; Park and Steensma, 2013) and exploit possible synergies between their ventures' innovative capabilities and their own existing operations (Dushnitsky and Lenox, 2005; Wadhwa and Kotha, 2006). Accordingly, scholars agree that CVC investments increase ventures' innovative performance through higher output in patenting, scientific publications, and copyrighting (Alvarez-Garrido and Dushnitsky, 2016; Chemmanur et al., 2014; Uzuegbunam et al., 2019). At this stage, there are however mixed results for CVC investments' effect on ventures' commercial outcomes. Prior studies report negative effects such as the reduced likelihood to receive commercial trademarks (Uzuegbunam et

al., 2019), no effects on product approvals (Pahnke et al., 2015) and positive effects for sales growth (Bertoni et al., 2013). Yet, recently, Sabel and Di Lorenzo (2021) offered insight from the Norwegian venture market in knowledge-intensive industries that corporate investors in fact have a strong influence on ventures' commercial performance, especially on late-stage ventures.

Innovative Performance

Due to its relevancy of this thesis, we will explore the growing body of literature that examines CVC-backed ventures' innovative performance and provide a more in-depth review of these articles.

Park and Steensma (2013) were among the first to empirically investigate how the preferences, resources, and influence of corporate investors compared to IVCs affect their selection of investments and subsequent nurturing of ventures. By focussing on ventures within the ITC-industry, they find that corporate investors tend to invest in ventures with greater pre-funding innovative capabilities (i.e., selection effect) but also exhibit greater post-funding innovation rates (i.e., nurturing effect) compared to those funded solely by IVCs. Interestingly, they find support for both the selection and the nurturing effect and emphasize that higher post-funding innovating rates are attributed to corporate investors' preference for innovation and their ability to provide tailored resources to facilitate this preference.

Along the same lines, Alvarez-Garrido and Dushnitsky (2016) compare CVCs to IVCs to underscore investor heterogeneity and study the ventures' ability to access corporates' firm-specific resources to measure the subsequent effect on innovative performance. By focusing on ventures within the biotechnology industry, they find that CVC-backed ventures exhibit higher innovation output (measured by patents and scientific publications) compared to IVC-backed ventures. In addition, they find that the innovation output is sensitive to the ventures' ability to benefit from- and access to the corporate parents' complementary assets (e.g., R&D facilities and personnel) using geographical proximity as a proxy (i.e., lower distance increases access).

Likewise, Chemmanur et al. (2014) study how CVCs differs from IVCs in nurturing innovative activities in ventures. They find that CVC-backed ventures are more innovative, measured by their patenting output, but also typically younger, riskier, and less profitable than IVC-backed ventures. They highlight industry background of CVC-backed ventures to be an important predecessor for their innovativeness, particularly, finding that the life science and information and technology communication (ITC) industries are the most innovative. They similarly emphasize the corporate investors' nurturing effect on the ventures' innovative performance and present evidence

for two underlying mechanisms supporting this: 1) CVC's greater industry knowledge, especially, when there is a technological fit between their parent and the venture; and 2) CVC's greater tolerance for failure.

Kim and Park (2017) examine the effect of corporate venture capital funding in early state ventures' innovativeness in the ITC-industry. They, similar to the other researchers, underscore investor heterogeneity and base their sample on ventures funded by IVCs and CVCs. They find that CVC-backed ventures who receive funding in their first three years of life (i.e., young ventures) tend to patent more after accounting for the selection effect (i.e., indicating that the timing of resources is important for ventures). They suggest that the incentives and capabilities of corporate investors leave a strong imprinting effect on the ventures' long-term innovation rates.

In contrast, by similarly comparing CVC- and IVC-backed ventures while drawing on institutional logics, Pahnke et al. (2015) find that corporate investors have a none-to-negative impact on new ventures' innovation outcome (in the medical device industry). They suggest that even though CVCs in many instances have access to substantial and superior resources compared to those of IVCs, various attributes related to the corporate institutional logic such as dispersed business units, fragmented authority, and long-time horizons, impede access to those resources and particularly heighten the danger of misappropriating IP-right and so limit mutual interest in deep engagement from the ventures' perspective.

Implications

Pertinent to the ventures' ability to undertake innovation activities is, that they must rely on their available resources to execute value-creating activities (Gilbert et al., 2008; George and Bock, 2011) yet are likely to be constrained in terms of resource availability due to their liability of newness (Wadhwa and Basu, 2013; Katila et al., 2008).

Katila et al. (2008) focus on the tension that ventures face between the need for resources from corporate investors and the potentially damaging misappropriation of the venture's resources (e.g., knowledge and IP-rights) by the corporate investors. They pioneered this dilemma of ventures' accepting CVC-funding and termed it "the sharks dilemma". In other words *when* should a venture accept CVC financing. Katila et al. (2008) find that ventures take the risk of "swimming with sharks (i.e., corporate investors)" when the need for resources that corporates uniquely can provide is high and the ventures' have effective defence mechanisms to protect their own resources. These defence mechanisms include secrecy and timing. Secrecy defence refers to the protection against a range of intellectual property where the ventures choose not to disclose any of these or aim to sign nondisclosure agreements, material transfer agreements and non-compete clauses (Scotchmer, 2004) to defend against potential

misappropriation (Katila et al., 2008). In terms of timing defence, each successive funding round is tied to a significant development in the venture, such as completion of design, pilot production, first profit, etc. therefore demarcating the ventures' development stages (Sahlman, 1990). Later timing is likely to make it more difficult for corporate investors to misappropriate the ventures intellectual property (Lerner and Merges, 1998) because it is easier to protect a more mature technology that is more fully embodied in a product from misappropriation (Katila et al., 2008). Overall, their findings show that tie formation is a negotiation that depends on the ventures' resource needs, defence mechanisms, and opportunity for alternative partners.

Supplementing this dilemma, Dushnitsky and Shaver (2009) find that new ventures are less inclined to take on CVC investments under a weak intellectual property protection regime (e.g., in the ITC-industry compared to the life science industry). They find this to be especially important when the venture is operating in the same industry as the corporate investor, since the corporates' ability to effectively understand and potentially imitate the invention under such circumstances is substantially higher. In fact, this intensifies the "sharks dilemma" for the ventures as forming ties with same-industry CVCs is viewed as the most valuable partner (e.g., Gompers and Lerner, 2000a) due to the same-industry corporates' ability to provide complementary resources (Alvarez-Garrido and Dushnitsky, 2016), unique insights into industry trends and evolution (Hendricks, 2002; Henderson and Leleux, 2002) and deep technical knowledge (Maula et al., 2006; Chemmanur et al., 2014) but also increases the risk of imitation and misappropriation. Dushnitsky and Shaver (2009) termed this dilemma the "paradox of corporate venture capital". Pertinent to this paradox is the fact that corporates have a higher motivation to misappropriate ventures' resources when operating in the same industry to limit the chance of creating a new competitor and erode corporate earnings (i.e., take a pie of the profit pool within the same industry) (Dushnitsky and Shaver, 2009; Colombo and Shafi, 2016).

Extending the research on defence mechanisms, Hallen et al. (2014) investigate how relationships form (i.e., between a corporate investor and a venture) under the absence of suitable defence mechanisms such as legal and timing defences, or, when the most dangerous "shark" also has the best resources. Specifically, they study how social defences influence ventures' tie formation with corporate investors from a power balance perspective. They argue that central to the misappropriation dilemma is power imbalance, i.e., when one partner (the venture) needs the relationship much more than the other (the corporate) because the venture is more dependent on accessing corporates resources, compared to the corporate accessing the ventures' knowledge. Interestingly, they find that centrally positioned third parties (such as other VCs in the investment syndicate) are a particularly powerful social defence, when traditional defences (formal defences) are unavailable.

2.2.3. Syndication

Researchers have so far neglected to study the presence of multiple corporate investors in an investment syndicate and the related effects on venture performance. To our best knowledge the only example is an almost twenty-year-old study by Maula and Murray (2002) who find that the involvement of CVC investment by one or multiple investors is positively related to higher market capitalisation of the venture. Yet, due to the relevancy to our research question on syndications of multiple corporate investors, we aim to provide a review of existing literature on syndication between corporate venture capitalists and other venture capitalist. The stream of literature from a CVC perspective primarily focuses on two areas: 1) the motive and benefits of engaging in syndications; and 2) potential conflicts. These will be reviewed in this section and rounded off with the article by Maula and Murray (2002) on venture performance.

Motivation and benefits

Corporate venture capitalists are in general not able to attract the same type of experienced personal as IVCs due to lower incentive schemes and therefore typically recruit employees within the ranks of its (own) parent corporation (Birkinshaw et al., 2002; Dushnitsky and Shapira, 2010; Hill et al., 2009). As a result, key motivations for CVCs to engage in syndications with other VCs are: 1) to increase acceptance in the VC community (i.e., higher legitimacy as a trustworthy and reliable partner (Keil et al., 2008) which helps both to provide a better deal flow and to identify promising targets (Sorenson and Stuart, 2001; Sorenson and Stuart, 2008); and 2) to introduce best practices from experienced VCs and assist in nurturing the ventures (Winters and Murfin, 1988; Sykes, 1990). In fact, Hill et al. (2009) find that when corporates invest in a syndicate with other VCs it leads to an increased number of annual venture investments and a lower "closure" rate of portfolio companies. These results are in part due to the CVCs obtaining a better network position in the VC community which helps to build quality relationships with potential venture investment targets while also learning from the IVCs in terms of how to better manage venture investments (Dushnitsky, 2008; Maula, 2007). Accordingly, 90% of CVCs syndicate their investments with other VCs (Basu et al., 2011) and in general have a preference to co-invest with other VC firms (Das et al., 2011; Ivanov and Xie, 2010).

VCs are on the other hand motivated to syndicate with CVCs due to their extensive insight into specific industry dynamics and ability to provide access to firm-specific resources (e.g., in R&D activities) (Henderson and Leleux, 2002). These capacities can help CVCs strengthen their network centrality in a syndicate (i.e., being an important investor in the syndicate) (Braune and Sahut, 2017). This is especially important for CVCs as a prior central

network position in a syndicate often leads to future central network positions, which can lead to increased benefits from CVCs engaging in syndicates (Keil et al., 2010). Yet, having a central position in a syndicate may entail a paradox for the CVC. On one hand, it creates significant value by being close to venture and the other investment partners (i.e., by learning from the venture and the partners) but on the other hand it increases the risks of leaking its proprietary knowledge resources to potential competitors (Anokhin et al., 2011).

Conflicts

While IVCs invest in ventures to achieve financial returns (e.g., Hochberg, Ljungqvist and Lu, 2007; Hellmann and Puri, 2002), corporates pursue CVCs activities to gain strategic returns (e.g., Dushnitsky and Lenox, 2005; Chesbrough, 2002), which can give rise to conflict of interest when both are engaging in a syndicate due to opposing objectives (Dushnitsky, 2008). In particular, Masulis and Nahata (2009) highlight that CVCs may prevent the ventures' development of financially viable products in case it competes with the corporates business, or in case the venture does not support the corporates' long-term strategic objectives, which may not maximise the ventures value. They further find that, CVCs may prohibit an optimal exit strategy such as an acquisition (e.g., to a competitor) or IPO of the venture if the corporate does not benefit from this (e.g., in terms of creating a new competitor) (Masulis and Nahata, 2009). However, Souitaris and Zerbinati (2014) interestingly find that CVCs prefer to syndicate with other VCs instead of CVCs, which is primarily due to the lack of complementary rooted in different strategic agendas when syndicating with fellow CVCs. From a venture perspective, Hellmann (2002) find that ventures prefer to have an investor syndicate led by other VCs and the corporate investor being a passive co-investor, especially, when the venture has a strong substitute product or technology to the corporate investor.

Venture performance

Note that in section 2.2.2., when investigating ventures' performance, many scholars do not explicitly distinguish between whether there is *only* one corporate investor (i.e., no other IVCs) or there is *presence* of one (or more) corporate investor(s) (i.e., together with other IVCs). It can therefore not be ruled out that syndicates between the two investor types may be intertwined in those findings (likewise for multiple corporate venture capital). Yet, it becomes evident that there is little known about how syndications of multiple corporate investors affect ventures' performance. To the best of our knowledge, Maula and Murray (2002) are the only ones exploring this. They find that syndicates containing multiple corporate investors can lead to superior venture performance (in terms superior IPO valuation) over ventures solely funded by VCs. The superior performance is however contingent on corporate

investors cooperativeness and willingness to work together with its co-investors. They argue that the superior performance is a result of the added relational benefit that each additional investor brings to the table.

Summing up the literature review on corporate venture capital, it becomes evident that the impact of multiple corporate investor syndication on ventures' innovative performance remains a gap in the literature. Indeed, scholars have found a nontrivial number of their sample ventures that were funded by multiple corporate investors and called for research to understand how such influences the outcome of such ventures (e.g., Park and Steensma, 2013; Dushnitsky and Shapira, 2010). In general, most research on ventures' innovative performance does not distinguish between the presence of one or multiple corporate investors (e.g., Pahnke et al., 2015; Kim and Park, 2017; Park and Steensma, 2013) although some scholars do control for multiple corporate investors (e.g., Alvarez-Garrido and Dushnitsky, 2016). We, therefore, aim to bridge this gap and to compensate for lack of research of multiple corporate venture capital syndications, we will subsequently undertake a literature review on the strategic alliance literature to help explain potential performance implications in a multiple corporate venture capital situation.

2.3. Strategic Alliance

In this section we introduce selected aspects of the strategic alliance literature to help explain some of the dynamics that may exist in multiple corporate venture capital syndications. We do not aim to review the whole spectrum of strategic alliance literature but rather discuss areas that are relevant to this thesis. Specifically, we aim to review research on the partner selection and the operational stage of an alliance. Prior research on IVCs and CVCs have similarly used some of the strategic alliance concepts to help explain dynamics between the (corporate) investors and the ventures (see for example Dushnitsky, 2012; Hallen et al., 2014; Maula 2001; Wright and Lockett; 2003). For instance, Wright and Lockett (2003) directly compare an IVC syndicate to an equity joint venture (a type of alliance), and Dushnitsky (2012) argue that corporate venture capital and equity alliances are comparable as they both involve interorganizational relationships. Additionally, in the context of multiple corporate venture capital syndication, the corporate investors typically have a strategic agenda (e.g., Chesbrough, 2002) and serves as mechanism for accessing external resources for the ventures (e.g., Katila et al, 2008; Wadhwa and Basu, 2013) which is similarly the case in many strategic alliances (e.g., Das and Teng, 2000a), which underscores the applicability of drawing on strategic alliance literature. In general, the alliance research has evolved in four streams (Lavie, 2007): 1) the strategic alliance literature; 2) studies of stock market returns following alliance announcement; 3)

social network theory application; and 4) the emerging research on strategic network. We will primarily review the stream from the strategic alliance literature as this is deemed the most relevant for our thesis.

Stabilities versus instabilities

We aim to explore the factors influencing the stability and success of alliances as scholars find this vital for alliance survival, development and evolution, and it provides a necessary condition and a good proxy for performance gains and alliance success (e.g., Dussauge and Garrette, 1995; Beamish and Inkpen, 1995). Alliances evolve during their lifetime and various stability issues such as cooperative and competitive behaviour may appear among alliance partners (Das and Teng, 2000b). Although researchers agree that alliances evolve in stages, there is no consensus on the specific stages that alliances go through. We subscribe to the four stages laid out by Das and Teng (1999): 1) partner selection; 2) structuring; 3) operational; and 4) performance evaluation. Each alliance is a repetitive sequence of the four stages, and some stages may repeatedly occur as the alliance evolves (Ring and Van de Ven, 1994; Doz, 1996). In the context of our thesis, we will focus on the partner selection and operational stages of strategic alliance to understand the concepts that can assist in explaining specific dynamics in multiple corporate venture capital syndications. Researchers accordingly argue that the operational stage, i.e., managing the "alliance" relationship over time, is the most important (e.g., Doz and Hamel, 1998) and is the most pivotal one for the evolution and success (Jiang et al., 2008).

2.3.1. Partner selection stage

According to Das and Teng (2003) selecting the *right* alliance partner(s) is crucial for the success of the alliance. This relies on the strategic fit among partners in terms of resources, goals, and strategic objectives. Partners therefore need to assess their potential fit, which is a combination of partner complementarity, congruence, and compatibility (Russo and Cesarani, 2017).

Partner complementarity refers to the strategic fit between partners. The strategic fit is especially high when complementary resources can help close the resource gap between each partner, therefore, being critical for alliance success (Child et al. 2005). In contrast, if partner resources are too similar it can potentially lead to a situation of surplus resources (Das and Teng, 2000a; Tsai, 2000), i.e., a situation where the pool of resources is in excess of the minimum necessary to produce a given level of organizational output (Nohria and Gulati, 1996). In addition,

if partner resources are too similar, they are more likely to be competitors, which increases the likelihood of alliance failure due to competing goals and opportunistic behaviour (Park and Russo, 1996).

Partner congruence refers to mutual alignment between each partner's goals and objectives of the alliance. Partners can have different goals and objectives, but they need to be compatible and should not be pursued simultaneously or be overtly conflicting as this may lead to alliance failure (Russo and Cesarani, 2017). Therefore, congruence in terms of strategic fit between partners is likely to involve partners of comparable size and/or strength, resources and capabilities (Child et al., 2005). A lack of congruence may lead to opportunistic behaviour and a non-corporative environment which can lead to failure of the alliance (Arend, 2009).

Partner compatibility refers to the cultural and organizational fit between alliance partners. Cultural fit is crucial for the alliance success and is affected by how sensible partners are towards diverse cultures and their willingness to integrate and accept potential distances and differences (Russo and Cesarani, 2017). A lack of cultural fit or cultural resistance can create conflicts that may jeopardize the success of the alliance (i.e., reaching what they intent to achieve) (Child et al., 2005). Organizational fit is additionally crucial for the success of the alliance and considers partner's willingness to adapt to each other's management practices, organizational culture, procedures, and way of working (Park & Ungson, 1997). A lack of organizational fit can lead to conflicts and coordination issues and lead to failure of the alliance (Child et al., 2005).

2.3.2. Operational stage

In the operational stage, the alliance is translated into economic reality, and partner interactions and risk of conflicts increases considerably. Das and Teng (1998) particularly emphasize the increased risk of ineffective cooperation due to a lack of pursuing common interests. In fact, this can translate into a competitive environment which may lead to opportunistic behaviour, zero-sum game and the pursuit of private benefits (Khanna et al., 1998; Yoshino and Rangan, 1995). To ensure alliance stability and success, Russo and Cesarani (2017) identify five critical factors to manage: 1) coordination; 2) trust and commitment; 3) control; 4) communication; 5) conflicts.

<u>Coordination</u>

Coordination is the set of tasks that each partner expects the other partner to perform to reach the common objective, by other means, effective coordination increases the stability of the alliance and among partners (Mohr and

Spekman, 1994). Often, firms have developed frameworks composed of rules, policies, and procedures to prevent unclear roles and responsibilities to guide effective coordination and limit opportunistic behaviour (Varma et al., 2015). In a situation of high coordination costs, cooperation between alliance partners become costly and can potentially lead to a situation of opportunistic behaviour (Das and Teng, 2000b). Coordination costs is the anticipated organizational complexity of decomposing tasks among partners along with ongoing coordination of activities to be completed jointly or individually across organizational boundaries and the related extent of communication and decisions that would be necessary (Gulati, 1998). Coordination costs are for instance found to increase when the number of alliance partners increase (Das and Teng, 2002) and when diversity among alliance partners is high (White and Lui, 2005).

Trust and commitment

Trust and commitment are often based on the degree of social capital. According to Varma et al. (2015) the sense of belonging between partners increase the likelihood of alliance success, and supports and fosters more effective alliance operations, allowing firms to increase productivity and lower coordination costs. In addition, higher trust and commitment among partners can prevent opportunistic behaviour such as holding back vital information (Gulati, 1995) and free-riding issues (Das and Teng, 2002). The combination of higher trust and commitment among partners help firms to reduce the risk of opportunistic behaviour as it helps partners to work together towards common objectives (Yang et al., 2011). Mutual trust further promotes cooperation and provides a variety of benefits such as allowing firms with different knowledge bases (know-how) and experience to expand the activities and projects within the alliance, and furthermore limit the use of "formal" control mechanism (such as signing formal contracts) (Gulati, 1995; Das and Teng, 2001). Since interorganizational trust typically results from the social structure of prior interaction, firms may have developed routines together to enable ease in joint interaction with each other from prior experience (Gulati, 1995; Gulati and Gargiulo, 1999). Therefore, trusting firms have greater competence in transacting with each other, which makes the interface between them easier to manage, and the information processing requirements associated with an anticipated coordination costs more easily addressed (Gulati, 1998).

Dyer and Chu (2000) argue that trust is based on expectations. Expectations may among others evolve from social relationships and embedded ties from ongoing interaction between partners which ultimately lead to relationship-based trust (Granovetter, 1985; Gulati, 1995). Along the same lines, Gulati et al. (2009) find that previous inter-firm relationships (prior ties) between partners increase trust and cooperation, which can lead to enhanced performance. Adding to this, when partners have prior ties, they gain extensive knowledge about each other's capabilities

and degree of cooperative behaviour (Granovetter, 1985; Gulati, 1995; Das and Teng, 2000b). In general, there is a higher preference for familiar partners (e.g., from prior ties) in environments that are characterized by: 1) high market uncertainty (Podolny, 1994; Beckman et al., 2004; Hoetker, 2005); 2) when a high degree of technological commitment is required (i.e., providing valuable technological resources to such as a R&D project) (Li and Ferreira, 2008); and 3) when undertaking radical innovation projects (Li et al., 2008). Despite many scholars arguing that prior ties increase trust and decrease coordination costs, other studies find a non-significant (Pangarkar, 2003; Hoang and Rothaermel, 2005; Hsieh and Rodrigues, 2014) or even a negative relationship between prior ties and alliance success (Park and Kim, 1997; Goerzen, 2007). For instance, Hoang and Rothaermel (2005) find that continuously allying with the same partner(s) can lead to negative outcomes as the partner(s) in many instances provide redundant information, which may limit bringing "new" ideas to the table and the transfer of new knowledge. In the same vein, when allying with the same partner(s) they may rely on prior established partnering routines and therefore restrict variation (e.g., doing things differently) in their subsequent alliances (Levinthal and March, 1993). In addition, Goerzen (2007) find that in environments with technological uncertainty, prior ties can lead to a decreased economic performance in equity-based partnerships as repeated ties lock out newcomers that potentially possess strongly required cutting-edge technologies. In fact, many studies that find a non-significant relationship between prior ties and performance are in industries with high technological uncertainty and intensity such as the biotechnology and electronics industry (Park and Kim, 1997; Pangarkar, 2003; Hoang and Rothaermel, 2005).

Control

In order to prevent opportunistic behavior and increase ability to predict partner behavior, control (such as enforced rules and various mechanisms) between alliance partners is important (Child et al., 2005). As partners bring valuable resources to the alliance, inefficient control may limit the protection and utilization of these resources as alliance partners must balance the collaborative aspect with competitive ones (Child et al., 2005). Establishing some level of formal control will therefore enhance cooperation and solve potential conflicts (Sklavounos et al., 2015). On the other hand, excessive control among partners can destroy goodwill and willingness to cooperate (Child et al., 2005). In relation to trust and prior ties between partners, when a high level of trust exists, it turns the alliance into a self-enforcing agreement that does not need complex contracts, and therefore reduces the overall costs of control and coordination (Gulati, 1995; Das and Teng, 2000b; Reuer and Arino, 2007).

Communication

Briefly touching on communication, it is critical to the success of the alliance to continuously communicate, as it enhances better coordination between partners (Russo and Cesarani, 2017). To achieve a common goal and increase the likelihood of success, it is therefore necessary to promote ongoing communication efforts and ensure that the information sharing being open and accurate in order to promote mutual understanding, trust and commitment (Spralls et al., 2011).

Conflicts

Lastly, conflicts often happen due to alliance partners being highly interdependent upon each other (Das and Teng, 2003). The main reasons for alliance conflicts are rooted in organizational, managerial, and cultural differences among partners. If partners are too different, they may to a larger degree be incentivized to opt for private rather than common benefits (Das and Teng, 2000b). In terms of interdependencies among partners, Jiang et al. (2008) argue that a balanced relationship will increase the stability of the alliance. For instance, a low-balance relationship, e.g., in terms of a large and small firm, instabilities are likely to occur since the larger and more powerful firm may be more incentivized to take advantage of its position and demonstrate opportunistic behavior (Hsieh et al., 2010). Das and Rahman (2009) identify several ways to mitigate or lower conflicts such as partner opportunism in alliances. These are: 1) equity involvement (i.e., binds partner firms to the alliance and makes it more difficult to withdraw), 2) making partners mutual hostages (i.e., firms exchange their respective critical resources), and 3) alliance horizon (shorter alliance horizon foster opportunistic behavior, whereas long alliance horizon deters such behavior). Furthermore, partners can diminish conflicts via their social behavior, as partners develop reputations for their actions over time, it encourages cooperation since a partner will then be known to be less risky to engage with (Parkhe, 1993).

2.4. Theoretical Concepts

In this section, a brief introduction to game theory and prisoner's dilemma is presented. The theoretical concepts have specifically been chosen to help explain some of the dynamics that appear in relation to our research question on multiple corporate investor's participation in a venture syndicate. Instead of providing an exhaustive review of the literature on game theory, this section will focus on areas particularly related to this thesis. To our best knowledge, no scholars have previously investigated corporate venture capital in a prisoner's dilemma situation.

Some research exists in a venture capital setting, where one of the most cited articles being Cable and Shane (1997) who investigate the entrepreneur-venture capital relationship in prisoner's dilemma situation and present various proposition of both parties' decision to cooperate or defect (being non-cooperative).

Drawing on game theory, specifically the prisoner's dilemma situation, is of relevance to the context of understanding the relationship between multiple corporate venture capitalists and the venture. This is primarily due to its applicability to the cooperation-defection scenario (i.e., reward structure) of the actions that partners take. It has similarly been used in many real-life settings and relationships such as to investigate business-government relationships, market pricing, advertising and university research (e.g., Aram, 1989; Corfman & Lehmann, 1994).

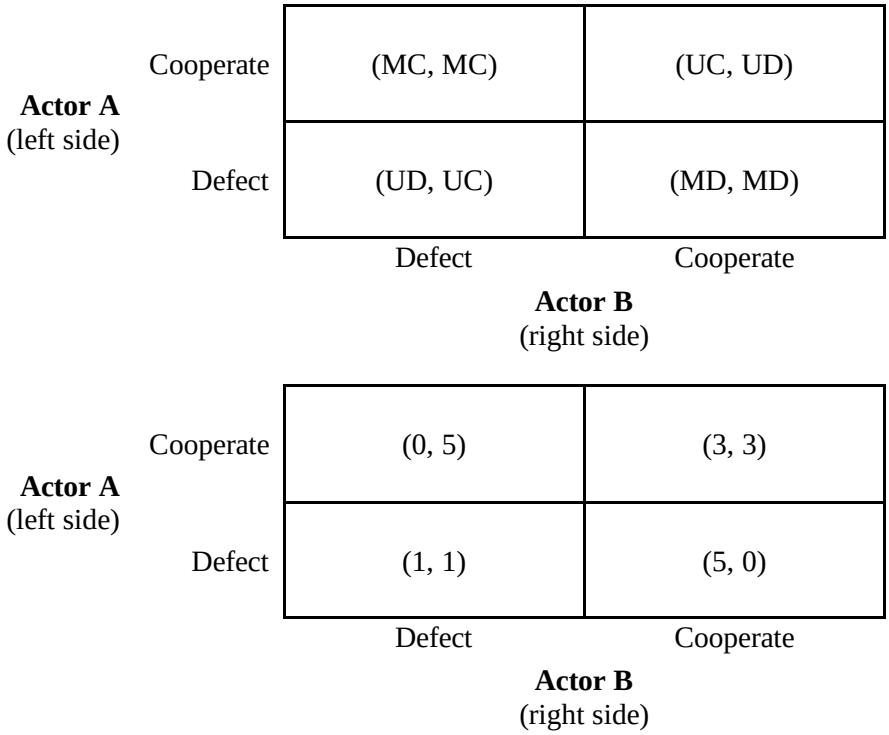
2.4.1. Prisoner's dilemma

Game theory was initially introduced by Von Neuman and Morgenstern (1944) with the idea of mixed-strategy equilibria in two-person zero-sum game. Throughout the 1970's, scholars began to draw on game theorical concepts to analyze strategies within a broad range of fields such as economics, politics, international relations, business and biology (Carmichael, 2005). Osbourne and Rubinstein (1994) define game theory as a bag of analytical tools designed to understand a specific phenomenon that is observed when decision-makers interact. Accordingly, they state the underlying assumption of game theory as: "decision-makers pursue well-defined exogenous objectives (i.e., they are rational) and take into account their knowledge or expectations of other decision-makers' behavior (i.e., uses strategic reasoning)" (p. 1).

Game theory entails multiple player-specific assumptions (Osbourne and Rubinstein, 1994). First, it is assumed that each player attempts to obtain, prior to making his decision, information about the other players' behavior. Second, it is assumed that each decision-maker (i.e., player) is rational, meaning that the decision makers are aware of alternatives, forms expectations about any unknowns, has clear preferences, and chooses their action deliberately after some process of optimization (i.e., tries to maximize their outcome as different behavior involves different payoffs measured by some utility scale). Third, it is assumed that the players often must make decisions under conditions of uncertainty such as the objective of the environment, imperfect information about events that can happen in the game, actions of the other players that are not deterministic, and the reasoning of the other players.

Game theory presents various models that represent a variety of different situations, where a certain phenomenon is in focus (for a comprehensive overview see for example Osbourne and Rubinstein, 1994). One of these are strategic and extensive games (Osbourne and Rubinstein, 1994). Strategic games are considered a game *in normal form*, which means it can be represented by a matrix, and specifies for each player a set of possible actions and a preference order over the set of possible action profiles (Osbourne and Rubinstein, 1994). An example such a strategic game is the so-called *prisoner's dilemma*, a well-known metaphor used in physiological, sociological, and economic research to model situations of social conflict between two or more interdependent actors (Dawes, 1980; Luce and Raiffa, 1957; Pruitt, 1967; Rapoport and Chammah, 1965). The essence of the dilemma is that each individual actor has an incentive to act according to a competitive and narrow self-interest even through all actors are collectively better off (i.e., receive higher rewards) if they cooperate. The most common used example is when two actors are suspected of a crime and put in separate cells. Each must decide whether to cooperate or defect in the given situation (Osbourne and Rubinstein, 1994). The payoff for each actor is illustrated in Figure IV and represents the number of years in prison.

FIGURE IV: GENERAL 2X2 PAYOFF MATRIX FOR TWO-FIRM PRISONER'S DILEMMA



Source: Parkhe et al. (1993)

The strategies for each actor can be summarized as cooperation (seek mutual gains at the expense of short-term self-interest) or defection (seek individual gains at the expense of long-term mutual benefit). The payoffs for each actor in Figure IV are dictated by the strategy adopted by the other actor and follows the payoff structure (Axelrod and Dion, 1988):

$$UD > MC > MD > UC$$

UD (unilateral defection) represents the temptation of extra payoff from defection; MC (mutual cooperation) represent the reward for mutual cooperation; MD (mutual defection) signifies the penalty for mutual defection; and UC (unilateral cooperation) represents the sucker's payoff (i.e., the penalty for cooperating while the other actor defects).

The payoff structure (bottom matrix in Figure IV) illustrates the prisoner's dilemma's conceptual value by highlighting the conflict between individual and collective rationality; while defection is the optimal choice for an individual who does not know his counterpart's strategy, cooperation is collectively optimal for both parties (Komorita et al., 1991). In some instances, one actor may have a dominant strategy which refers to the most optimal (pay-off) option for the actor among all the competitive strategy sets, no matter how that actor's opponent may play (Watson, 2013). Yet, despite having a dominant strategy, economic researchers suggest that the actors may not necessarily decide to follow their dominant strategy because other things beside monetary payoffs may strongly influence the choices of the actors (Gabbay et al., 2012).

By convention, the prisoner's dilemma matrix is symmetric, i.e., MC(a) = MC(b) (Parkhe et al., 1993). However, Axelrod (1984) argues that the individual payoffs for actor A and B do not need to be comparable or symmetric. Most studies investigating the prisoner's dilemma are designed in such a way that payoffs are identical for both players (Beckenkamp et al., 2007). Asymmetry is, however, an important property of many economic and non-economic problems as most real-world interactions entails different outcomes for each actor, even if all actors choose cooperatively and non-cooperatively (Beckenkamp et al., 2007). Examples of such instances span from competition policy questions surrounding collective dominance or cartel stability issues (Friederiszick and Maier-Rigaud, 2007) to governance questions surrounding collective action problems and the management of common-pool resources (Ostrom, 1990). The asymmetric payoff matrix is especially profound when more powerful actors face less powerful actors (Axelrod and Keohane, 1985). In fact, experimental evidence demonstrates that the greater the conflict of interest between the actors, the higher the likelihood that the actors will decide to defect (Axelrod, 1984).

3. CONCEPTUAL DEVELOPMENT

Concluding the literature review it becomes evident that corporate investors have a positive impact on ventures' innovative performance. Scholars have therefore turned to explore the underlying mechanism that impact the CVC-backed ventures innovative performance. Most research focuses on a dyadic relationship, and to our best knowledge, the effect of multiple corporate investors impact on ventures' innovative performance has yet been left unexplored. By combining existing literature on CVC and IVC with the strategic alliance literature, while also drawing on game theoretical concepts, we seek to uncover potential performance implications on ventures innovativeness when receiving funding from multiple corporate investors which ultimately guides us to our research questions.

Multiple Corporate Venture Capital

Ventures must rely on their available resources to execute value-creation activities (Gilbert et al., 2008; George and Bock, 2011) but are likely to be constrained in terms of resource availability due to their liability of newness (Wadhwa and Basu, 2013). Ventures therefore often seek external relationships to overcome their initial resource constraints (Katila et al., 2008; Pahnke et al., 2015). In the market for venture financing a broad range of investor types exist, e.g., independent venture capitalists, corporate venture capitalists and government-affiliated venture capitalists (Luukkonen et al., 2013), whereof IVCs and CVCs stand out as the two most active investor types. Apart from providing financial resources to invest in value-generating activities such as R&D, production, and marketing (Park and Steensma, 2013), IVCs provide new ventures with such as strategic and operational guidance and the network opportunities with potential customers, suppliers, and managers (Hellmann and Puri, 2002; Hochberg et al., 2007). On the other hand, CVCs have the capabilities and abilities to provide, besides financial resources, access to a wide set of resources to increase ventures' innovative performance which IVCs lack (Park and Steensma, 2013; Gompers and Lerner, 2000a). This makes CVC-investors highly valuable investment partners for ventures (Gompers and Lerner, 2000a) and particularly when ventures need relationship-specific assets (Park and Steensma, 2012). Accordingly, researchers find that ventures exhibit higher innovation output, especially in high-technological industries, when corporate investors are present compared to only IVCs (e.g., Chemmanur et al., 2014; Park and Steensma, 2013).

While there is a general consensus among scholars that corporate investor increases ventures' innovative performance, more recent research has turned to focus on the underlying mechanisms that lead to these improvements in innovative performance and potential performance implications (e.g., Alvarez-Garrido and Dushnitsky, 2016;

Pahnke et al., 2015). So far, the research on performance implications has been centred around a dyadic relationship, and scholars have called for research to understand the influence on the outcome of ventures when backed by multiple corporate investors (e.g., Park and Steensma, 2013; Dushnitsky and Shapira, 2010). Until now, to our best knowledge, only one study by Tian (2012) focusing on IVC syndication have found evidence of positive effects on ventures' innovative performance in terms both higher patent output and patents with higher impact (i.e., forward citations). Yet, as CVCs and IVCs have different investment objectives, it is important to understand how a syndication of multiple corporate investors impact ventures' innovative performance.

Corporations primarily engage in corporate venture capital activities to generate strategic gains such as to facilitate learning and realize innovative benefits (Dushnitsky and Lenox, 2006). This may for instance be from the use of new information to support, complement, or augment their internal R&D capabilities, exploit it to enter new markets or introduce new products earlier than competitors (Chesbrough and Tucci, 2003; Maula et al., 2003), and improve existing products by adding new features and functionality (Keil et al., 2004). In contrast, IVCs invests in ventures to generate financial returns (Colombo and Murtinu, 2016; Hochberg et al., 2007) by maximizing the value of their portfolio companies (Chumming et al., 2015) in order to return capital gains to their investors (Sahlman, 1990). Accordingly, Chesbrough (2002) finds that it is deemed undesirable for corporates to only invest for financial gains as their investors are better off diversifying their own risks. Indeed, Dushnitsky and Lenox (2006) find that corporates pursuing a strategic objective are associated with higher firm value.

Taking it all together, based on prior research, one would expect that ventures benefit from having *multiple* corporate investors. As ventures suffer from the liability of newness (Katila et al., 2008), having multiple corporate investors will increase the pool of resources that the venture can access and help overcome its initial resource constraints (Wadhwa and Basu, 2013) and execute value-creation activities such as innovation (Gilbert et al., 2008; George and Bock, 2011). Especially since research shows that CVCs are associated with nurturing their venture investments (e.g., Chemmanur et al., 2014) and have the incentive, capability, and ability to provide access to a variety of resources to promote higher innovative performance (e.g., Park and Steensma, 2013; Kim and Park, 2017; Alvarez-Garrido and Dushnitsky, 2016). The marginal effect of having one extra corporate investor would therefore be expected to result in higher venture innovative performance.

On the other side, there are several costs and risks associated with having more than one corporate investor that potentially could negatively impact ventures' innovative performance. First, the presence of a corporate investor raises the risks of misappropriation of the ventures' resources (e.g., knowledge, discoveries and inventions) (Katila et al., 2008). Therefore, increasing the number of corporate investors may increase the risk of misappropriation if the corporate investors decide to pursue private benefits (i.e., misappropriate) and potentially leave the venture

empty-handed (Dushnitsky and Shaver, 2009). According to the strategic alliance literature, the risk of opportunistic behaviour (i.e., misappropriation) particularly increases when there is a lack of control mechanisms and monitoring efforts (Child et al., 2005) which underscores the need to enforce some level of formal control to avoid such behaviour (Sklavounos et al., 2015).

Drawing further on the strategic alliance literature, increasing the number of partners (i.e., corporate investors) in an alliance (i.e., the syndicate) that must adapt to each other's expectations in order to reach a common objective, may impact the stability of the alliance (i.e., the syndicate) (Das and Teng, 2002; Mohr and Spekman, 1994). Especially, joint decision-making (e.g., in terms of coordinating resources to the venture, deciding which innovation activities to undertake, and the ventures' strategic agenda) between more strategically oriented corporations can lead to higher coordination costs (Gulati, 1998; Das and Teng, 2002). Notably, when coordination costs are high, cooperation between partners becomes costly and can potentially lead to a situation of opportunistic behaviour (Das and Teng, 2000b). Therefore, having multiple corporate investors, each with their own strategic objectives and agendas attempting to influence the ventures strategic direction (Kim and Park, 2017), is expected to increase coordination costs and possibly lead to a conflict of interest between partners (Das and Teng, 2002; Gulati, 1998; Mohr and Spekman, 1994). Along the same lines, the lack of pursuing mutual interests (i.e., the pursuit of different strategic agendas) increases the risks of ineffective cooperation which may translate into a competitive environment potentially leading to opportunistic behaviour (Das and Teng, 1998) and the pursuit of private benefits (e.g., misappropriation) (Khanna et al., 1998; Yoshino and Rangan, 1995). These conflicts and costs may become more profound when there are other investor types in the syndicate, e.g., IVCs, due to different agendas and investment objectives (Park and Steensma, 2013; White and Lui, 2005). In essence, increasing the number of corporate investors may not marginally benefit the venture, e.g., in terms of resource availability, if the corporate investors are unable to work together, and potentially translate into to a non-cooperative environment with the pursuit of private benefit.

Taken together, there seems to be significant benefits, but also considerable costs and risks associated with multiple corporates investing in a venture. As the literature does not provide a clear prediction on the influence on ventures' innovative performance when multiple corporate investors are present in the syndicate, this thesis is guided by the following research question:

Q1: Does multiple corporate venture investors impact ventures' innovative performance?

Prior ties

It becomes evident that the presence of multiple corporate investors entails several relationships in a syndicate consisting of both CVCs, IVCs and the venture itself. First, a conflict of interest may arise between each corporate investor as they pursue their own strategic agendas, and second, between the corporate investors and other IVCs pursuing financial objectives (if they are present in the syndicate as well). Third, a relationship exists between each investor and the venture itself where conflicts of interest may also arise. As no previous papers have investigated the corporate-corporate relationship in a multiple corporate venture capital setting, we aim to explore this relation and its performance implication on the ventures' innovative performance.

The strategic alliance literature suggests that there is high preference for familiar partners especially in environments characterized by high market uncertainty (Podolny, 1994; Beckman et al., 2004; Hoetker, 2005) and when committing to radical innovation projects (Li et al., 2008). Familiarity among partners (i.e., CVCs) may for instance be based on previous engagement (e.g., by previously investing together in a venture), which leads to a higher degree of inter-firm trust among the partners (Dyer and Chu, 2000). This likely leads to higher cooperation, lowers the likelihood of opportunistic behaviour such as taking advantage of each other (Gulati, 1995; Granovetter, 1985; Das and Teng, 2000a) and free-riding issues (Das and Teng, 2002). In addition, high inter-firm trust among partners help firms to work together towards common objectives, e.g., the strategic agenda (Yang et al., 2011) and allow for better coordination in their nurturing role towards the venture, e.g., in terms of providing resources (Gulati and Gargiulo, 1999; Gulati, 1998). The preference for familiar partners is similarly found in the VC community, where VCs often engage in syndications with other VCs based on past interaction and collaboration, as stable co-investment partnerships are key to build trust among VCs (Wright and Lockett, 2001).

As a matter of fact, these traits (i.e., higher inter-firm trust, pursuing common objectives and better coordination) can be interpreted as the corporate investors (with prior ties) being considered as one "unit" (instead of two or more independent corporate investors) which, in our own words, can be labelled a "coordinated syndicate". This kind of group-level construct is similar to the notion employed by Zhang et al. (2017) in a multi-party VC syndication, who find that various cooperation and coordination conflicts can be mitigated by familiarity and trust based on prior collaboration for syndicating VCs. As ventures are resource constrained (Wadhwa and Basu, 2013), a "coordinated syndicate" will likely be highly beneficial for the ventures in terms of increasing its innovative performance, as a "coordinated syndicate" will be better at working together towards a common objective, effectively provide critical resources and limit coordination issues. Accordingly, scholars likewise find that VCs investing with familiar partners increase the ventures' performance (De Clerq and Dimov, 2008).

On the contrary, the venture is now facing a "shark" (i.e., the "coordinated syndicate") of an unprecedented size (e.g., due to the pooling of corporate resources and capabilities) (Katila et al., 2008). This is likely to shift the power balance substantially, e.g., in terms of bargaining power and resource position between the venture and the "coordinated syndicate", leaving the venture in a more vulnerable position (Hallen et al., 2014). Following a game theoretical perspective, the increased asymmetric power balance leads to a situation with a more powerful actor (i.e., the "coordinated syndicate") facing a less powerful actor (i.e., the venture), yielding an asymmetric payoff (after the tie formation) (Axelrod and Keohane, 1985). This leads to a situation similar to that of a prisoner's dilemma with asymmetrical payoffs. For *illustrational* purposes, Figure V presents the prisoner's dilemma situation with asymmetric actors in terms of size and payoff between the "coordinated syndicate" and the venture.

FIGURE V: 2X2 ASYMMETRIC PAYOFF MATRIX FOR "COORDINATED SYNDICATE"-VENTURE PRISONER'S DILEMMA

Syndicate (left side)	**Venture** (right side): Defect	**Venture** (right side): Cooperate
Cooperate	**DC** (1, 3)	**CC** (4, 6)
Defect	**DD** (2, 1)	**CD** (7, 0)

Note: From a *v*enture perspective: DC (venture defect, syndicate cooperates), DD (venture defects, syndicate defects), CC (venture cooperates, syndicate cooperates), and CD (venture cooperates, syndicate defects).

Given this situation, it is expected that the dominant strategy for the "coordinated syndicate" is to defect (Watson, 2013), e.g., to limit resource-sharing to the resource constrained venture (Wadhwa and Basu, 2013) or misappropriate its resource (Katila et al., 2008). In case the "coordinated syndicate" decides to cooperate (e.g., provide the venture with firm-specific resources), the ventures' payoff is expected to increase substantially, where on the contrary, in case the "coordinate syndicate" chooses to defect, the "coordinated syndicate" is assumed to have a much greater ability to coordinate their efforts in terms of gathering information and misappropriate the ventures' resources, which eventually lowers the ventures' payoff substantially. Meanwhile, it is expected in this given situation, that if both parties defect, the "coordinated syndicate" will still capture a higher payoff than the venture as the "coordinated syndicate" will still hold a (possibly diluted) equity stake in venture.

To put the ventures' defection strategy into context; the venture is not per se obligated to pursue any distinct strategy put forward by the "coordinated syndicate" (e.g., Basu et al., 2011). Therefore, the venture may seek other and more successful *private* benefits that are not necessarily in line with the strategic objective of the "coordinated syndicate" (Cable and Shane, 1997). For instance, the venture may decide to develop competing products or services or limit information sharing which is of strategic importance for the corporates to use in their own R&D efforts (Dushnitsky and Lenox, 2006; Chesbrough and Tucci, 2003; Maula et al., 2003). Moreover, the venture may refuse to develop products that stimulate demand for complementary products offered by the "coordinated syndicate" (Kann, 2000; Chesbrough, 2002). Therefore, in case both the "coordinated syndicate" and the venture choose to defect, the venture may still be able to innovate, yet not as effectively, and may have to seek other potential investors.

On the other hand, despite the dominant strategy of the "coordinated syndicate" to defect, they may not necessarily pursue this strategy as the corporate investors risk damaging their reputation and legitimacy in the VC community, potentially leading to other ventures being reluctant to accept an investment from them or other investors being unwilling to syndicate with them in the future (Hallen et al., 2014; Gompers and Lerner, 2004; Lockett and Wright, 1999). Yet, the decision to defect may be contingent on how "effective" other investors in the syndicate are at broadcasting (communicating) the allegations of opportunistic behaviour (for instance depending on its overall network position) (Hallen et al., 2014). Therefore, depending on how the "coordinated syndicated" view the risk of the other parties' broadcasting the allegations of misappropriation, they may choose not to pursue their dominant strategy: to defect (e.g., Gabbay et al., 2012).

Lastly, in case both the "coordinated syndicate" and the venture choose to cooperate, the venture is expected to yield a relatively higher payoff compared to the "coordinated syndicate" since it is *more critical* for the venture to access firm-specific corporate resources to innovate than for the "coordinated syndicate" to access the ventures' knowledge resources (e.g., Hallen et al., 2014; Sabel and Di Lorenzo, 2021).

Taken together, familiarity and inter-firm trust guided by prior ties between corporate investors can lead to a situation of substantial benefits for the venture. However, it also increases the asymmetric payoffs, leaving the venture highly contingent on the decision of the "coordinated syndicate" to cooperate and not defect. As the literature does not guide on how this dynamic affects ventures' innovative performance, the second research question is guided by:

Q2: How does multiple corporate investors with prior ties impact ventures' innovative performance?

Industry relatedness

The concept of industry relatedness is closely related to business relatedness which has been widely discussed in the strategic management literature (e.g., Wang and Zajac, 2007). To conceptualize industry relatedness, we subscribe to the definition by Koh and Venkatraman (1991) who define business relatedness as the level of similarity between firms in terms of products, markets, resources, and technologies. A similar understanding between the two have been used by researchers in the corporate venture capital literature (e.g., Dushnitsky and Shaver, 2009; Hallen et al., 2014).

In the corporate venture capital literature, scholars have to some degree investigated how industry relatedness influence CVC investments and ventures' innovative performance. For instance, Dushnitsky and Shaver (2009) find that a CVC investment is less likely to form in case the corporate parent and venture are in the same industry with a weak intellectual property regime due to the ventures' fear of imitation of its knowledge and IP-rights. Although not directly investigating industry relatedness, Alvarez-Garrido and Dushnitsky (2016) find that a same-industry corporate investor is able to provide complementary assets such as R&D facilities and personnel which is found to increase the ventures' innovative performance. This gives a good basis to explore how industry relatedness may affect the ventures' innovative performance when there are multiple corporate investors present in related industries to the venture.

Along the same lines, there is a consensus within the strategic alliance literature that partner complementarity is critical for success (e.g., Tsai, 2000; Das and Teng, 2000a). Specifically, that resource complementarity can help close the resource gap between each partner (i.e., between the corporate investors and the venture), and hence, increase the availability of complementary resources to the venture (Child et al., 2005). Yet, the discussion in terms of industry relatedness is two-fold, as too similar partners (corporate investors) may have non-differentiated skills and too similar resources which can lead to a situation of surplus resources (Das and Teng, 2000a; Tsai, 2000; Nohria and Gulati, 1996). The marginal effect of similar corporate investors may therefore be disproportionate on the ventures' innovative performance. It is however difficult to distinguish between resource similarity and complementary in terms of industry relatedness as both types of resources can be found in related industries (e.g., Alvarez-Garrido and Dushnitsky, 2016; Yu et al., 2015). Accordingly, it is expected that ventures to a higher degree benefit from higher industry relatedness between them and the corporate investor(s). Primarily due to the corporates' better ability to nurture the venture through such as providing complementary resources (Alvarez-Garrido and Dushnitsky, 2016), unique insights into industry trends and evolution (Hendricks, 2002; Henderson

and Leleux, 2002) and deep technical knowledge (Maula et al., 2006; Chemmanur et al., 2014). Indeed, Gompers and Lerner (2000a) suggest that the same-industry corporate investor is the most beneficial to the venture.

On the contrary, a same-industry corporate investor is also the most dangerous due to a higher inclination and ability to imitate and misappropriate the ventures' resources, for instance, due the chance of the venture becoming a new competitor and erode corporate earnings (Dushnitsky and Shaver, 2009; Colombo and Shafi, 2016). Along the same lines, when industry relatedness between multiple corporate investors and venture is high, the corporate investors might reduce their willingness to cooperate to limit the risks of leaking propriety knowledge to other potential competitors, which may impact the ventures' ability to access corporate resources (Anokhin et al., 2011). Furthermore, when industry relatedness between all partners is high, they are more likely to competitors, and have reasons to collaborate for shared benefits, but may simultaneously behave opportunistically or try to alter the agenda for their own benefit (Agarwal et al., 2010; Gulati and Singh, 1998). Given all these implications, higher industry relatedness may negatively affect the ventures' innovative performance.

In case the corporate investors in related industries to the venture additionally have prior ties (see sub-section "prior ties"), the asymmetric payoff is expected to increase considerably. For *illustrational* purposes see Figure VI. Especially, since the venture to a higher degree will benefit from corporate investors in related industries, but on the contrary, the inclination and ability of the "coordinated syndicate" to misappropriate and imitate the ventures' resource likewise increases. Yet, the learning benefits may also increase for the corporates as they can leverage industry-specific and related technology information directly in its own R&D efforts. Ultimately, this increases the trade-off between value-creation and value-capture for the "coordinated syndicate" leaving the venture in a very vulnerable position.

FIGURE VI: 2X2 ASYMMETRIC PAYOFF MATRIX FOR "COORDINATED SYNDICATE"-VENTURE PRISONER'S DILEMMA (WITH INDUSTRY RELATEDNESS)

Syndicate (left side)		**Venture** (right side): Defect	**Venture** (right side): Cooperate
	Cooperate	**DC** (1, 5)	**CC** (6, 9)
	Defect	**DD** (2, 1)	**CD** (11, 0)

Note: From a venture perspective: DC (venture defect, syndicate cooperates), DD (venture defects, syndicate defects), CC (venture cooperates, syndicate cooperates), and CD (venture cooperates, syndicate defects).

Taken together, high industry relatedness between the venture and corporate investors can lead to substantial benefits for venture, however, may on the other hand also increase the risks of imitation and misappropriation and cooperation issues. The third research question is therefore guided by:

Q3: How does multiple corporate investors in related industries to the venture impact the ventures' innovative performance?

4. METHODOLOGY

The following sections outline our scientific stance and methodological approach to answer our research questions. Specially, we first of focus on the research philosophy to elaborate on the view and assumptions when conducting our study, and further explain our approach to theorical development. Secondly, we describe our research design by unfolding our methodological choice and strategies. Third, we provide a description on the data collection process. Forth, we elaborate on the proxies used for our conceptual development (i.e., what variables are applied) with the collected data. Finally, we explain the statistical tools used in the empirical analysis.

4.1 Research philosophy

In this thesis, we apply an epistemological and ontological stance to define our knowledge and approach to methodology (Saunders et al., 2016). As we in our research intend to reveal information that is both true and insightful, and in combination, not yet researched, we adhere to a positivistic assumption within the epistemological sphere, meaning that we use accurate data that is observable and the subject is testable (Saunders et al., 2016). In addition, we claim to take a detached approach to our collection and analysis of measurable data, which we believe reflects the reality, implying that our ontological view is objective (Saunders et al., 2016). Moreover, by taking this view we believe the causalities being studied exists independently of this research study and external facts are beyond our reach of influence (Bryman, 2012).

To address the research question, we apply a deductive research approach to theory development. We formulate our research question by using established concepts from the literature and theory to build up our argumentation while considering a set of boundary condition to derive testable propositions, which we subsequently evaluate in our empirical analysis. We operationalize the applied concepts from the VC, CVC, strategic alliance and game theorical literature in our conceptual development to collect accurate and observable data and develop measures in order to examine our propositions (Saunders et al., 2016). We aim to develop our variables to the simplest possible element to better understand the implications as a whole which also allows us to differentiate between them. Moreover, we direct particular attention to selecting our sample and retaining a large size over the course of the study, yet do not intend to widely generalize our results (Saunders et al., 2016).

4.2. Research design

In line with our research philosophical orientation and approach to theory, we apply a quantitative research design to ensure these are coherent (Saunders et al., 2016). Specifically, quantitative research is frequently associated with positivism and a deductive approach (Saunders et al., 2016), and is deemed most suitable in our study as well, as it will enable us to investigate our research questions empirically with a large richness of data. Based on the proposed conceptual links, we use the collected data to explain and evaluate the relationship between the innovativeness (i.e., patent applications) of the ventures and the different investor "types" and the underlying dynamics using statistical analysis (Saunders et al., 2016). We solely rely on secondary data such as investments, investors, and patents. Although secondary data can be biased, we consider it the most beneficial for our research purpose due to availability and completeness (Veal and Darcy, 2014). In this sense, we try to ensure the quality of our research by using high-quality and reliable sources and continuously throughout the study evaluate the reliability and validity of our data and statistical models (Veal and Darcy, 2014). Given the purpose of our study, we design our research by undertaking a panel data study due to its capacity to study change and development over time and create accurate inferences of model parameters compared to cross-sectional data (Saunders et al., 2016). The accurate inferences of model parameters from using double dimensionally panel data emerge from such as more informative data, higher variability, and lower collinearity among variables (Gujarati and Porter, 2009). Through the chosen research design, we aim to ensure a high degree of trustworthiness of the study (Saunders et al., 2016).

4.3. Data collection

To address our research questions, we established a dataset that contains information about the investment characteristics of the VC-backed ventures, the corporate investors and patent information of the ventures. In the following section we describe the data collection processes, and how we merged the data into a single dataset for the purpose of analysis.

Corporate investors

Two raw data extractions from the Refinitiv VentureXpert database constitutes the basis of our sample. More specifically, one list contained all the corporate investors that have performed venture investments, and the other a raw list contained all the ventures that have received venture capital funding. The database, formerly known as Thomson VentureXpert, has been used extensively in previous corporate venture capital research and is considered

to be a reliable source on venture funding (e.g., Alvarez-Garrido and Dushnitsky, 2016; Basu et al., 2011; Maula et al., 2003; Wadhwa and Kotha, 2006).

The raw list with all corporate investors (see corporate venture capitalists) includes all investors which are classified as "corporate" by VentureXpert. The list additionally contained information on such as the corporate investor's nation, number of investments, and first and last investment year. The raw list amounted to 2,057 distinct corporate investors from 61 different nations that invested in the period 1990 to 2020 (note the time period was expanded to capture corporate investors prior to 2003, as will be explained in the "ventures" data collection process). In the first process of our sample construction, we focused on the corporate investors and included the following steps: 1) ensure that all corporate investors are correctly classified according to the definition of corporate venture capital and eliminate those that are incorrectly classified; and 2) assign the parent company to each respective corporate investor and eliminate those corporate investors whose parent company is not publicly traded (as private companies typically lack available and reliable data). The purpose of this process was to enhance the quality of the data.

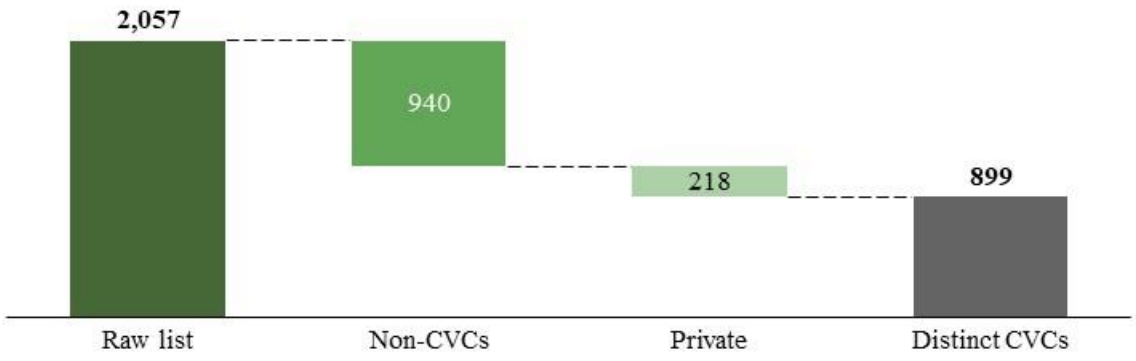
In the first step, non-strategic corporate investors were eliminated as the nature of their investments differ from those of strategic corporate investors (examples of such are financial firms, i.e., insurance companies, banks, etc.) (e.g., Wadhwa et al., 2016; Park and Steensma, 2013) and pension funds that mainly pursue venture capital as a mean of diversifying their portfolio (e.g., Dushnitsky and Shaver, 2009). By performing searches on each corporate investors' activities, we were able to eliminate non-strategic investors which were nonetheless classified as "corporate" by the VentureXpert database. By excluding financial firms, pension funds and miscellaneous holding companies, 940 corporate investors were eliminated, reducing the sample to 1,117 distinct corporate investors (see CVCs).

In the second step, we manually assigned the parent company to each corporate investor (see CVCs) in order to derive the parent company's primary industry as defined by the Standard Industry Classification (SIC) code and financial data. Similar to other researchers, we eliminated those corporate parents that were not publicly traded to ensure availability and reliability of the data (e.g., Wadhwa et al., 2016). By excluding non-publicly traded companies it reduced the sample further from 1,117 to 899 distinct corporate venture capitalists. Note that this effectively resulted in 738 distinct corporations (i.e., parent organizations) as some corporates have multiple CVC arms, e.g., Dell Technologies Inc. both have *Dell Technology Capital* and *Dell Ventures*.[1] To derive the parent company's SIC-code and financial data, we extracted the information from the Compustat database by obtaining a list

[1] The "unit of analysis" will be the distinct corporate investors. For instance, in the example of Dell Technologies Inc., if both its CVC arms have invested in the same venture it will be characterized as *one* corporate investor.

of publicly traded companies in both North America and globally, as some corporate investors are geographically located outside the US. Since the financial data is denoted in the country of origin, we additionally extracted foreign exchange rates from 1990 to 2020 from the Compustat database to convert all financial data into US Dollars. Through our manual process of assigning the parent company for each corporate investor, we established a common identifier between the two datasets, and were able to merge the SIC-code and financial data for each corporate investor. In some instances, the SIC-code provided by Compustat was missing or did not represent the parent companies' actual primary industry. Therefore, to ensure higher data quality and completeness of the data, we manually went through each parent company and adjusted the SIC-code if necessary. In case the SIC-code was manually inserted or changed we documented this in a dummy variable *parent_source*, where 1 indicates that the information is taken from Compustat and 0 indicates manual insertion.

FIGURE VII: SUMMARIZED OVERVIEW OF CVC SAMPLE CONSTRUCTION



Note: Own illustration

Ventures

The second raw list extracted from VentureXpert contained information on ventures that received funding from at least one IVC and/or corporate investor. We limited our data to US-based ventures due to higher data availability and the ability to triangulate the data (i.e., patent data) compared to other geographical regions. In addition, US ventures are an important source of technologically advanced and commercially viable inventions (Kortum and Lerner, 2000) and are therefore more likely to be targeted by established corporations (Dushnitsky and Shaver, 2009). US-based ventures have similarly been used extensively in previous corporate venture capital research (Alvarez and Dushnitsky, 2016; Pahnke et al., 2015; Park and Steensma, 2013) which confirms the validity of

limiting the research to this geographical region. Furthermore, we limited our data to ventures that operate in the life science and information and communication technology (ITC) industries. More specifically, we define life science industry to include the following "sub"-industries: 1) pharmaceuticals, 2) medicinal instrument equipment; and 3) biotechnology; and for ITC: 1) hardware; and 2) software. See Appendix I for the specific SIC-codes and a short description of the industries. The industries were chosen as they previously having been used extensively in corporate venture capital research due to their high patent activity and high venture funding activity (e.g., Park and Steensma, 2013; Alvarez-Garrido and Dushnitsky, 2016; Pahnke et al., 2015; Kim and Park, 2017). Lastly, we limited our data time period to ventures that received funding between 2003 and 2020 to ensure the data is up to date and mitigate potential issues with overlap of multiple macroeconomic crises (see the IT-bubble and the financial crisis) and CVC evolutions (see section 2.2.1.). To briefly sum up, the extracted list includes all ventures with the following characteristics: 1) received funding from at least one IVC and/or corporate investor between 2003 and 2020; and 2) operates within the life science or the information and communication technology (ITC) industry. The final list amounted to 14,109 distinct ventures in the observation period. For each respective venture, the list contained information on such as the equity invested at a given year, the specific investors and the ventures' SIC-code. 61 of the ventures were reported to have received zero equity, why we decided to exclude these. This ultimately resulted in 14,048 distinct ventures. For an overview of the ventures by industries see Appendix II.

Although this study only considers ventures that received investments between 2003 and 2020, some ventures also received funding prior to 2003. We therefore expanded the data collection period to 1990 to capture all the prior funding rounds and investments (without including additional ventures outside the time period in focus: 2003-2020) to mitigate potential biases. Subsequently, we undertook the second process of our manual sample construction that included the following steps: 1) insert all prior funding rounds for each venture; and 2) perform a clerical review of ventures' investors and merge the list of ventures with the list of corporate investors.

In the first step, we manually inserted all prior funding rounds that were not included in the raw list (between 2003 and 2020). Through this process we were able to capture all the information about each venture and increase the quality of the data.

In the second step, we undertook a clerical review of all the investors that VentureXpert classified as independent venture capitalists to ensure a correct classification. We identified that a few were wrongly classified, for instance, "Lilly Venture Management Company LLC" was classified as an IVC but is in fact a corporate investor of the parent company "Eli Lilly and Company". Subsequently, we matched the list of all the ventures to the one of corporate investors. As the data was retrieved from the same data source, VentureXpert, we were able to use standard merging by using the *merge* command in Stata (through a common identifier). By performing this merge,

we were able to ensure that the match between the ventures' that received funding by corporate investor(s), despite the classification of VentureXpert, were in fact what is considered a strategically oriented corporate investor (i.e., CVC). Additionally, all the information gathered on corporate investors was also merged in the process.

Patent data

In the last step we collected patent information on the ventures. This information is used for both the dependent variable and control variables in our analysis. We retrieved the patent information by extracting raw files from the publicly available PatentsView database. The PatentsView database sources its information from the United States Patent and Trademark Office (USPTO) and therefore includes official information on patents in the US (PatentsView, 2021). Specifically, we retrieved information on applied for and granted patents, assignees, and citations from 1976 to 2021 which allowed us to track all the patenting activity for each venture. For each patent applied for or granted patent, the files contained information on such as application or granted date, the unique assignee ID, and the type of patent (e.g., design, utility, etc.). In this study, we choose to only include utility patents as these represent a novel and valuable solution to a technical problem and covers the creation of new or improved, and useful, products or processes, hence, known for "patent for invention" (Jensen et al., 2007). The utility patents also represented the vast majority of the patents.

After collecting the patent information, we undertook the third process of manual sample construction. As the patent information is separated in different files (e.g., application data in one and assignee in another) we linked them through common identifiers (i.e., variables that exist in more than one data file, such as *patent ID*). This was performed in Stata by using standard merging. For reference, a list of the used files from PatentsView can be found in Appendix III.

Subsequently, we merged the patent data with the sample venture dataset by using the name of the ventures and the assignee name. During this process we experienced one issue as the assignee of the patent data and the venture name were not consistently similar. In general, the USPTO does not assign a unique organization ID for each individual firm in patent fillings. PatentsView mitigates this issue by using a disambiguation algorithm to assign the respective unique organization(s) to each patent ID (PatentsView, 2021). However, as organizations use different names and abbreviations, and names frequently contain spelling errors, these could not be perfectly matched with the ventures. To overcome this issue, we used fuzzy matching (*reclink2* command in Stata) to match the patents assignee name to the venture name as a common identifier. The *reclink2* command assigns a probability for each match (which we set at lowest possible probability: 0.6), i.e., the names must resemble each other to some degree. This resulted in over 80,000 unique patents. We subsequently undertook a clerical review of all the

matched pairs and only kept those could be assigned directly to the specific venture. As some patents were missing the application date, we manually performed searches using Google Patents to assign the application date and additionally looked up each patent to ensure that the patents assigned to the specific ventures were in fact correct.

Lastly, we counted the number of citations for each patent ID. We only included US citations (i.e., did not include foreign citations) which we believe are representative of the study. The file contained over 117 million citations, with each citation containing the citing patent (*patent_id*), cited patent (*citation_id*) and the citing date (*date*). We counted each patent ID's forward citations and forward self-citations using the Stata *collapse* command. Subsequently, we merged the count to the unique patent ID that was linked to the specific venture.

In summary, by performing these processes of manual sample construction, we established our sample data consisting of the ventures relevant to this study including their respective investment data, correctly assigned corporate investor(s) (combined with its parent organization, SIC-code, and financial data) and each ventures' patent data. After the collection and cleaning process, we started to process the data and constructed a multitude of variables (to be described in the next section), with each variable separated in a single data files, that were subsequently merged into the final panel dataset. The observation period for each venture in panel dataset are the years in between first and last year of investment, including the first and last year of investment. Note the cut off period was made in the end to capture all relevant data prior to first investment, e.g., patent stock and venture quality (to be described in the next section).

4.4. Variables

In the following section, we will explain the variables we intend to use in our empirical analysis. We believe the variables are good measures for our analysis and we strive to present solid argumentation for their aptness.

Dependent variable

The dependent variable in this study measures the innovative performance of the ventures. Similar to prior research, we use patent data to measure innovative performance as this serves as a superior indication of the innovativeness (e.g., Kim and Park, 2017; Alvarez-Garrido and Dushnitsky, 2016). In this study we use patent applications as the measurement for innovativeness since this captures the timing of knowledge creation (Wadhwa and Kotha, 2006) and is not subject to an extended waiting period before it is granted (i.e., it can take multiple years

before the patent is granted). We operationalized this variable by first counting the number of patent applications for a given venture in a given year within the observation period. Since innovation is an unstable activity and varies over time, we developed the dependent variable by the counting the cumulative patent applications in a given year and included those applications prior to first investment. This enabled us to capture continuity of the ventures' innovative performance and is deemed the most adequate measure for its innovativeness.

Independent variables

To the best of our knowledge, the independent variables used in this study have not been used in prior CVC research as most literature is centered around a dyadic relationship (i.e., one corporate and one venture) and most research does not differentiate between one or multiple corporate investors (e.g., Pahnke et al., 2015; Kim and Park, 2017; Park and Steensma, 2013). In some cases, scholars' control for multiple corporate venture capital (e.g., Alvarez-Garrido and Dushnitsky, 2016) using a binary variable if multiple corporate investors are present or not. We therefore aim to develop suitable independent variables that capture what we intend to investigate as guided by our research questions.

Multiple Corporate Venture Capital

To measure how the presence of multiple corporate investors impact ventures' innovative performance, we use multiple variables that enable us to distinguish between the different investor types. We employ three different binary variables at the time of observation: 1) *venture_capital* taking the value of 1 if the venture is purely funded by IVC(s) and 0 if otherwise; 2) *one_corporate* taking the value of 1 if precisely one corporate investor has invested in the venture (IVCs may be present) and 0 if otherwise; and 3) *MCVC* taking the value of 1 if more than one corporate investor has invested in the venture (IVCs may be present) and 0 if otherwise.

To put the variables into context, a venture may receive an investment from one corporate in 2005, hence, *one_corporate* takes the value 1 and the other binary variables 0 (i.e., *venture_capital* and *MCVC*). In case another corporate invests in the same venture in 2007, then the value of *one_corporate* becomes 0 and MCVC becomes 1 while *venture_capital* remains 0. Since we cannot detect if a corporate investor sold its shares in a venture in the sample period, the variable in the example above will not change during the remaining of the observation period.

Prior ties

We use prior ties to measure the corporate investors' level of familiarity, inter-firm trust and ability to coordinate their efforts. To capture prior ties, we reviewed all the ventures that received funding from multiple corporate investors and counted all the possible combinations of prior ties in the syndicate. By counting all the possible combinations of prior ties, it enables us to measure the *strength* of the prior ties. First, we reviewed all the individual corporate investors' venture investments and noted all the ventures they had invested in with other corporate investors. This allowed us to view which corporate investors had prior ties and in which ventures. The first time two (or more) corporate investors invested together in a venture was not counted as a prior tie, but instead their "first tie". All their subsequent venture investments, where they invested together, was however labelled a "prior tie". Next, we counted all the combinations of prior ties for the respective syndicate. To put it into context, consider the following example of two corporate investors (*a* and *b*), three (*a*, *b* and *c*) and four (*a*, *b*, *c* and *d*) in a syndicate:

- Two corporate investors can have one combination: 1) *a* and *b*.
- Three corporate investors can have four combinations: 1) *a* and *b*; 2) *a* and *c*; 3) *b* and *c;* 4) *a, b* and *c*.
- Four corporate investors can have eleven combinations: 1) *a* and *b*; 2) *a* and *c*; 3) *a* and *d*; 4) *b* and *c*; 5) *b* and *d*; 6) *c* and *d*; 7) *a, b* and *c*; 8) *b, c* and *d*; 9) *a, c* and *d*; 10) *a, b* and *d*; 11) *a*, *b*, *c* and *d*.

And for {5, 6, 7, 8} corporate investors: {26, 57, 120, 247}[2] (the maximum number of corporate investors in a syndicate in our sample is eight). After counting all the "numbers" of prior ties in the syndicate, we established a variable for the maximum number of possible combinations (i.e., calculations above) and divided it by the actual number of combinations to derive the "fraction" (i.e., the "strength") of prior ties in the syndicate which will be used as the independent variable. We subsequently apply the natural logarithm to this variable due to non-normal distribution (as will be set out in see section 4.5.) (Stock and Watson, 2015).

Industry relatedness

To capture the corporates' ability and inclination to imitate the venture, and the ventures' access to complementary resources, i.e., the industry affiliation between the corporate investor(s) and the venture, we measured the industry relatedness by using the SIC-code of the corporate investors' parent and the venture. To operationalize industry relatedness, we measured the "degree" of industry relatedness by matching their SIC-codes on all four digits

[2] Equation: $\frac{n!}{r!(n-r)!} + \frac{n!}{r!(n-r)!} + \cdots + \frac{n!}{r!(n-r)!}$, $n = \{5, 6, 7, 8\}$; $r = \{2, 3, .., 8\}$ where, "n" is equal to the number of corporate investors present and "r" is equal to the number of "corporate investors" to choose from

separately. First, four distinct variables were established and set to one if both parties have their primary operations in the same one-, two-, three- and four-digit SIC code and zero if otherwise. Subsequently, we summed the number of overlaps/matches. This means that if both parties operate in the same three-digit SIC code the number of matches/overlaps is three. To put it into context, the "degree" of industry relatedness is computed as:

- 4 if both parties have their primary operations in the same four-digit SIC-code
- 3 if both parties have their primary operations in the same three-digit SIC-code
- 2 if both parties have their primary operations in the same two-digit SIC-code
- 1 if both parties have their primary operations in the same one-digit SIC-code

This variable-definition shares similarity to Dushnitsky and Shaver (2009) who measures *industry overlap* using a binary variable taking the value 1 if both parties, i.e., the corporate investor and the venture, operate in the same four-digit NAICS-code and 0 if otherwise. Since we measure industry relatedness our method is deemed adequate to capture the "degree" of industry affiliation between the corporate investor and the venture. In addition, Dushnitsky and Shaver (2009) measure the industry overlap in a dyadic relationship and since we also intend to study industry relatedness of multiple corporate investors and the venture, we measured the average industry relatedness by summing the total "number" of industry overlaps/matches and divided it by the number of corporate investors.

To put into context, consider the following example: The venture *Infinity Pharmaceuticals* is operating in the pharmaceutical preparation industry (4-digit SIC-code: 2834). It is funded by three corporate investors, namely: *Johnson and Johnson* (SIC-code: 2834), *Novartis* (SIC-code: 2834) and *Amgen* (SIC-code: 2836). The number of 4-digit SIC-code overlaps between the venture and the corporate investors is equal to 4 for *Johnson and Johnson* and *Novartis*, and 3 for *Amgen*. The sum of the industry relatedness is equal to (4+4+3 =) 11 and the number of corporate investors is equal to 3, hence, the average is (12/11) = 3.6667.

Control variables

In line with previous studies, we employ several control variables at the CVC- and venture-level to account for other factors influencing the dependent variable (the ventures' patenting activity). As many of the control variables are non-normal distributed and/or non-linear to dependent variable, we apply log-transformations. For descriptive statistics see section 5.1.

CVC-level control variables

On the CVC-level we control for: 1) CVC experience; 2) size of parent organization; and 3) the CVC equity share.

First, we control for the corporate investors' total years of CVC investment experience (*CVC_experience*) to account for experience effects with managing venture investments (Di Lorenzo and Sabel, 2021) such as higher internal legitimacy that can increase transferring of non-financial resources and promote effective collaboration between the business units and the venture. We operationalized this control variable by subtracting the given observation year of the given venture from the first investment year of CVC. For syndications we summed the individual corporate investors' experience and divided it by the total number of corporate investors in the syndicate. Due to a non-normal distribution, we log-transformed this variable.

Second, we control for the size of the CVC (i.e., parent organization) as it has previously been found to influence the ventures' innovative performance, e.g., in terms of resource availability (e.g., Chemmanur et al., 2014). Multiple measures have previously been used to control for the size of the parent, e.g., revenue and number of employees (e.g., Wadhwa and Basu, 2013). We decided to use the weighted average total assets (*weighted_total_assets*) due to higher data availability (since such as revenue and number of employees contained more missing data from the Compustat database) and as it has previously been found to have a positive effect on ventures' performance (e.g., Di Lorenzo and Sabel, 2021). The weighted average total assets were measured by the total assets divided by the number of corporate investors at the observation year. As some data on the corporate parent's total assets was missing, we estimated the total assets missing data points by using the compound annual growth of the two most recent data points and applied this to the missing data points. In addition, we looked up every parent to confirm that this estimate of total assets in fact represented the reality and decided to adjust it if not. For instance, in some cases the estimated total assets became abnormally large, and we therefore decided to apply a 5% growth rate to forecast the growth in total assets instead. This growth rate is approximately equal to annual Gross Domestic Production (GDP) growth rate in our time period (WorldBank, 2021) and was therefore deemed an adequate growth rate to proxy the growth in total assets. Lastly, due to non-normal distribution, we log-transformed this variable.

Finally, we proxied the ownership share of CVC investors (*CVC_equity_share*) by measuring the amount of CVC-invested capital as a percentage of total invested capital (i.e., compared to IVCs) at the time of observation. This proxy has similar been used as a control variable in prior research on ventures' innovativeness (e.g., Park and Steensma, 2013). Although the exact ownership share would have been a more accurate control variable, VentureXpert does not provide this information for privately held ventures. This measure serves as a control of how

vested the corporate investor is in the venture, and hence, for instance, their willingness to provide firm-specific resources. Due to a non-normal distribution, we log-transformed this variable.

Venture-level control variables

Prior research has presented a variety factors and the use of control variables that may be relevant in determining a venture's innovation performance. We therefore include a number of those variables and control for these in our models. At the venture-level we control for: 1) total investment amount; 2) funding round; 3) venture age; 4) patent stock; and 5) venture quality.

To consider the influence on innovative performance by the degree of available financial resources, e.g., extensive investments in R&D activities, we control for the total investment that a venture have received from the beginning of the sample to the given observation year (e.g., Alvarez-Garrido and Dushnitsky 2016; Di Lorenzo and van de Vrande, 2019). We operationalized the control variable (*total_investment_amount*) by calculating the total cumulative investment amount, in USD million, at a given observation year that a venture has received during the sample period. Due to a non-normal distribution, we natural log-transformed this variable.

Venture investments are made in series of discrete rounds because investors typically stage their investments to coincide with substantial advances in a venture's progress, e.g., in terms of technologies, products and strategic agendas (Katila et al., 2014; Hallen and Eisenhardt, 2012; Sahlman, 1990). We control for this progress (*funding_round)* to take the discrete value of the given funding round[3].

To further control for the ventures' progress, we control for the venture age as this serves as proxy of the growth of the venture such as in terms of number of employees, resources, and organization (e.g., Alvarez-Garrido and Dushnitsky, 2016; Aggarwal and Hsu, 2009). We operationalized this variable (*venture_age*) by calculating the given observation year minus the founding date[4]. Due to a non-normal distribution, we log-transformed this variable.

We control for the ventures' patent stock prior to receiving investment as this gives an indication of the ventures' pre-funding innovative capabilities and knowledge stock. This might influence how corporate investors select and perceive the value added to the venture, impact the post-innovative funding rates (e.g., Park and Steensma, 2013)

[3] Despite funding round is non-normally distributed, we do not log-transform this variable as the discrete variable is tied to the given investment round and the interpretation would not be logical.
[4] As some ventures' age was disproportionately high compared to the others (e.g., some was over 80 years), we decided to cap the maximum years at 30, which we still believe captures the "intent" with this control variable.

and the ventures' capacity to absorb new knowledge (e.g., Yang et al., 2014). We operationalized this control variable (*patent_stock*) by counting the number of cumulative granted patents at the given observation year. Due to a non-normal distribution, we log-transformed this variable.

While patent stock does not take the quality of the innovation into account, i.e., ground-breaking vs incremental discoveries, we control for the venture quality by counting the cumulative number of forward citations for each ventures' granted patent(s) at the observation period (Di Lorenzo and van de Vrande, 2019, Chemmanur et al., 2014). We operationalized this control variable (*venture_quality*) by the number forward citations minus forward self-citation to ensure only external verified quality is considered. Due to a non-normal distribution, we log-transformed this variable.

4.5. Statistical tools

This section will explain the econometric models which are used to address the research questions. First, we elaborate our main regression model and its underlying assumptions. Second, fixed effects and interaction terms will be explained as these will be employed in the models.

Regression model: Ordinary least square regression

In this thesis, we perform a panel data analysis on the effect of the *presence* of multiple corporate investors, prior ties between corporate investors and industry relatedness, on ventures' innovation performance using multiple regression. The most common and widespread multiple regression model for empirical analysis in economics and other social sciences is the linear (Ordinary Least Squares, OLS) model as it offers some attractive statistical properties and is easy to interpret (e.g., Gujarati and Porter, 2009; Woolridge, 2012; Stock and Watson, 2015). In addition, it can be used to measure count data (Stock and Watson, 2015) and has been used in prior research to study patent data (e.g., Griliches, 1990; Knudsen et al., 2008), and is therefore, deemed a suitable regression model in our context. In basic terms, OLS is a method to determine unknown coefficients by minimizing the sum of squared differences between the actual and predicted values (Gujarati and Porter, 2009). To ensure unbiased estimates, there are six assumptions of the OLS model that need to be considered. These are (Wooldridge; 2012): 1) linearity; 2) no perfect collinearity; 3) zero conditional mean; 4) homoskedasticity; 5) no serial correlation; and 6) normality. We will discuss these properties in relation to our model (to see proofs of the theorems of these properties, see for example Wooldridge, 1994). The first five assumptions are, according to the Gauss-Markow

Theorem, the most important, and if these holds, the OLS estimator is "Best Linear Unbiased Estimator (BLUE)" (Woolridge, 2012).

First, we find that the dependent variable (*cumulative_patent_applications*) is non-normally distributed, and therefore, take the natural logarithm of the dependent variable (adding +0.01 to handle observations to zero cumulative patent applications) (see Appendix IV) (Stock and Watson, 2015). Essentially, converting it to a log-linear OLS model (depending on the given model, as will be set out in section 5.2.). In the same vein, we check for linearity and non-normal distribution of the independent and control variables to ensure correctness and reliability of the model. In case the linearity assumption does not hold and/or the variables are non-normally distributed, we perform a non-linear transformation of the variables, in our case, taking the natural logarithm (as laid out in section 4.4.) (e.g., Gujarati and Porter, 2009; Woolridge, 2012; Stock and Watson, 2015).

Perfect multicollinearity occurs when one of the variables is a perfect linear combination of other factor variables, which could lead to imprecise estimation of the coefficients (e.g., Stock and Watson, 2015). We check for multicollinearity by performing a correlation matrix between the independent variables and control variables and aim to eliminate or modify highly correlated variables to reduce estimation errors (will be performed in section 5.2.).

The assumption of the expected conditional mean of the error term, given the explanatory variables for all periods, is zero, implies that the error term at time *t* is *uncorrelated* with each explanatory variable in *every* time period (Wooldridge, 2012). This will *not* happen if the data are obtained by sampling at random from the population because randomness of the sampling process ensures that the errors are independently distributed from one observation to the next (Stock and Watson, 2015). However, in the context of panel data, random sampling is almost never appropriate (Stock and Watson, 2015; Wooldridge, 2012) which is the same in our case. Essentially, our sample is non-random as it consists of ventures in specific industries in the US, in other words, a sub-group of a population, i.e., ventures in all industries in the US. Therefore, according to Woolridge (2012), we must explicitly assume that the expected value of the error term is *not* related to the explanatory variables in any time period, hence, *uncorrelated* and confirms assumption of the expected zero-conditional mean. In the same vein, Wooldridge (2012) suggest that for this assumption to hold for non-random panel data, there are two common failures in relation to the *uncorrelation* condition. These are (Wooldridge, 2012): 1) omitted variables; and 2) measurement error in some of the regressors. We, therefore, aim to address both the omitted variable bias and the measurement errors bias in the regressors, which accordingly, increases the internal validity for the study (i.e., the statistical inferences of the casual effects are valid for the population and setting being studied).

An omitted variable bias arises when a variable that both determines the dependent variable and is correlated with one or more of the included regressors is omitted from the regression model (Stock and Watson, 2015). To

eliminate this bias, we add additional adequate regressors in the form of control variables (see section 4.4.) and include fixed effects in the regression (see section 4.5.). Measurement errors and errors in-variable bias can occur when there are errors in the data and lead to biased predictions (Stock and Watson, 2015). For all variables we rely on the three databases, namely Refinitiv VentureXpert, PatentsView and Compustat. These databases stems from official records which decrease the possibility of measurements errors. However, we did observe that VentureXpert wrongly classified some investors as CVCs which we manually accounted for and removed those ventures with missing data, e.g., investment amount. Furthermore, we decided to only include publicly traded corporate investors to decrease measurement errors as these have stricter information requirements, hence, more reliable data (e.g., Chemmanur et al., 2014; Wadhwa et al., 2016). Lastly, we manually looked up the patents for each assignee venture to address potential "errors" from the disambiguation algorithm by the PatentsView database. Yet, due to limited access to data and limited scope of the thesis, we cannot exclude the possibility of measurement errors in from the *presence* of (multiple) corporate investors as corporate investors may have liquated its equity share over the course of the observations period.

Homoscedasticity, as opposed to heterogeneity, implies a *constant* variance of the conditional distribution for the error term and independence from the regressors (Stock and Watson, 2015). In case this assumption is violated, it can lead to biased results in the standard errors of the OLS estimates (i.e., undesired confidence levels). To ensure our model is robust in this sense, we apply heteroscedasticity-robust standard errors, which makes statistical inference valid for both cases, as homoscedasticity is a special narrow case of heteroscedasticity (Stock and Watson, 2015).

Serial correlation in regression models refers to the independence of error terms, and if violated can lead to biased and inconsistent error terms (Stock and Watson, 2015). It is primarily caused by three factors (Verbeek, 2004): 1) incorrect functional forms; 2) omitted variables; and 3) inadequate dynamic specification of the model. Unfortunately, serial correlation is most likely violated in panel data regression models (Wooldridge, 2012; Stock and Watson, 2015). Yet, we aim to address issues with serial correlation by separately addressing the three factors as suggested by Verbeek (2004). First, if the true regression function is nonlinear but the estimated regression is linear, then this functional form misspecification makes the OLS estimator biased (Stock and Watson, 2015). We address the incorrect functional forms by log-transforming relevant variables which are non-linear and/or non-normally distributed in the OLS log-linear regression model as suggested by Stock and Watson (2015). Second, we aim at ensuring sufficient control variables to decrease the possibility of omitted variables, and third, perform one-year lags of the dependent variable (t+1) to correct for the trend component (i.e., dynamic specification of the model). By performing one-year lags (t+1) we additionally address the fact that there is no same-year effect of the

ventures' innovativeness and an investment as it likely takes some time to, for instance, make use of the financial resources, gain access firm-specific resources and leverage the knowledge-sharing.

The last assumption of normality assumes normal distribution in the error term and independence of the regressors (Woodridge, 2012). According to Gujarati and Porter (2009) a sufficiently large (non-random) sample will be approximately normally distributed (i.e., according to the central limit theorem) regardless of the distribution of the individual variables. We believe our sample size is sufficiently large to justify this assumption.

To put our OLS regression model into context, the variables can be specified as:

$$(1.0) \quad \ln(Y_{i,t+1}) = \beta_0 + \beta_1 X_{1,i,t} + \beta_2 X_{2,i,t} + \beta_3 X_{3,i,t} + C_{i,t} + \varepsilon_{i,t}, \qquad i = 1, 2, \dots, n; \;\; t = 1, 2, \dots, T$$

where $Y_{i,t+1}$, represent the dependent variable of the number of cumulative patent applications for a specific venture (i) at time (t+1). The $\beta_i's$ represent the regression coefficients for the given independent variables. X_i's represent the independent variable regressors. In general, the $\beta_i's$ represent the changes in the dependent variable, $Y_{i,t+1}$, when the independent variable changes by a "unit", given all other variable are held constant. The control variables are denoted by $C_{i,t}$ and represent all the control variables. The residuals are captured by ε_i. Since we intend to employ several regression models, the OLS regression models and use of variables will vary. This will be specified in the empirical analysis (section 5.2.).

Fixed effects

To control for omitted variables in the panel data and eliminate alternative explanations resulting from differences between ventures, fixed effects are employed in the regression models (Stock and Watson, 2015). Especially, fixed effects can be used when there are two or more observations for each entity (i.e., ventures) and considers all dissimilarities between entities. This helps to control for variances that exists within each venture instead of across all ventures altogether. In other words, in our empirical case, the ventures (i), the IDs, are grouped to specify that the observations are independent across groups but not necessarily within them. Consider the OLS regression model in equation (1.0) with the dependent variable and regressors denoted as $Y_{i,t+1}$ and $X_{i,t}$, respectively:

$$(2.0) \quad \ln(Y_{i,t+1}) = \beta_0 + \beta_1 X_{1,i,t} + \beta_2 X_{2,i,t} + \beta_3 X_{3,i,t} + B_4 Z_i + C_{i,t} + \varepsilon_{i,t},$$

$$i = 1, 2, \dots, n; \;\; t = 1, 2, \dots, T$$

here, Z_i, is an unobserved variable that varies from venture to the next but does not change over time for each specific venture. This can for example be the ventures' size, smartness of the founder and geographical area.

Because Z_i varies from one venture to the next but is constant over time, the population regression in equation (2.0) can be interpreted as having *n* intercepts, one for each venture. Specifically, if we let $a_i = \beta_n X_{it} + a_i + C_{it} + \varepsilon_{it}$ then equation (2.0) becomes (Stock and Watson, 2015):

$$(2.1) \quad \ln(Y_{i,t+1}) = \beta_0 + \beta_1 X_{1,i,t} + \beta_2 X_{2,i,t} + \beta_3 X_{3,i,t} + a_i + C_{i,t} + \varepsilon_{i,t},$$

$$\mathrm{i} = 0, 1, 2, \ldots, \mathrm{n};\ \mathrm{t} = 0, 1, 2 \ldots, \mathrm{T}$$

Equation (2.1) is the fixed effect OLS log-linear regression model in which a_i, … , a_n are treated as unknown intercepts to be estimated, one for each venture. The slope coefficient of the population regression, i.e., the independent and control variables, is the same for all ventures, but the intercept of the population regression line varies from one venture to another.

Interaction terms

To capture the partial effect of the dependent variable for an independent variable to depend on the magnitude of yet another independent variable, we make use of interaction terms (Ai and Norton, 2003; Stock and Watson, 2015). In this study we use interaction term to understand the differential effect of ventures' innovative performance for industry relatedness to depend on the presence multiple corporate investors as well as for prior ties to depend on industry relatedness. The interaction term in our model can be mathematically expressed as:

$$(3.0) \quad \ln(Y_{i,t+1}) = \beta_0 + \beta_1 X_{1,i,t} + \beta_2 X_{2,i,t} + \beta_3 X_{1,i,t} X_{2,i,t} + C_{i,t} + \varepsilon_{i,t}, \quad i = 1, 2, \ldots, n;\ t = 1, 2, \ldots, T$$

where, in the former example, β_1 = MCVC="multiple corporate venture capital"; β_2 = industry relatedness; and β_3 represent the "new" regression coefficient and $X_{1,i,t}X_{2,i,t}$ is the interaction term. We both perform interaction terms with one binary variable (e.g., MCVC) and one continuous variable (e.g., industry relatedness), two continuous variables (e.g., prior ties and industry relatedness) and two binary variables (in robustness checks, as will be laid out in section 5.2.) (Stock and Watson, 2015).

5. RESULTS

In this section we introduce our results. We start out by presenting the descriptive statistics in our sample, followed by the empirical analysis. In the empirical analysis we start by performing a correlation matrix of the variables to check for multicollinearity, following by the statistical models and lastly, robustness checks.

5.1. Descriptive statistics

In this sub-section, our sample data will be described. We start out by broadly investigating our sample of 14,048 ventures where 316 distinct corporate investors, i.e., parent organizations, could be associated with an investment in our sample. Specifically, we highlight the distribution of investor types, noteworthy characteristics of the ventures and other general statistics. Subsequently, we will elaborate on the descriptive statistics among the different investor types and describe notable differences among them. Lastly, we will present our sample patent data and briefly describe these.

All sample statistics

In Table I the descriptive statistics for all variables we use in this study are presented (without log-transformation). The cautious reader will note that there is a lower number of observations for the corporate-specific variables, i.e., industry relatedness, weighted average total assets, CVC experience and CVC equity share. This is expected as these are sensible to whether corporate investor(s) are present or not. This is the same case for prior ties as this variable are only associated to situations with the presence of multiple corporate venture capitals (MCVC).

The first noteworthy statistics are the differences in investors. The majority of ventures received funding from only independent venture capital firms at around 78% (n=10,948) and the remaining with one or more corporate investors present at around 22% (n=3,100). In terms of corporate investors, most ventures received investments from one corporate investor at around 15% (n=2,190) while ventures receiving financing from multiple corporate investors only represent a small fraction of the total venture funding activity with around 6% (n=910). The fraction of ventures receiving funding from at least one corporate investor is fairly consistent with prior research (e.g., Pahnke et al., 2015; Alvarez-Garrido and Dushnitsky, 2016). The smaller fraction of multiple corporate venture capital syndications may underscore the findings of Souitaris and Zerbinati (2014) that CVCs are reluctant to syndicate with other CVCs due to conflicting strategic agendas, hence, preferring to syndicate with other IVCs.

In the same vein, across the sample, the average CVC equity share of the total investment amount is around 26%. This highlights that in many instances other independent venture capitalists are also present when corporate investors invest in ventures. This is consistent with the literature that many CVCs syndicate their investments with other VCs (Basu et al., 2011) and that CVCs have a preference to co-invest other VCs in general (Das et al., 2011; Ivanov and Xie, 2010).

Table I: Descriptive Statistics

VARIABLES	OBS.	MEAN	STD. DEV.	MIN.	MAX.
Dependent variables					
Patent applications	51,956	0.479	2.140	0	133
Patent applications (cum)	51,956	2.354	9.885	0	461
Independent variables					
Industry relatedness	11,322	1.026	1.395	0	4
Prior ties	3,337	0.277	0.418	0	1
Venture-level controls					
Total investment amount	51,956	2.7ee+07	6.18e+07	400	3.68e+09
Funding round	51,956	3.292	2.744	1	35
Venture age	51,956	6.744	7.0591	0	30
Patent stock	51,956	1.069	6.235	0	367
Venture quality	51,956	53.274	550.38	0	43,548
CVC-level controls					
CVC equity share	11,322	0.259	0.222	0.0002	1
Weighted average assets	11,322	83,235	103,074	1	797,769
CVC experience	11,322	12.521	7.650	0	45
Investors					
Venture capital	51,956	0.782	0.413	0	1
One corporate	51,956	0.154	0.361	0	1
MCVC	51,956	0.064	0.245	0	1

Ventures (n=14,048)
Note: 1) Total investment amount is in US dollars; 2) Weighted average assets is in million US dollars

The average total investment amount in our sample is USD 27 million with a maximum of USD 3.7 billion. The venture that received the highest investment amount in the sample period of USD 3.7 billion is Uber Technologies that operates in the ITC-industry (SIC-code: 7372), more specifically, the software industry. Interestingly, Uber Technologies was backed by corporate investor Alphabet Inc. in their fifth funding round in 2013 and accompanied

by other prominent independent venture capitalists such as Sequoia Capital. As a matter of fact, Uber Technologies later went public in 2019 at an 82 billion valuation (Wall Street Journal, 2019).

Investor sample statistics

In Table II, III and IV we distinguish between the different investor types. By first looking at the patenting activity, we see that ventures solely backed by independent venture capital firms on average apply for the lowest number of patents (i.e., are less innovative) while ventures backed by the presence of one corporate investor rank second. This is in general consistent with the literature (e.g., Alvarez-Garrido and Dushnitsky, 2016; Chemmanur et al., 2014). Interestingly, ventures backed by multiple corporate investors apply for the highest number of patents with an average of 0.9, which is more than double that of ventures solely backed by IVCs of 0.4.

We see a similar picture when looking at the average pre-investment patenting activity and venture quality. On average, the statistics indicate that corporate investors tend to invest in ventures with a higher number of patents pre-investment compared to IVCs, which could potentially indicate a selection effect of the higher patent application activity for CVC-backed ventures (e.g., Park and Steensma, 2013). Moreover, looking at the average funding round and venture age, the statistics indicate that IVCs generally tend to invest in ventures at an earlier stage than corporate investors. The average funding round and venture age is particularly higher (compared to only IVC-backed) when there is one corporate investor present and even higher when there are multiple corporate investors present. This may indicate the ventures' wait to accept investments from corporates due to the need to establish appropriate defence safeguards from potential misappropriation (i.e., timing defence) (Katila et al., 2008). Yet, there is no one-sided explanation to these results as corporate investors may, on the other hand, also prefer to invest at later stages and select higher patenting and "proven" ventures, for instance, due to strategic reasons to gain greater knowledge about the specific patents and technologies (e.g., Dushnitsky and Lenox, 2006).

When looking at the independent variables, we see that the average industry relatedness between one corporate investor and the venture is on average around 0.96 SIC-code digits (out of 4), while the average industry relatedness when multiple corporate investors are present is around 1.17 SIC-code digits (out of 4). There is no definitive explanation to this; either corporates prefer to syndicate with similar industry peers, or the ventures prefers to receive investments from multiple corporates in similar industries to itself. In terms of prior ties, we see that the average fraction of prior ties (to reiterate: the number of prior ties divided by the maximum number of possible combinations of prior ties between the corporate investors in the syndicate) is around 0.28. The average fraction of prior ties for corporate investors is considerably higher for ventures operating in the life science industry at around 0.40 compared to the ITC-industry with around 0.21. A similar pattern is seen when looking at the industry

relatedness between multiple corporate investors and the venture, where the average industry relatedness is higher in the life science industry (1.56) compared to the ITC-industry (0.97). An explanation to why the fraction of prior ties and industry relatedness is higher within the life science industry may be due to the life science industry having a larger concentration of some of the largest and most prominent corporations that, in our dataset, (more) often pursue CVC investments together such as Pfizer, Merck & Co., and Novartis. In the same vein, the higher industry relatedness in the life science industry may be a result of ventures in this industry having a greater need for (industry-specific) complementary resources. For instance, in the sub-industry "drugs", there is a substantial need for highly skilled scientist, state-of-the-art laboratories and costly R&D infrastructure in the discovery stage (e.g., Alvarez-Garrido and Dushnitsky, 2016). Likewise, in the development stage, there is a high need for scientific knowledge and experience in terms of preclinical and clinical test to corroborate the therapeutic potential of the prospective drug, its efficacy as well as certifying its safety according to strict regulatory requirements (e.g., Alvarez-Garrido and Dushnitsky, 2016). Along the same lines, we see a slightly lower presence of corporate investors in the ITC-industry (21%) compared to the life science industry (23%)[5]. In combination, the slightly lower average presence of corporate investors in the ITC-industry and on average lower industry relatedness may be explained by the findings of Dushnitsky and Shaver (2009). They find that ventures in weak IPP-regimes such as the telecommunication equipment, computer equipment, semiconductors, and software (i.e., ITC-industry) are more reluctant to accept funding from corporate investors (within the same industry) compared to ventures in stronger IPP-regimes such as the pharmaceuticals, biological products, surgical instruments, and electromedical equipment (i.e., life science industry) due to a higher fear of imitation.

Table II: Descriptive Statistics for Independent Venture Capital

VARIABLES	OBS.	MEAN	STD. DEV.	MIN.	MAX.
Dependent variables					
Patent applications	40,634	0.392	1.730	0	133
Patent applications (cum)	40,634	1.483	5.765	0	253
Venture-level controls					
Total investment amount	40,634	2.03e+07	4.28e+07	400	2.27e+09
Funding round	40,634	2.940	2.539	1	35
Venture age	40,634	6.650	7.360	0	30
Patent stock	40,634	0.729	4.134	0	223
Venture quality	40,634	39.134	527.28	0	43,548

Ventures (n=10,948)
Note: 1) Total investment amount is in US dollars

[5] ITC-industry: one corporate (15%); MCVC (6%); life science industry: one corporate (16%); MCVC (7%).

Table III: Descriptive Statistics for One Corporate Investor

VARIABLES	OBS.	MEAN	STD. DEV.	MIN.	MAX.
Dependent variables					
Patent applications	7,985	0.745	2.934	0	91
Patent applications (cum)	7,985	4.298	17.370	0	461
Independent variables					
Industry relatedness	7,985	0.963	1.448	0	4
Venture-level controls					
Total investment amount	7,985	4.50e+07	8.54e+07	10,000	2.43e+09
Funding round	7,985	4.177	2.943	1	24
Venture age	7,985	6.801	5.948	0	30
Patent stock	7,985	2.171	11.786	0	367
Venture quality	7,985	105.757	666.53	0	24,010
CVC-level controls					
CVC equity share	7,985	0.248	0.230	0.0002	1
Weighted average assets	7,985	83,685	113,289	1	797,769
CVC experience	7,985	12.554	8.049	0	45

Ventures (n=2,190)
Note: 1) Total investment amount is in US dollars; 2) Weighted average assets is in million US dollars

Table IV: Descriptive Statistics for Multiple Corporate Investors

VARIABLES	OBS.	MEAN	STD. DEV.	MIN.	MAX.
Dependent variables					
Patent applications	3,337	0.910	3.719	0	86
Patent applications (cum)	3,337	5.410	14.743	0	318
Independent variables					
Industry relatedness	3,337	1.176	1.248	0	4
Prior ties	3,337	0.277	0.418	0	1
Venture-level controls					
Total investment amount	3,337	6.99e+07	1.29e+08	800,100	3.68e+09
Funding round	3,337	5.469	3.159	1	26
Venture age	3,337	7.728	5.524	0	30
Patent stock	3,337	2.578	7.634	0	141
Venture quality	3,337	99.879	509.91	0	13,284
CVC-level controls					
CVC equity share	3,337	0.285	0.202	0.005	1
Weighted average assets	3,337	82,158	73,050	937	441,341
CVC experience	3,337	12.444	6.597	0	42

Ventures (n=910)
Note: 1) Total investment amount is in US dollars; 2) Weighted average assets is in million US dollars

Patent sample data

In Table V the total number of patent applications alongside the venture concentration for each SIC-code in our sample is presented. The total number of unique patent applications is 24,887. The most patenting industry is the computer programming and data processing industry (SIC-code 737) (normally associated with the software industry) with 7,861 patent applications while the cable and other pay television services (484) is the lowest patenting industry with only one patent application. The cautious reader will note that the highest concentration of ventures is also in the software industry, while the cable and other pay television services industry has the lowest concentration of ventures. Particularly interesting is however, that even though the software industry is the most patenting industry, it is on average the third lowest patenting industry per venture with an average of 0.89 patent applications, whereas the electronic components and accessories (normally associated with the semiconductor industry) is the most patenting industry per venture with an average of 6.16. This is followed by the surgical, medical and dental instrumental and supplies (normally associated with the medical device industry) with an average of 4.57 patent applications per venture. Accordingly, 17.6% of all patent applications are filed by ventures within the semiconductor industry even though the ventures in this industry only account for 5.1% of the sample, while 22.4% of the patent applications are filed by ventures within the medical device industry while the industry only account for 8.7% of the ventures in the sample.

Table V: Patent Data across SIC-codes

	VENTURES			PATENT APPLICATIONS		
SIC-3	**FREQ.**	**PERC.**	**CUM.**	**FREQ.**	**PERC.**	**MEAN**
737	8,843	62.9%	62.9%	7,861	31.6%	0.89
873	1,266	9.0%	72.0%	1,619	6.5%	1.28
283	1,256	8.9%	80.9%	3,117	12.5%	2.48
384	1,220	8.7%	89.6%	5,570	22.4%	4.57
367	710	5.1%	94.6%	4,371	17.6%	6.16
489	220	1.6%	96.2%	586	2.4%	2.66
366	218	1.6%	97.8%	908	3.6%	4.17
357	169	1.2%	99.0%	659	2.6%	3.90
481	71	0.5%	99.5%	45	0.2%	0.63
483	56	0.4%	99.9%	150	0.6%	2.68
484	19	0.1%	100.0%	1	0.0%	0.05
Total	14,048	100%		24,887	100%	1.77

Notably, when looking across the top four industries (SIC-codes) with the highest concentration of ventures, the life science industry represents three out of four, i.e., 873, 283 and 284 (see Appendix I for an explanation for

these), yet the industry only accounts for 26.6% of the total sample size (see Table VI). Meanwhile, they represent 41.4% of the patenting activity, hence, on average patenting more than ventures within the ITC-industry.

Table VI: Patent Data across Industries

	VENTURES		PATENT APPLICATIONS		
INDUSTRY	**FREQ.**	**PERC.**	**FREQ.**	**PERC.**	**MEAN**
ITC	10,306	73.4%	14,581	58.6%	1.41
Life Science	3,742	26.6%	10,306	41.4%	2.75
Total	14,048	100%	24,887	100%	1.77

Interesting to note is that many of ventures within sub-industries of the ITC-industry have a higher patenting activity compared to those ventures within drugs and pharmaceutical preparations (283) industry and biotechnology (873) industry. However due to the high number of ventures and lower average patenting activity within the ITC-sub-industry, software, it lowers the overall average patenting activity per venture within the ITC-industry.

5.2. Empirical analysis

In this section, we will look at the pairwise correlations between the variables and consider necessary changes to address potential issues to internal validity of the model. Next, we will build the different models and lastly perform robustness checks.

Correlation matrix

To ensure that the variables of the investor types are mutually exclusive in the empirical analysis, we constructed a variable named *category* and categorized the different investor types into categories. These are: 1) *venture_capital* = 1; 2) *one_corporate* = 2; and 3) *MCVC* = 3.

In Table VII, we present an overview of the pairwise correlations between the variables that we intend to use in our model to see if they are related. Accordingly, we use the log-transformed variables as described in section 4.4. and check for multicollinearity which high correlations can indicate. Specifically, high correlations can lead to

imprecise estimations of the partial effects of the regression coefficients (for reference, see section 4.5.) (Stock & Watson, 2015).

Table VII: Correlation Matrix for Input Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	1.00												
(2)	0.04	1.00											
(3)	-0.06	-0.01	1.00										
(4)	0.29	0.04	0.02	1.00									
(5)	0.24	-0.02	-0.04	0.52	1.00								
(6)	0.14	-0.04	-0.10	0.26	0.33	1.00							
(7)	0.58	0.02	-0.07	0.29	0.36	0.22	1.00						
(8)	0.56	0.00	-0.09	0.27	0.34	0.21	0.94	1.00					
(9)	-0.15	-0.02	0.15	-0.42	-0.37	-0.14	0.15	-0.15	1.00				
(10)	-0.03	-0.17	0.25	0.12	0.05	0.03	0.00	-0.01	0.01	1.00			
(11)	0.07	-0.07	0.24	0.15	0.18	0.13	0.12	0.11	-0.04	0.28	1.00		
(12)	0.12	0.07	-	0.25	0.21	0.08	0.13	0.13	0.14	0.14	0.07	1.00	
(13)	0.17	0.07	-	0.35	0.26	0.11	0.18	0.18	0.14	0.14	0.07	0.78	1.00

Note: (1) Patent applications (cum) $(\ln)_{t+1}$; (2) Industry relatedness; (3) Prior ties (ln); (4) Total investment amount (ln); (5) Funding round; (6) Venture age (ln); (7) Patent stock (ln); (8) Venture quality (ln); (9) CVC equity share (ln); (10) Weighted average assets (ln); (11) CVC experience (ln); (12) MCVC; (13) Category
Correlations $\neq 0.00$ are significant at 5%.

As can be seen, there are two highly correlated variables: (7) Patent Stock (ln), the cumulative number of granted patents, and (8) Venture Quality (ln), the cumulative number of forward citations (ρ = 0.94). We use venture quality to measure the "quality" of the venture. To offset this issue, we omit one of the variables (Stock and Watson, 2015). As patent stock, i.e., the proxy for innovative capabilities, cannot be substituted by one of the other variables this one is kept. Meanwhile, the quality of venture can be proxied by the amount of investment received, and therefore, we decide to omit the (8) Venture Quality (ln) variable.

Note that prior ties have missing correlations for MCVC and category. This is expected as they are sensitive to whenever multiple corporate venture capital is present and missing values when not. In addition, there are high pairwise correlations between MCVC and category which is also expected as, for example, when MCVC takes the value 1, category will take the value 3, and when MCVC takes the value 0 then category will take the value of either 1 or 2. Yet, these variables are not used in the same model why the high correlations are not an issue.

For the remaining variables, some still have correlations greater than 40%, yet these correlations are not too high for the separate variables to encounter multicollinearity, and hence, deemed acceptable to be included in the model.

Empirical models

After having established the input variables for our model, results from the empirical analysis are presented in this section. To begin with, we investigate the first research question, whether the presence of multiple corporate investors impact the ventures' innovative performance. In the second sub-section we investigate the underlying dynamics within a (multiple) corporate venture capital setting, specifically, prior ties and industry relatedness. Lastly, we will perform robustness checks to verify the strength and structural validity of the model.

Multiple Corporate Investors

To measure the dependent variable, patent applications (cum) $(\ln)_{t+1}$, we conduct multiple OLS regression models. For this purpose, we employ the *xtreg* command in Stata with robust standard errors and fixed effects. To investigate the multiple corporate investors impact on ventures' innovative performance, we distinguish between the different investor types (i.e., purely IVC-funded, presence of one corporate investor and presence of multiple corporate investors) and include all the venture-level control variables since the CVC-level control variables are only associated with corporate investors. To build this model, we follow the approach of Di Lorenzo and Almeida (2017) and specify different stages of our model: Model 1.1 only specifies the control variable, Model X.1 (X = 2, 3) only the independent variables (the new *category* variable), and Model X.2 (X = 2, 3) both the control and independent variables. It should be noted that when we interpret the results, we look at the expected *average* effect on ventures' cumulative patent applications for each venture per year.

See Table VIII for the results. The cautious reader will note that only 8,419 ventures are included in the models. The lower number of ventures compared to the initial sample is due to the one-year lag of the dependent variable where ventures with only one observation are left out. This is common in time-lagged panel data and does not

impair the predictions. The average observation per venture is 4.5 and all the models are statistically significant ($p<0.01$).

Model 1.1 shows that all our control variables are statistically significant ($p<0.01$) and positively related to the number of cumulative patent applications. To put each variable into context:

- Increasing the total investment amount by 10% (holding the other variables constant), the increase in each ventures' expected average cumulative patent applications is equal to $(1.10)^{0.267} \approx 1.026$ equivalent to 2.6% per year;
- A one-unit increase (holding the other variables constant) in funding round (i.e., one later funding round), increases each ventures' expected average cumulative patent applications by $\exp(0.107) \approx 1.113$ equivalent to 11.3% per year;
- As ventures become more mature in terms of venture age, i.e., a proxy for the growth of the ventures, a 10% increase in the age (e.g., from 10 years to 11 years) (holding the other variables constant) increases each ventures' expected average cumulative patent applications by $(1.10)^{0.179} \approx 1.017$ equivalent to 1.7% per year;
- An increase in pre-funding innovative capabilities (proxied by the patent stock) of 10%, i.e., number of granted patents, leads to an increase in each ventures' expected average cumulative patent applications (holding the other variables constant) of $(1.10)^{0.098} \approx 1.009$ equivalent to 0.9% per year

This underscores that all the control variables are decent proxies and serve as good controls for other factors that influence the dependent variable – the ventures' patenting activities.

Turning to explore the effect on ventures' innovative performance by the different investor types, we shift the attention to Model X.1-X.2 (X = 2, 3). The "baseline" in these models are ventures funded only by independent venture capitalists. We observe that across all models all the control variables remain statistically significant ($p<0.01$) and positively related to the number of cumulative patent applications.

In Model 2.1 and 2.2 (one corporate investor) we find that the presence of one corporate investor is statistically significant ($p<0.01$) and positively related to the ventures' cumulative patent applications. When excluding all the control variables (Model 2.1), the coefficient for one corporate investor is equal to 1.229 ($p<0.01$) and when including all the control variables (Model 2.2), the coefficient decreases to 0.182 yet remains statistically significant

(p<0.01). This implies that having one corporate investor (holding the other variables constant) increases each ventures' expected average cumulative patent applications by exp(0.182) ≈ 1.120 equivalent to 20.0% per year.

Table VIII: Regression Results for Different Investor Types

D.V. Patent applications (cum) $(ln)_{i,t+1}$	**MODEL 1.1**	**MODEL 2.1**	**MODEL 2.2**	**MODEL 3.1**	**MODEL 3.2**
Independent variables					
One corporate investor		1.229***	0.182***		
		(0.034)	(0.066)		
Multiple corporate investors				2.253***	0.559***
				(0.050)	(0.107)
Venture-level controls					
Total investment amount (ln)	0.267***		0.246***		0.246***
	(0.237)		(0.024)		(0.024)
Funding round	0.107***		0.100***		0.100***
	(0.012)		(0.012)		(0.012)
Venture age (ln)	0.179***		0.178***		0.178***
	(0.011)		(0.011)		(0.011)
Patent stock (ln)	0.098***		0.096***		0.096***
	(0.008)		(0.008)		(0.008)
Constant	-6.743***	-2.991***	-6.456***	-2.991***	-6.456***
	(0.356)	(0.028)	(0.360)	(0.028)	(0.360)
Observations	37,908	37,908	37,908	37,908	37,908
Ventures	8,419	8,419	8,419	8,419	8,419
Robust standard errors	yes	yes	yes	yes	yes
Fixed effects	yes	yes	yes	yes	yes
Prob. > F	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parenthesis; ***p<0.01, **p<0.05, *p<0.1

In Model 3.1 and 3.2 (multiple corporate investors) we likewise find that the presence of multiple corporate investors (MCVC) is statistically significant (p<0.01) and positively related to the ventures' cumulative patent applications. When excluding all the control variables (Model 3.1), the coefficient for multiple corporate investors is equal to 2.253 (p<0.01) and when including all the control variables (Model 3.2), the coefficient decreases to 0.559 but remains statistically significant (p<0.01). This implies that having multiple corporate investors (holding the other variables constant) increases each ventures' expected average cumulative patent applications by exp(0.559) ≈ 1.749 equivalent to 74.9% per year.

This shows that the presence of one corporate investor increases the ventures' innovative performance, and even more with the presence of multiple corporate investors (i.e., 0.559 > 0.182). To further investigate if the effect of

having more than one corporate investor (i.e., multiple corporate investors) compared to the presence of one corporate investor is significant on the ventures' cumulative patent applications, we perform an F-test. Specifically, we specify the following hypothesis:

$$H_0: \text{one corporate investor} - \text{multiple corporate investors} = 0$$

$$H_1: \text{one corporate investor} - \text{multiple corporate investors} \neq 0$$

We subsequently reject the null hypothesis at the $p<0.01$-level (see Appendix V) and find that the effect of multiple corporate investors compared to one corporate investor is both significant and positive related to the ventures' innovative performance.

Summing up, we find that the presence of one and/or more corporate investors are both statistically significant and positively related to the ventures' cumulative patent applications (compared to purely backed by IVCs) and can therefore be confirmed to increase the ventures' innovative performance. Most importantly, we find that the presence of multiple corporate investors is statistically significant, positively related, and positively impact the ventures' innovative performance the most (compared to ventures that are purely IVC-funded and with the presence of one corporate investor).

Prior ties and industry relatedness

After having examined the different investor types, we shift the focus on the underlying dynamics, specifically, prior ties and industry relatedness, in a corporate venture capital setting, i.e., disregarding those ventures purely funded by IVCs. As the "baseline" will change throughout the analysis of the underlying dynamics, we will start by analysing the effect of industry relatedness between the ventures and the corporate investors, as it both considers ventures backed by one corporate investors and multiple corporate investors. The regression models on prior tries are, on the other hand, limited to only multiple corporate investors (since at least two corporate investors need to be present to examine prior ties). Like the empirical analysis on the different investor types, we employ the *xtreg* command in Stata with robust standard errors and fixed effects.

In Model 4.X (X = 1, 2, 3, 4, 5) we focus on all ventures backed by at least one corporate investor and investigate the impact of industry relatedness. We start by showing all the control variables, followed by the two independent variables (the variables "MCVC" and industry relatedness") and lastly, the interaction terms between the two independent variables.

In Model 5.X (X = 1, 2, 3, 4, 5) we focus on all the ventures backed by multiple corporate investors and investigate the impact of prior ties and industry relatedness. Equally, we start by showing all the control variables, followed by the independent variable (i.e., the variables "prior ties" and "industry relatedness"), and lastly, the interaction between the two independent variables.

See Table IX and X for the results. Naturally, the number of ventures decreases compared to the first models on the different investor types as the analyses of the underlying dynamics focuses on a subset of ventures which are either backed by at least one corporate investor and/or multiple corporate investors. Therefore, 1,899 ventures are studied in Model 4 and 587 ventures in Model 5. The average number of observations are 4.3 and 4.1, respectively, and all the models are statistically significant ($p<0.01$).

Model 4.1 show all the venture-level and CVC-level control variables. The venture-level control variables have changed coefficients (compared to Model 1.1) as the subset of ventures have changed and more control variables have been added. Yet, they remain statistically significant and positively related to the ventures' innovative performance. For the CVC-level control variables, all the variables are positively related to the ventures' innovative performance, however only the parents' size (weighted average assets) and CVC experience are statistically significant ($p<0.05$ and $p<0.1$, respectively) while the CVC equity share is insignificant. To put the CVC-level control variables that into context:

- A larger size of the parent organization (i.e., weighed average assets) is associated with higher venture innovative performance. Increasing the size of the corporate investor(s)' parent organization by 10% (holding the other variables constant) will lead to an increase in each ventures' expected average cumulative patent applications of $(1.10)^{0.196} \approx 1.019$ equivalent to 1.9% per year;
- More corporate venture capital experience is associated with higher venture innovative performance. A 10% increase in the corporate venture capital experience (e.g., from 10 years to 11 years) (holding the other variables constant) will lead to an increase in each ventures' expected average cumulative patent application of $(1.10)^{0.065} \approx 1.006$ equivalent to 0.6% per year;
- The higher CVC equity share, the higher venture innovative performance. Increasing the CVC equity share (compared to IVCs) by 10% (holding the other variables constant), increases each ventures' expected average cumulative patent applications by $(1.10)^{0.044} \approx 1.004$ equivalent to 0.4% per year

The CVC-level control variables are similarly to the venture-level control variable deemed good controls for other factors that influence the dependent variable – the ventures' patenting activities.

Table IX: Regression Results for Industry Relatedness

D.V. Patent applications (cum) $(ln)_{i,t+1}$	**MODEL 4.1**	**MODEL 4.2**	**MODEL 4.3**	**MODEL 4.4**	**MODEL 4.5**
Independent variables					
Multiple corporate investors (MCVC)		0.183		0.172	-0.046
		(0.128)		(0.127)	(0.164)
Industry relatedness			-0.181*	-0.175*	-0.202*
			(0.106)	(0.104)	(0.106)
MCVC × Industry relatedness					0.167*
					(0.095)
Venture-level controls					
Total investment amount (ln)	0.308***	0.280***	0.304***	0.278***	0.278***
	(0.121)	(0.075)	(0.072)	(0.075)	(0.076)
Funding round	0.121***	0.119***	0.124***	0.121***	0.123***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Venture age (ln)	0.204***	0.203***	0.205***	0.203***	0.200***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
Patent stock (ln)	0.031**	0.031**	0.031**	0.031**	0.031**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
CVC-level controls					
CVC equity share (ln)	0.044	0.005	0.050	0.013	0.019
	(0.100)	(0.100)	(0.100)	(0.100)	(0.101)
Weighted average assets (ln)	0.196**	0.176**	0.183**	0.164**	0.162**
	(0.773)	(0.079)	(0.077)	(0.079)	(0.080)
CVC experience (ln)	0.065*	0.069*	0.064*	0.068*	0.066*
	(0.392)	(0.393)	(0.039)	(0.392)	(0.392)
Constant	-9.527***	-8.965***	-9-121***	-8.612***	-8.538***
	(1.326)	(1.395)	(1.337)	(1.415)	(1.418)
Observations	8,220	8,220	8,220	8,220	8,220
Ventures	1,899	1,899	1,899	1,899	1,899
Robust standard errors	yes	yes	yes	yes	yes
Fixed effects	yes	yes	yes	yes	yes
Prob. > F	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parenthesis; ***p<0.01, **p<0.05, *p<0.1

In Model 4.2 we see that the binary variable "MCVC=multiple corporate venture capital" is positively related to ventures' innovative performance but statistically insignificant when we include all the CVC-level control variables. This is surprising considering the results in hypothesis test in the sub-section "multiple corporate venture capital" where we find that the presence of multiple corporate investors is *significant* and more positively related to the ventures' innovative compared to the presence of one corporate investor. We, therefore, intend to perform robustness checks in the next section to verify the previous results. Although the statistically insignificance, the

coefficient is still positive, and shows that when multiple corporate investors are present (compared to the presence of one corporate investor) it leads to an increase in each ventures' expected average cumulative patent applications of exp(0.183) ≈ 1.201 equivalent to 20.1% per year.

Turning the attention to industry relatedness between the venture and the corporate investor(s), we find in Model 4.3 that industry relatedness is statistically significant ($p<0.1$) and negatively related with ventures' innovative performance. Essentially, this means that increasing the industry relatedness by on average one-digit (i.e., higher industry relatedness) (holding other variable constant) decreases each ventures' expected average cumulative patent applications by exp(-0.182) ≈ 0.833 – 1 = (0.167) equivalent to 16.7% per year. When including both independent variables in Model 4.4 to analyze the multivariate effect, the magnitude of the coefficients become slightly lower (compared to the univariate effects in Model 4.2 and Model 4.3), but the "concluding" results remain the same.

By introducing the interaction term in Model 4.5, we present interesting insights into the industry relatedness dynamics between the presence of one corporate investor and multiple corporate investors. First, both the industry relatedness and the interaction term are statistically significant ($p<0.1$) while MCVC changes to having a negative impact on ventures innovative performance but remains statistically insignificant. The regression results show that both types of investors negatively affect the ventures' cumulative patent applications when industry relatedness increases. However, the magnitude is significantly smaller with the presence of multiple corporate investors as shown by the positive interaction terms between multiple corporate venture capital and industry relatedness.

In essence, the analyses on industry relatedness show that a higher degree of industry relatedness between the venture and the corporate investor(s) has a negative effect on ventures' innovative performance. The magnitude of the negative effect of industry relatedness is significantly higher for ventures when one corporate investor is present compared to when multiple corporate investors are present.

We now shift the focus to how prior ties between corporate investors affect ventures' innovative performance. As outlined above, for this analysis we only focus on the subset of ventures that are funded by multiple corporate investors.

Model 5.1 shows all the venture-level and CVC-level control variables. Interestingly, many of control variables are now insignificant and not able to explain the ventures' innovative performance when only considering the ventures where multiple corporate investors are present. The only statistically significant control variables are funding round ($p<0.01$), venture age ($p<0.1$), CVC equity share ($p<0.05$) and parent size (weighted average assets) ($p<0.01$). At the same time, CVC equity share has a negative effect on ventures' innovative performance in a

multiple corporate investor context. Otherwise, the control variables are positive similar to Model 4.1, but the magnitude have changed, especially for the total investment amount (decrease) and parent size (increase). This can indicate that there are other (unexplored) underlying dynamics in a multiple corporate investor setting that are worth exploring and can help to explain the ventures' innovative performance.

Table X: Regression Results for Prior Ties

D.V. Patent applications (cum) $(ln)_{i,t+1}$	**MODEL 5.1**	**MODEL 5.2**	**MODEL 5.3**	**MODEL 5.4**	**MODEL 5.5**
Independent variables					
Prior ties (ln)		0.172		0.174	0.057
		(0.142)		(0.142)	(0.192)
Industry relatedness			-0.137	-0.152	0.048
			(0.162)	(0.283)	(0.376)
Prior ties (ln) × Industry relatedness					0.080
					(0.078)
Venture-level controls					
Total investment amount (ln)	0.132	0.133	0.162	0.138	0.118
	(0.162)	(0.162)	(0.230)	(0.162)	(0.158)
Funding round	0.154***	0.143***	0.154***	0.143***	0.148***
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Venture age (ln)	0.201*	0.206*	0.203*	0.207*	0.212*
	(0.095)	(0.095)	(0.095)	(0.095)	(0.096)
Patent stock (ln)	0.005	0.003	0.006	0.004	0.002
	(0.023)	(0.023)	(0.022)	(0.022)	(0.022)
CVC-level controls					
CVC equity share (ln)	-0.487**	-0.553***	-0.487***	-0.550***	-0.555***
	(0.205)	(0.201)	(0.205)	(0.208)	(0.202)
Weighted average assets (ln)	0.705***	0.703***	0.705***	0.693***	0.681***
	(0.184)	(0.181)	(0.184)	(0.182)	(0.184)
CVC experience (ln)	0.040	0.038	0.040	0.040	0.037
	(0.117)	(0.112)	(0.117)	(0.115)	(0.114)
Constant	-12.78***	-12.30***	-12.78***	-12.08***	-11.96**
	(3.515)	(3.548)	(3.515)	(3.574)	(3.496)
Observations	2,427	2,427	2,427	2,427	2,427
Ventures	587	587	587	587	587
Robust standard errors	yes	yes	yes	yes	yes
Fixed effects	yes	yes	yes	yes	yes
Prob. > F	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parenthesis; ***p<0.01, **p<0.05, *p<0.1

In Model 5.2 we include prior ties as independent variable to analyse the univariate effect. Prior ties is positively related to the ventures' cumulative patent applications but is statistically insignificant. In essence, this means that

as a higher proportion of corporate investors in the syndicate have prior ties, it positively impacts the ventures' innovative performance. To investigate if the magnitude of prior ties is dependent on the degree of industry relatedness, we introduce the interaction in Model 5.5. To begin with, we check for univariate effect on industry relatedness in a multiple corporate investor situation in Model 5.3. We neither find it be statistically significant, yet, is negatively related to the ventures' innovative performance (as the results in Model 4 also indicates). Next, we check for multivariate effects and find that both prior ties and industry relatedness remain statistically insignificant but the "concluding" results remain the same. Lastly, we introduce the interaction term and find that all variables are statistically insignificant. The interaction term does however indicate that a higher degree of industry relatedness positively moderates prior ties.

To sum up on the underlying dynamics, the results show that industry relatedness is negatively associated with the ventures' innovative performance while prior ties is positively related but statistically insignificant. Meanwhile, the presence of multiple corporate investors positively moderates the negative effect of industry relatedness yet remains to have a negative effect on ventures' innovative performance. In the same vein, higher industry relatedness has a positive moderating effect on prior ties between the corporate investors on ventures' innovative performance but is statistically insignificant.

Robustness checks

Robustness checks are commonly performed in empirical studies to verify the strength and structural validity of the statistical model by investigating potential changes in regression coefficients when certain characteristics of the model are modified (Lu and White, 2014). We use one of main approaches as suggested by Plümper and Neumayer (2017) to adjust the existing variables of the original regression models. Accordingly, we adjust three of our independent variables; MCVC, industry relatedness and prior ties.

First, we adjust MCVC="multiple corporate venture capital" by changing it to a categorical variable and calculate the cumulative number of corporate investors that are present (i.e., 1, 2, …, 8). Secondly, we adjust the industry relatedness by changing it to a binary variable to check the impact on ventures' innovation performance of "high" and "low" industry relatedness. Specifically, we divide the industry relatedness variable with four (the number of possible SIC-code overlaps) and split the values between "high" and "low" industry relatedness. If industry relatedness on average is equal to or above 0.75 (i.e., the corporate investor(s) on average matches at least three SIC-codes with the venture) it takes the value 1, and 0 if otherwise. Third, we adjust the prior ties variable by changing it to a binary variable (non-natural logarithm) and split the values between "strong" and "weak (to none)" prior

ties. Specifically, we split the values of prior ties to take the value 1 if prior ties is "strong" (i.e., equal to or above 0.75) and 0 if otherwise (i.e., weak to none; lower than 0.75). To put it into context:

- If there are two corporate investors, they need to have prior ties for the new variable to be categorized as "strong" prior ties;
- If there are three corporate investors, they need to have at least three prior ties, meaning that all corporate investors need to have invested with each other before but not necessarily all together at the same time (i.e., *a*, *b*, and *c*), for it to be categorized as "strong" prior ties;
- If there are four corporate investors, they need to have at least eight prior ties, meaning that all corporates need to have invested together before and at least one instance where three of the corporate investors have invested together before for it be categorized as "strong" prior ties;
- And for {5, 6, 7, 8} corporate investors: $0.75 \times \{26, 57, 120, 247\} = \{20, 43, 90, 193\}$

To shortly recap, in Model 2.2. and 3.2., we find a statistically significant and positive effect of the presence of at least one corporate investor on the ventures' innovative performance. In addition, we find a *higher* positive effect of having *more* than one corporate investor which is statistically significant in the hypothesis test (compared to one corporate investor). However, in Model 4.2 the presence of multiple corporate investors is statistically insignificant (when comparing it to the subset of ventures with the presence of at least one corporate investor). We, therefore, start to focus on the subset of ventures that are funded by at least one corporate investor to check if increasing the number of corporate investors increases the ventures' innovative performance. This is shown in Model 6.1. Subsequently, we turn the attention to industry relatedness. We find that a higher "degree" of industry relatedness negatively impacts ventures' innovative performance both for one corporate investor and multiple corporate investors (Model 4). We, therefore, check if "high" industry relatedness between the venture and the corporate investor(s) impact ventures' innovative performance. This is shown in Model 7. Lastly, we focus on prior ties. We find that a higher degree (fraction) of prior ties between corporate investors insignificant (Model 5). We, therefore, check if "strong" prior ties between corporate investors impact ventures' innovative performance as well as how it is affected by whether industry relatedness is "high" or "low". This is shown in Model 8.

Looking at Model 6.1 (Table XI) we see that for all ventures backed by at least one corporate investor, increasing the number of corporate investors positively impacts the ventures' innovative performance. In addition, the new measure is statistically significant ($p<0.05$). This means that increasing the number of corporate investors by one (from the "baseline" of one corporate investor), (holding other variable constant) increases each ventures' expected average cumulative patent applications by $\exp(0.175) \approx 1.191$ equivalent to 19.1% per year. This is consistent with

the findings in the hypothesis test and confirms that increasing the number of corporate investors positively impacts the ventures' innovative performance, and *more* than those ventures with the presence of one corporate.

Table XI: Robustness Checks

D.V. Patent applications (cum) $(ln)_{i,t+1}$	**MODEL 6.1**	**MODEL 7.1**	**MODEL 7.2**	**MODEL 7.3**
Independent variables				
Number of corporate investors	0.175**			
	(0.087)			
Industry relatedness (new)		-0.497*	-0.430	-0.573*
		(0.291)	(0.302)	(0.320)
Multiple corporate investors (MCVC)			0.107	-0.007
			(0.131)	(0.140)
MCVC × Industry relatedness (new)				0.487
				(0.318)
Venture-level controls				
Total investment amount (ln)	0.266***	0.294***	0.280***	0.278***
	(0.756)	(0.073)	(0.076)	(0.075)
Funding round	0.116***	0.122***	0.120***	0.122***
	(0.026)	(0.026)	(0.025)	(0.026)
Venture age (ln)	0.201***	0.202***	0.202***	0.201***
	(0.095)	(0.039)	(0.039)	(0.039)
Patent stock (ln)	0.029**	0.031**	0.031**	0.031**
	(0.013)	(0.013)	(0.013)	(0.013)
CVC-level controls				
CVC equity share (ln)	-0.026	0.029	0.008	0.015
	(0.103)	(0.100)	(0.101)	(0.101)
Weighted average assets (ln)	0.168**	0.170**	0.162**	0.162**
	(0.078)	(0.078)	(0.078)	(0.080)
CVC experience (ln)	0.071	0.068*	0.070*	0.067*
	(0.039)	(0.039)	(0.039)	(0.039)
Constant	-8.88***	-8.96***	-8.71***	-8.63***
	(1.367)	(1.355)	(1.41)	(1.41)
Observations	8,220	8,220	8,220	8,220
Ventures	1,899	1,899	1,899	1,899
Robust standard errors	yes	yes	yes	yes
Fixed effects	yes	yes	yes	yes
Prob. > F	0.0000	0.0000	0.0000	0.0000

Standard errors in parenthesis; ***p<0.01, **p<0.05, *p<0.1

In Model 7.1, we find the new variable for industry relatedness is statistically significant (p<0.1) and that a "high" industry relatedness is negatively related to the ventures' innovative performance. This is consistent with Model 4.3. Specifically, we see that the magnitude of the coefficient is "more negative" in Model 7.1 compared to Model

4.3. This makes sense due to the modification in the variable and confirms that higher industry relatedness between the corporate investor(s) is negatively associated with the ventures' innovative performance. When including both independent variables (industry relatedness (new) and MCVC) both variables are statistically insignificant, which however is inconsistent with Model 4.4. By subsequently introducing the interaction term in Model 7.3, we find that it is statistically insignificant which indicates that the new variable with "high" or "low" industry relatedness is not dependent on the presence of multiple corporate investors. Yet, the new variable for industry relatedness remains statistically significant ($p<0.1$) which suggests that "high" industry relatedness between corporate investors and the venture negatively impacts ventures' innovative performance, meanwhile, despite the insignificance of the interaction terms, the presence of multiple corporate investors positively moderates this effect, which is consistent with Model 5.5.

Model 8 (Table XII) provides insights into how the strength of "low" and "high" prior ties impact ventures' innovative performance. In Model 8.1, we see that prior ties is statistically significant ($p<0.05$) and that "strong" prior ties between the corporate investors negatively affects the ventures' innovative performance (~29% of the ventures have corporate investors with strong prior ties at some point in the observation period). This is however inconsistent with Model 5.2. As most of the ventures do not have corporate investors with "strong" prior ties but only some-to-no degree, the positive effect in Model 5.2 captures those in this "tail". It indicates that having corporate investors with only some degree of prior ties is desirable in terms of positively impacting the ventures' innovative performance, yet, if these are too strong, it negatively affects its performance.

For reference, to verify these results, we replicated Model 5 with the actual number of prior ties and controlled for the maximum possible combinations (see Model 9 in Appendix VI). The conclusion remains the same (from Model 5): that increasing the number of prior ties positively impact the ventures' innovative performance, after controlling for the maximum number of possible combinations, yet remains insignificant.

In Model 8.2., the new industry relatedness variable is statistically significant ($p<0.1$) and show that "high" industry relatedness negatively impacts the ventures' innovative performance (in a multiple corporate venture capital setting). By including both independent variables in Model 8.3, both are statistically significant ($p<0.5$ and $p<0.1$, respectively) and negatively affect ventures' innovative performance. Introducing the interaction term in Model 8.4., we find that the new variable for prior ties remains statistically significant ($p<0.1$) and negatively related to the ventures' innovative performance, but the new variable of industry relatedness and the interaction are statistically insignificant. The results indicate that prior ties is *not* dependent on the degree of industry relatedness which is consistent with Model 5.5. Yet, despite its insignificance, the new interaction term suggests that under the circumstances of "strong" prior ties between the corporate investors, then "high" industry relatedness negatively

"intensifies" this effect. This is inconsistent with Model 5.5, where the interaction term indicates that the higher industry relatedness positively moderate the effect of prior ties (same for Model 9.5 in Appendix VI).

Table XII: Robustness Checks (continued)

D.V. Patent applications (cum) $(ln)_{i,t+1}$	**MODEL 8.1**	**MODEL 8.2**	**MODEL 8.3**	**MODEL 8.4**
Independent variables				
Prior ties (new)	-0.974**		-0.955**	-0.910*
	(0.470)		(0.471)	(0.535)
Industry relatedness (new)		-0.666*	0.573*	-0.546
		(0.374)	(0.342)	(0.366)
Prior ties (new) × Industry relatedness (new)				-0.223
				(0.971)
Venture-level controls				
Total investment amount (ln)	0.056	0.122	0.049	0.048
	(0.157)	(0.162)	(0.157)	(0.156)
Funding round	0.164***	0.155***	0.165***	0.165***
	(0.047)	(0.047)	(0.047)	(0.047)
Venture age (ln)	0.183*	0.202**	0.185*	0.185*
	(0.097)	(0.095)	(0.097)	(0.097)
Patent stock (ln)	0.007	0.006	0.008	0.008
	(0.023)	(0.023)	(0.022)	(0.022)
CVC-level controls				
CVC equity share (ln)	-0.526**	-0.503**	-0.539***	-0.542***
	(0.207)	(0.206)	(0.097)	(0.209)
Weighted average assets (ln)	0.685***	0.681***	0.665***	0.669***
	(0.187)	(0.186)	(0.190)	(0.189)
CVC experience (ln)	0.056	0.045	0.590	0.059
	(0.119)	(0.117)	(0.119)	(0.119)
Constant	-11.12***	-12.3***	-10.73***	-10.76***
	(3.486)	(3.52)	(3.500)	(3.504)
Observations	2,427	2,427	2,427	2,427
Ventures	587	587	587	587
Robust standard errors	yes	yes	yes	yes
Fixed effects	yes	yes	yes	yes
Prob. > F	0.0000	0.0000	0.0000	0.0000

Standard errors in parenthesis; ***p<0.01, **p<0.05, *p<0.1

To sum up on the robustness checks, increasing the number of corporate investors (compared to one corporate investor) has a positive effect on ventures' innovative performance. The robustness checks on "low" or "high" industry relatedness show a negative relationship between "high" industry relatedness and ventures' innovative performance yet is not statistically significant when moderated by the presence of multiple corporate investors.

Meanwhile, in the robustness checks on prior ties as well as industry relatedness for ventures backed by multiple corporate investors, both new variables are statistically significant and negatively related to the ventures' innovative performance. Especially when prior ties are "strong". Yet, consistent with prior results, there is no statistically significant relationship between prior ties and industry relatedness.

6. DISCUSSION

In the following section, we discuss the results, limitations and potential future research directions, and implications of the findings. Firstly, the results of the analysis will be discussed where we reflect on unobservable factors that may have played a role to our findings in relation to existing literature. Secondly, limitations and suggestions for further research directions will be laid out. This will include potential biases that might affect the results (e.g., data issues), opportunities for future research avenues and potential for generalizing our results. Lastly, the implications of thesis (i.e., for whom this is relevant) will be set out.

6.1. Discussion of results

In this sub-section we will discuss the results. We discuss the results in the same order as the research questions and reflect on unobservable factors and possible explanations that may have played a role to our findings in relation to existing literature.

Multiple corporate venture capital

The analysis of 14,048 US-based life science and ITC ventures uncovers that the presence of corporate investors have a positive impact on ventures' innovative performance (Model 2 and 3). This is consistent with the CVC literature, where scholars likewise find that the presence of corporate investors leads to higher venture innovative performance (e.g., Alvarez-Garrido and Dushnitsky, 2016; Chemmanur et al., 2014). Moreover, the analysis shows that multiple corporate investors enhance ventures' innovative performance *more* compared to when one corporate investor is present. The results are backed by comparing all the 14,048 ventures and those 1,899 ventures with the "baseline" of least one corporate investor present (in the robustness check; Model 6), where increasing the number of corporate investors is shown to positively impact the ventures' innovative performance as well as in the hypothesis test. In essence, the analyses indicate that the increased benefit of "swimming of multiple sharks" outweigh the higher costs and risks associated with increasing the number of corporate investors.

Besides revealing that multiple corporate investors enhance ventures' innovative performance, the analyses were not able to precisely detangle *why* this is the case. The descriptive statistics clearly show that when multiple corporate investors are present, the venture is typically more mature (i.e., later funding rounds and venture age), the

total investment amount is typically higher, and the pre-funding innovative capabilities (patent stock) is typically greater, compared to those ventures backed by only independent venture capitalists and those where one corporate investor is present. This questions what the dominant causality *is* related to the increase in venture performance. More specifically, the discussion in the literature, whether (corporate) investors are superior at selecting ventures with high existing innovative capabilities (i.e., selection effect) or are superior at nurturing the ventures through, e.g., by providing tailored resources and/or other value-added activities to enhance the ventures' (innovative) performance (i.e., nurturing effect) (e.g., Park and Steensma, 2013; Sørensen, 2007; Chemmanur et al., 2014). Yet, our analysis shows that after controlling for the maturity of the venture, pre-funding innovative capabilities, and total investments amount, the presence of multiple corporate investors remains statistically significant and enhance ventures' innovative performance which may indicate a nurturing effect (Model 3 and 6).

Along the same lines, in the analysis of the 558 ventures funded by multiple corporate investors (Model 5 and 8), several of those effects that scholars normally associate with enhancing the venture innovativeness, such as total investment amount and pre-funding innovative capabilities, were statistically insignificant. This further supports the nurturing effect, i.e., the fact that these effects (total investment amount and pre-funding innovative capabilities) are not associated with increased venture innovative performance. As the effects were not able explain the increase in ventures' innovative performance when multiple corporate investors are present, the results indicate that increasing the number of corporate investors who have the incentive, capability, and ability to provide the venture access to a variety of resources (Park and Steensma, 2013) can help ventures' overcome their initial resource constrains (Katila et al., 2008) and subsequently increases the ventures' innovative performance (Pahnke et al., 2015; Kim and Park, 2017).

In the same vein, there may be other unexplored dynamics that can help explain the increase in ventures' innovative by the presence of multiple corporate investors. Accordingly, we focused on two underlying dynamics that could assist in explaining potential performance implications, namely prior ties and industry relatedness.

Prior ties

In the analysis of the 558 ventures that are funded by multiple corporate investors, the results show that when the corporate investors have "strong" prior ties it negatively affects ventures' innovative performance (Model 8). Meanwhile, Model 5 and 9 (see Appendix VI) indicate that corporate investors who have some degree of prior ties, despite its insignificance, positively impacts the ventures' innovative performance. In essence, having corporate investors with some degree of prior ties may lower the initial coordination costs and limit opportunistic behaviour (e.g., to misappropriate the venture at the expense of each other) (Gulati, 1995; Granovetter, 1985; Das

and Teng, 2000a). This may ease the coordination effort in corporate investors nurturing role towards the venture (Park and Steensma, 2013) in terms of transferring resources, and hence, positively impact the ventures' the innovative performance (Gulati and Gargiulo, 1999; Gulati, 1998).

On the other hand, if prior ties is "strong", we conceptualize that the syndicate can be considered as one "unit" where the asymmetric power- and resource-sharing relationship, as well as asymmetric payoff changes substantially (e.g., Katila et al., 2008; Axelrod and Keohane, 1985). This may help explain this negative effect. Given the "strong" prior ties, the venture faces a "coordinated shark" of unprecedented size which shifts the power balance substantially, leaving the venture in an extremely vulnerable position (Hallen et al., 2014). We theorize that this leads to situation similar to that of a prisoner's dilemma situation (after tie formation). Eventually, when the corporate investors have "strong" prior ties, i.e., a high ability to coordinate their effort and to work together towards a common objective (building on inter-firm trust) (Dyer and Chu, 2000; Yang et al., 2011; Gulati, 1998), their dominant strategy is to defect and capture the highest payoff. Essentially, in the context of power imbalance, defecting means limiting resource-sharing to the resource constrained venture (Wadhwa and Basu, 2013) and/or misappropriate its resources (e.g., knowledge, inventions, discoveries) which will limit the ventures' ability to innovative (e.g., Katila et al., 2008; George and Bock, 2011). Accordingly, the results indicate that despite the corporate investors' risk of damaging their reputation and legitimacy in the VC community, the pursuit of private benefits (i.e., defecting; opportunistic behaviour) to capture the higher payoff is outweighed by such risks. In essence, suggesting a preference for value-capturing (i.e., to misappropriate) over value-creation (e.g., coordinated nurturing effort to the venture to, for instance, access the corporates resources).

Along the same lines, the results show that as corporate investors increase their equity share (compared to IVCs) in a multiple corporate investor setting, it decreases the ventures' innovative performance (Model 5 and 8). Essentially indicating that when fewer IVCs are present or at least own a less "significant" equity share compared to the corporate investors, it decreases the ventures' innovative performance. At the same time, the descriptive statistics show that ventures typically receive financing from multiple corporate investors at later funding rounds and when the venture is more mature (venture age). These variables are additionally statistically significant and positively related to the ventures' innovative performance (Model 5 and 8). Accordingly, these traits could indicate that if the venture leverages its defence mechanisms, such as its social defences (e.g., invite third-party IVCs to the investment syndicate) (Hallen et al., 2014) and timing defences (e.g., obtain investment at later funding rounds when technologies are more embodied in a product) (Katila et al., 2008), it may be able to withstand the opportunistic behaviour from multiple corporate investors with "strong" prior ties. Especially, as the venture has multiple "sharks" capable of coordinating their opportunistic behaviour to capture the higher payoff, it may be harder to uphold its secrecy defence mechanisms (Katila et al, 2008). In essence, the weaker actor (the venture) should pay

special attention to the configuration of their toolbox of dependency-reducing and defence-safeguard tactics, as these need to be intact when highly familiar "sharks" are present, who are attracted by the higher payoff, and therefore may engage in a coordinated misappropriation "attack".

Apart from the misappropriation perspective, by drawing on the strategic alliance literature, there may also be other reasons behind the ventures' negative innovative performance when multiple corporate investors with "strong" prior ties are present. For instance, corporate investors that have previously invested together may rely on established partnering routines (from prior investments), and may therefore not adjust to new the situation when investing together again, i.e., adapting to the specific needs of the new venture (Levinthal and March, 1993). Especially, as new ventures operate in environments characterized by high uncertainty, particularly associated with the life science- and ITC industry (Park and Kim, 1996; Hoang and Rothaermel, 2005), where each ventures' "situation and needs" are likely to differ from one another, hence, underscoring the need for corporate investors to adapt to different situations, e.g., in terms of setting the strategic direction and meeting the ventures' resource needs. Furthermore, repeated ties among corporate investors may lock out "newcomers" that possess strongly required knowledge and technologies for the venture to innovate (Goerzen, 2007). In other words, the preference for familiar and trustable partners may limit corporate investors inviting other corporates to (the) syndicate who may possess strongly needed resources that the venture needs to succeed in terms of innovating (e.g., Beckman et al., 2004; Hoetker, 2005; Goerzen, 2007). It may therefore be critical to syndicate with appropriate corporate investors and disregard the preference for familiarity to meet the needs of the venture.

Lastly, the results suggest that there is no relationship between prior ties and industry relationship in terms of impacting the ventures' innovative performance. Yet, it is worth considering why the interaction term is positive in Model 5.5 and 9.5 (see Appendix VI) and negative in Model 8.4. The majority of ventures (in our sample) have corporate investors with some-to-no degree of prior ties and some-to-no degree of industry relatedness. First, considering the positive effect (Model 5.5), we observed several examples in our sample where two or more corporate investors, with some degree of prior ties and some-to-no degree of industry relatedness, invested together in a venture with another corporate investor who were in related industries to the venture (in some instances had prior ties with (one of) the others). In this sense, the corporate investors with prior ties (but unrelated industries) may have the inclination, but not the ability to misappropriate the venture (Dushnitsky and Shaver, 2009). Meanwhile, the other corporate investor (in related industry) both has the ability and capability to nurture the venture (i.e., to increase the ventures' performance) (e.g., Alvarez-Garrido and Dushnitsky, 2016) but also to misappropriate. Yet, under these circumstances, the other corporate investors with prior ties (but unrelated industries) may act as a social defence for venture to mitigate misappropriation of the ventures resources by the same-industry corporate investor (Hallen et al., 2014).

On the other hand, under the circumstances of "high" industry relatedness and "strong" prior ties (Model 8.4), these "third-party chaperone(s)" (in unrelated industries) are not present (Hallen et al., 2014). Therefore, when the venture has same-industry corporate investors with "strong" prior ties, the corporates likely face lower risks from misappropriating the venture due to the "lack" of third-party chaperones, and furthermore have a higher ability and inclination to engage in a coordinated effort to misappropriate the ventures' resources, hence, impacting the ventures' innovative performance negatively.

Industry relatedness

In the analysis of the 1,899 CVC-backed ventures (Model 4 and 7), we find that higher industry relatedness between the venture and the corporate investor(s) negatively impact the ventures' innovative performance. These results demonstrate that the perceived misappropriation risks of receiving funding from corporate investor(s) in related industries outweigh the perceived benefits such as access to complementary resources (Alvarez-Garrido and Dushnitsky, 2016), gain unique insights into industry trends and evolution (Hendricks, 2002; Henderson and Leleux, 2002) and leverage the corporate investor(s)' deep technical knowledge (Maula et al., 2006; Chemmanur et al., 2014). These results build further on the findings of Dushnitsky and Shaver (2009), i.e., that ventures are more reluctant to receive investments from same-industry corporate investors due to their higher inclination and ability to imitate and misappropriate the ventures' resources. Accordingly, our findings suggest that the corporate investors may act opportunistically post tie formation, and therefore negatively influence the ventures' innovative performance.

The results additionally suggest, that in case only one corporate investor is present, the magnitude of the negative effect on the ventures' innovative performance is considerably higher compared to when multiple corporate investors are present. These findings may indicate that when only one corporate investor is present, the ventures' social defence mechanisms are less "strong" compared to when multiple corporate investors are present (Hallen et al., 2014). In other words, when multiple corporate investors in related industries are present, each pursuing their own strategic agenda (Souitaris and Zerbinati, Chesbrough, 2002; Dushnitsky and Lenox, 2005), then each corporate investor is likely to prevent the other corporates in misappropriating the ventures' resources, and hence, act as a "third-party chaperone" to discipline the threat of opportunistic behaviour out of self-interest (Hallen et al., 2014). Especially, when operating in related industries, the corporate investors may be better at detecting potential opportunistic behaviours. At the same time, the consequences of misappropriating the venture at the expense of the other corporates (likely same-industry peers) may be higher for the offending corporate. Particularly, as other corporates may terminate current ties or avoid future ties (e.g., in other inter-firm relationship such as strategic

alliances and commercial agreements) (Ahuja, 2000; Burt, 2005) and/or damage its reputation in both the VC community and industry network (e.g., suppliers and customers) (Gulati, 1995; Soda, Usai and Zaheer, 2004). Accordingly, when only one corporate investor is present, the consequences of misappropriation may be a less "harmful" endeavour as there are no other corporates present to monitor or broadcast allegations of opportunistic behaviour (Child et al., 2005; Hallen et al., 2014). Consequently, the inclination for "value-capture" and imitate and misappropriating the ventures' resources is higher (Dushnitsky and Shaver, 2009; Hallen et al., 2014).

There may also be other reasons for the negative effect on the ventures' innovative performance when backed by multiple corporate investors. For one, as industry relatedness increases (Model 4) and becomes high (Model 8.2), the corporate investors may become increasingly similar, which can potentially lead to a situation of the corporates possessing too similar resources for the venture to access, i.e., surplus resources, which may potentially limit the benefits for the venture in terms of innovating (Das and Teng, 2000a; Tsai, 2000; Nohira and Gulati, 1996). In essence, the venture needs to carefully select the *right* corporate investors and be aware of not to select corporate investors with too similar resources (Das and Teng, 2003; Russo and Cesarani, 2017). Moreover, if both the corporate investors and the venture are in related industries, hence, more likely to be competitors, they have reasons to collaborate for shared benefits, but may adversely alter the other party's agenda for their own benefits (Agarwal, Croson and Mahoney, 2010, Gulati and Singh, 1998). This may lead to a situation where the ventures' innovative activities and capabilities are shifted from focussing on one area to another if it competes with the one of the corporates. This situation may be especially profound due to the venture being resource constrained (Wadhwa and Basu, 2013) and forced to accept an unfavourable power balance (Emerson, 1962) as the corporate investors reside over valuable resources. Along the same lines, when industry relatedness is high between the parties, the corporate investors might reduce their willingness to cooperate, e.g., prevent access to resources or share inter-firm knowledge, to limit the risks of leaking propriety knowledge to other potential competitors (Anokhin et al., 2011).

6.2. Limitation and future research directions

This study is not without limitations. The following section serves to provide guidance on future research directions in relation to multiple corporate venture capital and ventures' performance outside the scope of our thesis. As laid out in the introduction, this thesis underscores investor heterogeneity and aims at exploring how multiple corporate investors impact ventures' innovative performance by distinguishing between different investor types. At the same time, this thesis explicitly chooses to explore the influence of prior ties and industry relatedness on the ventures' innovative performance, yet other factors may also potentially impact ventures' innovative

performance in a multiple corporate venture capital setting. This study therefore opens multiple avenues for further research to investigate a range of performance implications in a multiple corporate venture capital syndication context. In particular, qualitative surveys, case studies and the use of other variables in quantitative studies can be used in future research to help provide such enhanced understanding.

Our descriptive statistics show that a mere 6% of the ventures are funded by multiple corporate investors. Therefore, it would be fruitful to understand *when* ventures choose to accept investments from more than one corporate investor and the potential use of certain defense mechanisms (e.g., Katila et al., 2008; Hallen et al., 2014). Especially, as the summery statistics showed that the average venture age and funding round is considerably higher when multiple corporate venture capital investors are present compared to the other two types of investors. Additionally, this study does not distinguish between the selection and the nurturing effect of the ventures' innovative performance which would be useful to understand in a multiple corporate venture capital situation (e.g., Park and Steensma, 2013). In the same vein, this study was not able to conduct analyses exploring the different resources needs by ventures or tease out concrete mechanisms that multiple corporate investors use to help ventures increase their innovative performance. Examining the potential nurturing role of corporate investors in fulfilling different resources needs of ventures through different mechanisms would be fruitful to understand. This study neither considers the impact of multiple corporate investors on ventures' commercial activities nor exit options (IPO or acquisition). Studying such outcomes would have proven useful extensions and should be researched further.

In terms of patent data, the patent stock used as a measure for pre-funding innovative capabilities and patent applications used as a measure for innovative performance, were both measured by counting the number of patents (applications). Prior studies have pointed out the deficiencies in using patent data as a measure of innovation as not all inventions are patented and some are not even patentable (e.g., Pavitt, 1985). In addition, the propensity to patent can vary across industries which the descriptive statistics indeed suggests. Yet, this thesis subscribes to prior research on ventures' innovative performance that use patent data as a measure for innovativeness and moreover draw on similar industries that normally are associated with high patenting activity (e.g., Alvarez-Garrido and Dushnitsky, 2016; Pahnke et al., 2015; Park and Steensma, 2013). While the analysis suggests that multiple corporate investors enhance the rates of ventures' patent applications, this study does not capture the quality of these patents (i.e., number of forward citations). In case the corporate investors allocate excessive (to an extent similar) resources to R&D it could lead to relatively unproductive innovative outcomes and lower quality patents. Further research into this would be valuable.

The measurements of investment data also have its limitations. For one, some funding rounds are not publicly disclosed and could impact the measurements and lead to biased results. In addition, we aimed to mitigate measurement errors by only including corporate investors that are publicly traded which enabled us to create reliable control variables. However, by excluding privately held parent companies some venture investments with corporate investors have deliberately been left out. Along the same line, to proxy the corporate investors ownership share, it may not always accurately reflect the true ownership share since different share prices may be applied (e.g., depending on the development stage of the venture and market conditions). VentureXpert does also not disclose if an investor liquidates its shares. Therefore, corporate investors may have left a syndicate which could have implications for the predictions on the ventures' innovative performance when funded by our measure of (multiple) corporate investors. More fine-grained data from other data sources and private sources could enhance the reliability of these measurements.

As set out in the section 4.3., we use financial data from the Compustat database which also have its limitations. This database only contains financial data on publicly traded corporations. And even though we chose to only include publicly traded corporate investors, the database still had some missing data. In this sense, we applied the compound annual growth rate between the most recent data point to derive the missing values or the GDP growth rate to fill in the missing data when the financials become abnormally large. This may however not reflect the actual size of parent organization, for instance, in times of extreme volatility in the market, e.g., during the financial crisis and the aftermath, which could lead to a biased control variable. A comprehensive manual search or access to private sources could have mitigated this issue and increased the reliability.

In terms of matching prior ties, our sample is limited to the industries within life science and ITC between the years 2003-2020 (although we able to capture some ties before 2003 by inserting prior funding rounds). Corporate investors may have had prior ties before this period or in other industries. Furthermore, corporates could also have prior ties outside the CVC-sphere, for instance, in other inter-firm relationships such as non-equity strategic alliances and equity alliances (e.g., joint ventures), commercial agreements and alike. A thorough review of all prior ties between corporates could prove to be useful to further predict the impact of prior ties.

As laid out in the introduction, it is not our intention to generalize our results to other populations (e.g., industries) or settings (e.g., geographies). The study is limited to US-based ventures within the life science and ITC-sector. Future research is therefore warranted to investigate other industries to see if results vary which can open for generalizability of the results. In addition, because institutional contexts can play a significant

role in, for example, legal defenses and the ability to misappropriate (see for example Colombo and Shafi, 2016), more in-depth research across regions is warranted.

6.3. Implications

The findings of this thesis have several implications for both practitioners and academics. As described, we aim at investigating the impact of multiple corporate venture capital investors on ventures' innovative performance. This thesis shows that the syndication of multiple corporate investors is yet to be acknowledged in the CVC literature, and as the implications on venture performance are shown to be significant, the phenomenon is worth exploring further. Therefore, this section will briefly describe both academic and non-academic implications.

Academics

This thesis contributes to several research streams. First, it contributes to the literature on corporate venture capital, innovation and entrepreneurial finance. Although the CVC phenomenon has received increasing attention in recent years, and particularly on the perspective of the new ventures (e.g., Kim and Park, 2017; Alvarez-Garrido and Dushnitsky, 2016; Pahnke et al., 2015), most studies have focused on a dyadic relationship. Our study aims at bridging the research gap in the literature as a nontrivial number of ventures are funded by multiple corporate investors (Park and Steensma, 2013), and provide insights into the developmental consequences of new ventures considering CVC funding by multiple corporate investors. Essentially, founders of new ventures may wish to take the implications of funding sources into account. Although potential resources of corporate investors may appear particular attractive to entrepreneurs, corporate investors have their own interest at heart, which may not necessarily coincide with other investors' interest or maximize the performance of the venture. Consequently, our study suggests that multiple corporate investors enhance the ventures' innovative performance but under some circumstances the perceived benefits may to some extent evaporate. Consistent with prior studies examining the industry similarity between corporate investors and the venture (e.g., Dushnitsky and Shaver, 2009; Colombo and Shafi, 2016) our study advances these findings and suggest that a higher industry relatedness negatively influence the ventures' innovative performance.

Second, this study provides an early insight into a game theoretical perspective, more specific, the prisoner's dilemma, in a multiple corporate venture capital setting (i.e., cooperation-defection) by linking the preference for investing with familiar partners in the VC community (Wright and Lockett, 2001) and strategic alliances (Podolny,

1994; Hoetker, 2005). Our study suggests that due to shift in power balance and the ventures resource dependency (Katila et al., 2008; Hallen et al., 2014) it leads to a situation of asymmetric payoffs (Axelrod and Keohane, 1985) where corporate investors with strong prior ties are inclined to take advantage of the ventures' vulnerable position and "value-capture" by misappropriating its resources, hence, negatively impacting the ventures' innovative performance. Furthermore, it may also suggest that the preference for familiar partners can be damaging as it locks out "newcomers" who may possess unique knowledge and technologies that the venture strongly needs (Goerzen, 2007) as well as partners may rely on established partner routines and not adapt to the specific needs of the venture (Levinthal and March, 1993) which is essential when the venture operates in highly uncertain environments (Beckman et al., 2004; Hoetker, 2005).

Practitioners

While this thesis does not investigate *when* a venture should accept investments from multiple corporate investors (e.g., in terms of appropriate defence safeguards), the thesis still holds implications for ventures' performance. The thesis provides an increased understanding of ventures' "resource-building"-strategy in terms of executing value-creation activities, more specifically, enhancing innovation. It is attractive to receive from multiple corporate investors, yet only under certain circumstances. Although ventures may gain valuable resources from accepting investments by multiple corporate investors, they must balance such benefits of having corporate investors with strong prior ties and who operate in related industries to the venture.

This thesis neither investigate implications from a corporate perspective and thus not able to deduct their *strategic* gains from engaging in a multiple corporate venture capital syndication. Yet, the implications may be of relevance. As CVCs prefer to syndicate with VCs over other CVCs (Souitaris and Zerbinati, 2014), this thesis offers attractive insights to CVC managers. Particularly based on the notion that by syndicating with corporate investors a venture may enhance both its innovative performance and possibly the value of the venture (i.e., the value of the investment) as well as provide a greater opportunity to gain knowledge spillovers from the ventures' continued innovative activities (e.g., Dushnitsky and Lenox, 2006; Wadhwa and Kotha, 2006).

7. CONCLUSION

Most corporate venture capital research has been centered around a dyadic relationship. Yet, scholars have found a nontrivial number of their sample ventures being funded by multiple corporate investors and have called for research to understand how this influences the performance of such ventures. This thesis is set out bridge the research gap in the literature by exploring whether multiple corporate investors impact ventures' innovative performance. Further, this thesis investigates certain underlying dynamics in a multiple corporate investor setting that can have performance implications for the ventures' innovation activities, more specifically, the impact of the corporate investors having prior ties and when they are in related industries to the one of the venture. The conceptual development draws on the existing CVC and VC literature and relevant areas of the strategic alliance literature and game theoretical concepts.

Through an empirical analysis of 14,048 US-based ventures operating in the life science- and ITC-industry that received investments from independent venture capitalists and/or corporate venture capitalists between 2003 and 2020, and the ventures' patenting activity in the years 1976 to 2021, several findings are made. The data was retrieved from the Refinitiv VentureXpert, Compustat and PatentsView database, and the final sample was manually constructed and enriched through several rounds of clerical reviews on more than 50,000 observations and almost 25,000 patent applications.

The findings show that, compared to ventures funded only by independent venture capitalists and/or with the presence of one corporate investor, having multiple corporate investors present has a larger positive impact on the ventures' innovative performance. The results suggest that the increased innovative performance is based on the corporate investors' nurturing role through their incentives, capabilities, and abilities to provide the venture access to a variety of resources.

In terms of the underlying dynamics, the results show that strong prior ties between corporate investors negatively affect the ventures' innovative performance. We provide three possible explanations to this. First, as a considerable power imbalance and asymmetric payoffs exist, the corporate investors are inclined to misappropriate the ventures' resources and capture the higher payoff. Second, the corporate investors may rely on established partnering routines, and therefore, when investing together again not adjust to new situations. Third, repeated ties among corporate investors may lock out "newcomers" that possess strongly required knowledge and technologies that the venture uniquely need to innovate.

We find that higher industry relatedness between the venture and the corporate investor(s) negatively impact the ventures' innovative performance. The results demonstrate that the perceived benefits of partnering with same-

industry corporate investors outweighs the risks from partnering with corporate investors' who both have a higher ability and inclination to misappropriate. However, we find that this effect is positively moderated by the presence of multiple corporate investors compared to one corporate investor, as other corporates may act as "third party chaperones" to discipline the threat of opportunistic behaviour out of their own self-interest. We further propose three other reasons for the negative impact of higher industry relatedness in a multiple corporate investor situation. First, if corporate investors possess too similar resources (i.e., surplus resources) this may limit the benefits for the venture. Second, the corporates may adversely alter the ventures' agenda to their own benefits if the ventures' innovation activity or strategy competes with the corporates' business. Third, the corporates may have a low willingness to cooperate in terms of not letting the venture access corporate resources or share inter-firm knowledge to limit the risks of leaking propriety knowledge to other potential competitors.

We additionally perform analyses and robustness checks on the ventures' innovative performance related to the two underlying dynamics, namely prior ties and industry relatedness, to see if these depend on the magnitude of one another. We did however not find any statistical significance.

Finally, we suggest that the presence of multiple corporate investors is beneficial for the ventures, however, the ventures need to pay special attention to selecting the *right* corporate investors, and to the configuration of their toolbox of dependency-reducing and defence-safeguard tactics, as these need to be intact when highly familiar "sharks" are present or when swimming in their waters (i.e., are in related industries to the venture).

This thesis concludes with possible suggestions for future research. Most importantly, this first step towards an understanding of how multiple corporate investors influence the ventures' innovative performance should be investigated further in-depth, both with regards to other alternative performance measures, other underlying dynamics and *when* ventures choose to accept investments from multiple corporate investors.

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BIBLIOGRAPHY

Abell, P., & Nisar, T. M. (2007). Performance effects of venture capital firm networks. *Management Decision*, pp. 45 (5). pp. 923-936.

Acs, Z. J., Morck, R., Shaver, J. M., & Yeung, B. (1997). The internationalization of small and medium-sized enterprises: a policy perspective. *Small Business Economics*, pp. 9, pages 7–20.

Agarwal, R., Croson, R. T., & Mahoney, J. T. (2010). The Role of Incentives and Communication in Strategic Alliances: An Experimental Investigation. *Strategic Management Journal*, pp. 31(4), pp: 413 - 437.

Aggerwal, V. A., & Hsu, D. H. (2009). Modes of Cooperative R&D Commercialization by Start-ups. *Strategic Management Journal*, pp. 30: 835–864.

Ahuja, G. (2000). Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study. *Administrative Science Quarterly*, pp. Vol. 45, No. 3, pp. 425-455.

Ai, C., & Norton, E. C. (2003). Interaction terms in logit and probit models. *Economics Letters*, pp. 80(1): 123-129.

Alvarez-Garrido, E., & Dushnitsky, G. (2016). Are entrepreneurial venture's innovation rates sensitive to investor complementary assets? Comparing biotech ventures backed by corporate and independent VCs. *Strategic Management Journal*, pp. vol. 37(5), pages 819-834.

Anokhin, S., Örtqvist, D., Thorgren, S., & Wincent, J. (2011). Corporate Venturing Deal Syndication and Innovation: the Information Paradox. *Long Range Planning*, pp. 44(2): 134-151.

Aram, J. D. (1989). The Paradox of Interdependent Relations in the Field of Social Issues in Management. *The Academy of Management Review*, pp. Vol. 14, No. 2, pp. 266-283.

Arend, R. J. (2009). Reputation for cooperation : contingent benefits in alliance activity. *Strategic management journal*, pp. Vol. 30, p. 371-385.

Axelrod, R. (1984). *The Evolution of Cooperation.* Basic Books, Inc., Publishers.

Axelrod, R., & Dion, D. (1988). The Further Evolution of Cooperation. *Science New Series*, pp. Vol. 242, No. 4884, pp. 1385-1390.

Axelrod, R., & Keohane, R. O. (1985). Achieving Cooperation under Anarchy: Strategies and Institutions. *World Politics*, pp. Vol. 38, No. 1, pp. 226-254.

Balboa, M., Martí, J., & Zieling, N. (2011). Impact of funding and value added on Spanish venture capital-backed firms. *The European Journal of Social Science Research*, pp. Pages 449-466.

Basu, S., & Wadhwa, A. (2013). Exploration and Resource Commitments in Unequal Partnerships: An Examination of Corporate Venture Capital Investments. *Journal of Product Innovation Management*, pp. (5), pp 916-936.

Basu, S., Phelps, C., & Kotha, S. (2011). Towards understanding who makes corporate venture capital investments and why. *Journal of Business Venturin*, pp. 26(2): 153–171.

Basu, S., Wadhwa, A., & Kotha, S. (2016). Corporate Venture Capital: Important Themes and Future Directions. In S. Zahra, D. Neubaum, & J. Hayton, *The Handbook of Corporate Entrepreneurship* (pp. 203-234). Edward Elgar Publishing.

Beckenkamp, M., Hennig-Schmidt, H., & Maier-Rigaud, F. P. (2007). Cooperation in Symmetric and Asymmetric Prisoner's Dilemma Games. *Preprints of the Max Planck Institute for Research on Collective Goods*, pp. No. 2006,25.

Beckman, C. M., Haunschild, P. R., & Phillips, D. J. (2004). Friends or Strangers? Firm-Specific Uncertainty, Market Uncertainty, and Network Partner Selection. *Organization Science*, pp. 15(3): 259-275.

Bertoni, F., Colombo, M. G., & Grilli, L. (2011). Venture Capital Investor Type and the Growth Mode of New Technology-Based Firms. *Small Business Economics*, pp. 40, 527–552.

Birkinshaw, J., Van Basten Batenburg, R., & Murray, G. (2002). Venturing to Succeed. *Business Strategy Review*, pp. 13 (4), 10-17.

Brander, J. A., Amit, R., & Antweiler, W. (2002). Venture-Capital Syndication: Improved Venture Selection vs. The Value-Added Hypothesis. *Journal of Economics & Management Strategy*, pp. 11(3):423-452.

Braune, E., & Sahut, J.-M. (2017). Corporate venture capital and syndication networks. *Journée de l'innovation Abbé Grégoire (JAG)*.

Bruining, H., & Wright, M. (2002). Entrepreneurial orientation in management buy-outs and the contribution of venture capital. *Taylor & Francis Journals*, pp. vol. 4(2), pages 147-168, April.

Bryman, A. (2012). *Social Research Methods, 4th edition.* Oxford University Press.

Burt, R. S. (2005). *Brokerage and Closure - An Introduction to Social Capital.* Oxford University Press.

Bygrave, W. D. (1987). Syndicated investments by venture capital firms: A networking perspective. *Journal of Business Venturing*, pp. Vol. 2, issue 2, 139-154.

Bygrave, W. D. (1988). The structure of the investment networks of venture capital firms. *Journal of Business Venturing*, pp. Vol. 3, issue 2, 137-157.

Cable, D. M., & Shane, S. (1997). A Prisoner's Dilemma Approach to Entrepreneur-Venture Capitalist Relationships. *The Academy of Management Review*, pp. Vol. 22, No. 1, pp. 142-176.

Carmichael, F. (2005). *A Guide to Game Theory.* Pearson Education Canada.

Casamatta, C., & Haritchabalet, C. (2007). Experience, Screening and Syndication in Venture Capital Investments. *Journal of Financial Intermediation*, pp. 16(3):368-398.

Caseli, S., Gatti, S., & Perrini, F. (2009). Are Venture Capitalists a Catalyst for Innovation? *European Financial Management*, pp. 15(1):92-111.

CB Insights. (2018). *The 2018 Global CVC Report.* https://www.cbinsights.com/research/report/corporate-venture-capital-trends-2018/.

CB Insights. (2021). *The 2020 Global CVC Report.* Retrieved from https://www.cbinsights.com/research/report/corporate-venture-capital-trends-2020/.

Chahine, S., Saade, S., & Goergen, M. (2019). Foreign Business Activities, Foreignness of the VC Syndicate, and IPO Value. *Entrepreneurship Theory and Practice*, pp. vol. 43(5), pages 947-973.

Chemmanur, T. J., Loutskina, E., & Tian, X. (2014). Corporate Venture Capital, Value Creation, and Innovation. *The Review of Financial Studies*, pp. Volume 27, Issue 8, Pages 2434–2473.

Chemmanur, T., & Tian, X. (2011). Peer Monitoring, Syndication, and the Dynamics of Venture. *Available at SSRN: https://papers.ssrn.com/abstract=1343116.*

Chemmanur, T., Krishnan, K., & Nandy, D. (2011). How Does Venture Capital Financing Improve Efficiency in Private Firms? A Look Beneath the Surface. *Review of Financial Studies*, pp. vol. 24, issue 12, 4037-4090.

Chesbrough, H. (2002). Making Sense of Corporate Venture Capital. *Harvard Business Review*, pp. 80(3): 90-9, 133.

Chesbrough, H., & Tucci, C. (2004). Corporate Venture Capital in the Context of Corporate Innovation. *DRUID Summer Conference*.

Child, J., Faulkner, D., & Tallman, S. (2005). *Cooperative strategy*. Oxford University Press.

Colombo, M. G., & Murtinu, S. (2016). Venture Capital Investments in Europe and Portfolio Firms' Economic Performance: Independent versus Corporate Investors. *Journal of Economics & Management Strategy*, pp. 26(1), pp. 35-66.

Colombo, M. G., & Shafi, K. (2016). Swimming with sharks in Europe: When are they dangerous and what can new ventures do to defend themselves? *Strategic Management Journal*, pp. 37(11): 2307-2322.

Corfman, K. P., & Lehmann, D. R. (1994). The prisoner's dilemma and the role of information in setting advertising budgets. *Journal of Advertising*, pp. 23(2), 35–48.

Croce, A., Martí, J., & Murtinu, S. (2013). The Impact of Venture Capital on the Productivity Growth of European Entrepreneurial Firms: 'Screening' or 'Value Added' Effect? *Journal of Business Venturing*, pp. 28(4):489–510.

Crunchbase. (2020). Retrieved from Crunchbase: https://www.crunchbase.com/organization/alector

Cumming, D. (2006). Adverse Selection and Capital Structure: Evidence from Venture Capital. *Entrepreneurship Theory and Practice*, pp. vol. 30, issue 2, 155-183.

Dai, N., Hoje, J., & Sul, K. (2012). Cross-border venture capital investments in Asia: Selection and exit performance. *Journal of Business Venturing*, pp. vol. 27(6), pages 666-684.

Das, K. T., & Rahman, N. (2009). Determinants of Partner Opportunism in Strategic Alliances: A Conceptual Framework. *Journal of Business and Psychology*, pp. 25(1): 55-74.

Das, S., Jo, H., & Kim, Y. (2011). Polishing diamonds in the rough: The sources of syndicated venture performance. *Journal of Financial Intermediation*, pp. vol. 20, issue 2, 199-230.

Das, T. K., & Teng, B.-S. (1998). Between Trust and Control: Developing Confidence in Partner Cooperation in Alliances. *The Academy of Management Review*, pp. Vol. 23, No. 3, pp. 491-512.

Das, T. K., & Teng, B.-S. (2000a). A Resource-Based Theory of Strategic Alliances. *Journal of Management*, pp. 26(1):31-61.

Das, T. K., & Teng, B.-S. (2000b). Instabilities of strategic alliances: An internal tensions perspective. *Organization science*, pp. 11(1): 77–101.

Das, T. K., & Teng, B.-S. (2001). Trust, Control, and Risk in Strategic Alliances: An Integrated Framework. *Organization Studies*, pp. 22(2): 251-283.

Das, T. K., & Teng, B.-S. (2003). Partner Analysis and Alliance Performance. *Scandinavian Journal of Management*, pp. 19(3): 279-308.

Das, T. K., & Teng, H.-S. (1999). Managing Risks in Strategic Alliances. *The Academy of Management Executive*, pp. Vol. 13, No. 4, pp. 50-62.

Das, T. K.-S. (2002). Alliance constellations: A social exchange perspective. *Academy of Management Review*, pp. 27(3): 445–456.

Dawes, R. M., McTavish, J., & Shaklee, H. (1977). 7. Behavior, communication and assumptions about other people's behavior in a commons dilemma situation. *Journal of Personality and Social Psychology*, pp. 35: 1-11.

De Clercq, D., & Dimov, D. (2008). Internal Knowledge Development and External Knowledge Access in Venture Capital Investment Performance. *Journal of Management Studies*, pp. 45(3):585-612.

Di Lorenzo, F., & Almeida, P. (2017). The role of relative performance in inter-firm mobility of inventors. *Research Policy*, pp. 46(6), pp. 1162-1174.

Di Lorenzo, F., & Sabel, C. A. (2021). Are Sharks More Dangerous at Dusk or Dawn? Timing of CVC Investments & Ventures' Commercial Performance. *Danish Research Unit for Industrial Dynamics (DRUID), Annual Conference, Copenhagen (DK)*.

Dimov, D., & Milanov, H. (2010). The interplay of need and opportunity in venture capital investment syndication. *Journal of Business Venturing*, pp. vol. 25, issue 4, 331-348.

Doz, Y. L. (1996). The Evolution of Cooperation in Strategic Alliances: Initial Conditions or Learning Processes? *Strategic Management Journal*, pp. Vol. 17, pp. 55-83.

Doz, Y. L., & Hamel, G. (1998). *Alliance Advantage: The Art of Creating Value Through Partnering.* Harvard Business Review Press.

Drover, W., Busenitz, L., Matusik, S., Townsend, D., Anglin, A., & Dushnitsky, G. (2017). A Review and Road Map of Entrepreneurial Equity Financing Research: Venture Capital, Corporate Venture Capital, Angel

Investment, Crowdfunding, and Accelerators. *Journal of Management*, pp. Volume: 43 issue: 6, page(s): 1820-1853.

Du, Q. (2016). Birds of a feather or celebrating differences? The formation and impacts of venture capital syndication. *Journal of Empirical Finance*, pp. vol. 39, issue PA, 1-14.

Dushnitsky, G. (2008). Corporate Venture Capital: Past Evidence and Future Directions. In A. Basu, M. Casson, N. Wadeson, & B. Yeung, *The Oxford Handbook of Entrepreneurship.* Oxford University Press.

Dushnitsky, G. (2012). Corporate Venture Capital in the Twenty-First Century: An Integral Part of Firms' Innovation Toolkit. In D. Cumming, *The Oxford Handbook of Venture Capital.* Oxford University Press.

Dushnitsky, G., & Lenox, M. J. (2005). When do firms undertake R&D by investing in new ventures? *Strategic Management Journal*, pp. 26: 947–965.

Dushnitsky, G., & Lenox, M. J. (2006). When Does Corporate Venture Capital Create Firm Value. *Journal of Business Venturing*, pp. 21(6):753-772.

Dushnitsky, G., & Shapira, Z. (2010). Entrepreneurial Finance Meets Organizational Reality: Comparing Investment Practices and Performance of Corporate and Independent Venture Capitalists. *Strategic Management Journal*, pp. 31(9): 990-1017.

Dushnitsky, G., & Shaver, J. M. (2009). Limitations to Interorganizational Knowledge Acquisition: The Paradox of Corporate Venture Capital. *Strategic Management Journal*, pp. 30(10): 1045 - 1064.

Dussauge, P., & Garrette, B. (1995). Determinants of Success in International Strategic Alliances: Evidence from the Global Aerospace Industry. *Journal of International Business Studies*, pp. 26, pages 505–530.

Dyer, J. H., & Chu, W. (2000). The Determinants of Trust in Supplier-Automaker Relationships in the U.S., Japan and Korea. *Journal of International Business Studies*, pp. 31, 259–285.

Emerson, R. M. (1962). Power Dependence Relations. *American Sociological Review*, pp. Vol. 27, pp. 31-41.

Engel, D., & Keilbach, M. (2007). Firm-level implications of early stage venture capital investment - An empirical investigation. *Journal of Empirical Finance*, pp. vol. 14, issue 2, 150-167.

Fast, N. D. (1978). *The Rise and Fall of Corporate New Venture Divisions.* UMI Research Press.

Ferreira, M. A., & Li, D. (2008). Partner selection for international strategic alliances in emerging economies. *Scandinavian Journal of Management*, pp. 24(4): 308-319.

Florida, R., & Kenney, M. (1988). Venture-capital financed innovation and technology change in the USA. *Research Policy*, pp. 17(3):119-137.

Friederiszick, H. W., & Maier-Rigaud, F. (2006). In search of a pro-active cartel policy: Striking the balance between ex-officio and leniency cases. *Discussion paper, European Commission*.

Friedman, J. w. (1990). *Game Theory with Applications to Economics.* Oxford University Press.

Gabbay, D. M., Thagard, P., & Woods, J. (2012). *Philosophy of Economics.* North Holland.

George, G., & Bock, A. J. (2011). The business model in practice and its implications for entrepreneurship research. *Entrepreneurship Theory and Practice*, pp. 35(1): pp. 83-111.

Gilbert, B. A., McDougall-Covin, P. P., & Audretsch, D. B. (2008). Clusters, knowledge spillovers and new venture performance: An empirical examination. *Journal of Business Venturing*, pp. 23(4): pp. 405-422.

Goerzen, A. (2007). Alliance networks and firm performance: the impact of repeated partnerships. *Strategic Management Journal*, pp. 28(5): 487-509.

Gompers, P. A., & Lerner, J. (1998). What Drives Venture Capital Fundraising? *Brookings Papers on Economic Activity. Microeconomics*, pp. Vol. 1998 (1998), pp. 149-204.

Gompers, P., & Lerner, J. (2000a). The Determinants of Corporate Venture Capital Success: Organizational Structure, Incentives, and Complementarities. *National Bureau of Economic Research*, pp. pp: 17-54.

Gompers, P., & Lerner, J. (2000b). Money chasing deals? The impact of fund inflows on private equity valuation. *Journal of Financial Economics*, pp. vol. 55, issue 2, pp. 281-325.

Gompers, P., & Lerner, J. (2001). The Venture Capital Revolution. *Journal of Economic Perspectives*, pp. Vol. 15, No. 2, Spring 2001.

Gompers, P., & Lerner, J. (2004). *The Venture Capital Cycle, Second Edition.* MIT Press.

Gorman, M., & Sahlman, W. A. (1989). What do venture capitalists do? *Journal of Business Venturing*, pp. Volume 4, Issue 4, Pages 231-248.

Granovetter, M. (1985). Economic action and social structure: A theory of embeddedness. *American Journal of Sociology*, pp. 91: 481-510.

Griliches, Z. (1990). Patent Statistics as Economic Indicators: A Survey. *Journal of Economic Literature*, pp. Vol. 28, No. 4, pp. 1661-1707.

Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics.* McGraw-Hill.

Gulati, R. (1995). Social Structure and Alliance Formation Patterns: A Longitudinal Analysis. *Administrative Science Quarterly*, pp. Vol. 40, No. 4, pp. 619-652 (34 pages).

Gulati, R., & Gargiulo, M. (1999). *Where do interorganizational networks come from?* Retrieved from American Journal of Sociology.

Gulati, R., & Singh, H. (1998). The Architecture of Cooperation: Managing Coordination Costs and Appropriation Concerns in Strategic Alliances. *Administrative Science Quarterly*, pp. Vol. 43, No. 4, pp. 781-814.

Gulati, R., Lavie, D., & Singh, H. (2009). The Nature of Partnering Experience and the Gains from Alliances. *Strategic Management Journal*, pp. Vol. 30, No. 11, pp. 1213-1233.

Hallen, B. L., Katila, R., & Rosenberger, J. D. (2014). How Do Social Defenses Work? A Resource-Dependence Lens on Technology Ventures, Venture Capital Investors, and Corporate Relationships. *Academy of Management Journal*, pp. 57(4): 1078-1101.

Hausman, J. A., & Hall, B. H. (1984). Econometric Models for Count Data with an Application to the Patents-R&D Relationship. *Econometrica*, pp. Vol. 52, No. 4, pp.909-938,.

Hege, U., Palomino, F., & Schwienbacher, A. (2003). Determinants of Venture Capital Performance: Europe and the United States. *Working Paper*.

Hellmann, T. F. (2002). A Theory of Strategic Venture Investing. *Journal of Financial Economics*, pp. 64(2): 285-314.

Hellmann, T. F., & Puri, M. (2002). Venture Capital and the Professionalization of Start-Up Firms: Empirical Evidence. *The Journal of Finance*, pp. 57(1):169 - 197.

Hellmann, T., & Puri, M. (2000). The Interaction between Product Market and Financing Strategy: The Role of Venture Capital. *Review of Financial Studies*, pp. vol. 13, issue 4, 959-84.

Henderson, J., & Leleux, B. (2002). Corporate venture capital: effecting resource combinations and transfers. *Babson Entrepreneurial Review*, pp. p. 31-46.

Hendricks, L. (2002). How important is human capital for development? evidence from immigrant earnings. *American Economic Review*, pp. 92(1), 198–219.

Hill, S. A., & Birkinshaw, J. (2014). Ambidexterity and Survival in Corporate Venture Units. *Journal of Management*, pp. 40(7):1899-1931.

Hill, S. A., Maula, M. V., Birkinshaw, J. M., & Murray, G. C. (2009). Transferability of the venture capital: model to the corporate context: Implications for the performance of corporate venture units. *Strategic Entrepreneurship Journal*, pp. 3(1): 3–27.

Hirukawa, M., & Ueda, M. (2011). Venture Capital and Innovation: Which is First? *Pacific Economic Review*, pp. Vol. 16, Issue 4, pp. 421-465.

Hoang, H., & Rothaermel, F. T. (2005). The Effect of General and Partner-Specific Alliance Experience on Joint R&D Project Performance. *The Academy of Management Journal*, pp. Vol. 48, No. 2, pp. 332-345.

Hochberg, Y. V., Ljungqvist, A., & Lu, Y. (2007). Whom You Know Matters: Venture Capital Networks and Investment Performance. *The Journal of Finance*, pp. 62(1): 251-301.

Hochberg, Y. V., Ljungqvist, A., & Lu, Y. (2007). Whom You Know Matters: Venture Capital Networks and Investment Performance. *The Journal of Finance*, pp. 62(1):251-301.

Hochberg, Y., Ljungqvist, A., & Lu, Y. (2007). Who You Know Matters: Venture Capital Networks and Investment Performance. *The Journal of Finance*, pp. 62(1): 251-301.

Hoetker, G. (2005). How much you know versus how well I know you: selecting a supplier for a technically innovative component. *Strategic Management Journal*, pp. Vol. 26 No. 1, pp. 75-96.

Hsieh, L. H., & Rodrigues, S. B. (2014). Revisiting the Trustworthiness–Performance–Governance Nexus in International Joint Ventures. *Management International Review*, pp. vol. 54, issue 5, No 4, pp. 675-705.

Hsieh, L. H., Rodrigues, S., & Child, J. (2010). Risk perception and post-formation governance in international joint ventures in Taiwan: The perspective of the foreign partner. *Journal of International Management*, pp. 16, 288-303.

Hsu, d. H., & Kenney, M. (2005). Organizing Venture Capital: The Rise and Demise of American Research & Development Corporation, 1946–1973. *Industrial and Corporate Change*, pp. Vol. 14, Issue 4, pp. 579-616, 2005.

Inkpen, A. C., & Beamish, P. W. (1995). Keeping international joint ventures stable and profitable. *Long Range Planning*, pp. 28 (3), 26–36.

Ivanov, V. I., & Xie, F. (2010). Do corporate venture capitalists add value to start-up firms? Evidence from IPOs and acquisitions of VC-backed companies. *Financial Management*, pp. 39(1): 129-152.

Jensen, M. B., Johnson, B. H., Lorenz, E., & Lundvall, B.-Å. (2007). Forms of Knowledge and Modes of Innovation. *Research Policy*, pp. 36(5): 680-693.

Jiang, X., Li, Y., & Gao, S. (2008). The stability of strategic alliances: Characteristics, factors and stages. *Journal of International Management*, pp. 14(2):173-189.

Jiang, X., Li, Y., & Gao, S. (2008). The stability of strategic alliances: Characteristics, factors and stages. *Journal of International Management*, pp. Vol. 14, Issue 2, Pages 173-18.

Jääskeläinen, M. (2012). Venture Capital Syndication: Synthesis and future directions. *International Journal of Management Reviews*, pp. 444-463.

Kann, A. (2000). Strategic Venture Capital Investing by Corporations: A Framework for Structuring and Valuing Corporate Venture Capital Program. *Dissertation, Department of Management Science and Engineering, Stanford University*.

Katila, R., Rosenberger, J. D., & Eisenhardt, K. M. (2008). Swimming with Sharks: Technology Ventures, Defense Mechanisms and Corporate Relationships. *Administrative Science Quarterly*, pp. 53(2): 295-332.

Keil, T. (2002). *External Corporate Venturing: Strategic Renewal in Rapidly Changing Industries.* Praeger.

Keil, T. (2004). Building External Corporate Venturing Capability. *Journal of Management Studies*, pp. 41(5): 799 - 825.

Keil, T., Maula, M., & Wilson, C. (2010). Unique Resources of Corporate Venture Capitalists as a Key to Entry into Rigid Venture Capital Syndication Networks. *Entrepreneurship Theory and Practice*, pp. 34(1): 83–103.

Keil, T., Maula, M., Schildt, H., & Zahra, S. A. (2008). The Effect of Governance Modes and Relatedness of External Business Development Activities on Innovative Performance. *Strategic Management Journal*, p. 29(8).

Khanna, T., Gulati, R., & Nohria, N. (1998). The Dynamics of Learning Alliances: Competition, Cooperation, and Relative Scope. *Strategic Management Journal*, pp. Vol. 19, No. 3, pp. 193-210 .

Kim, J. Y., & Park, H. D. (2017). Two Faces of Early Corporate Venture Capital Funding: Promoting Innovation and Inhibiting IPOs. *Strategy Science*, pp. Vol. 2, No. 3, September 2017, pp. 161–175.

Kim, J. Y., Steensma, H. K., & Park, H. D. (2017). The Influence of Technological Links, Social Ties, and Incumbent Firm Opportunistic Propensity on the Formation of Corporate Venture Capital Deals. *Journal of Management*, pp. 2(3): 161–175.

Knudsen, B., Florida, R., Stolarick, K., & Gates, G. (2008). Density and Creativity in U.S. Regions. *Annals of the American Association of Geographers*, pp. 98(2), pp. 461-478.

Koh, J., & Venkatraman, N. (1991). Joint Venture Formations and Stock Market Reactions: An Assessment in the Information Technology Sector. *The Academy of Management Journal*, pp. Vol. 34, No. 4, pp. 869-892.

Komorita, S. S., Hilty, J., & Parks, C. (1991). Reciprocity and Cooperation in Social Dilemmas. *The Journal of Conflict Resolution*, pp. Vol. 35, No. 3, pp. 494-518.

Kortum, S., & Lerner, J. (2000). Assessing the contribution of venture capital to innovation. *RAND Journal of Economics*, pp. pp. 674-692.

Kovner, A., & Lerner, J. (2015). Doing Well by Doing Good? Community Development Venture Capital. *Journal of Economics & Management Strategy*, pp. Vol. 24, Issue 3, pp. 643-663.

Kovner, A., & Lerner, J. (2015). Doing Well by Doing Good? Community Development Venture Capital. *Journal of Economics & Management Strategy*, pp. Vol. 24, Issue 3, pp. 643-663, 2015.

Lahr, H., & Mina, A. (2016). Venture Capital Investments and the Technological Performance of Portfolio Firms. *Research Policy*, pp. Vol. 45, No. 1, 2016.

Lavie, D. (2007). Alliance portfolios and firm performance: A study of value creation and appropriation in the US software industry. *Strategic Management Journal*, pp. 28(12): 1187-1212.

Lee, S. U., Park, G., & Kang, J. (2018). The double-edged effects of the corporate venture capital unit's structural autonomy on corporate investors' explorative and explotative innovation. *Journal of Business Research*, pp. 88: 141-149.

Lerner, J. (1994). Venture capitalists and the decision to go public. *Journal of Financial Economics*, pp. Vol. 35, issue 3, 293-316.

Lerner, J., & Merges, R. P. (1998). The control of technology alliances: An empirical analysis of the biotechnology industry. *The Journal of Industrial Economics*, pp. pp. 125-156.

Levinthal, D. A., & March, J. G. (1993). The Myopia of Learning. *Strategic Management Journal*, pp. 14 (special issue): 95-112.

Li, D., Eden, L., Hitt, M. A., & Ireland, R. D. (2008). Friends, Acquaintances, or Strangers? Partner Selection in R&D Alliances. *The Academy of Management Journal*, pp. Vol. 51, No. 2, pp. 315-334.

Litvak, K. (2009). Venture Capital Limited Partnership Agreements: Understanding Compensation Arrangements. *The University of Chicago Law Review*, pp. Vol. 76 : Iss. 1 , Article 7.

Lockett, A., & Wright, M. (1999). The syndication of private equity: Evidence from the UK. *Venture Capital - An International Journal of Entrepreneurial Finance*, pp. Volume 1, 1999 - Issue 4.

Lockett, A., & Wright, M. (2001). The syndication of venture capital investments. *Omega*, pp. vol. 29, issue 5, 375-390.

Lu, X., & White, H. (2014). Robustness checks and robustness tests in applied economics. *Journal of Econometrics*, pp. Volume 178, Pages 194-20.

Luce, R. D., & Raiffa, H. (1957). *Games and decisions.* Wiley.

Luukkonen, T., Deschryvere, M., & Bertoni, F. (2013). The value added by government venture capital funds compared with independent venture capital funds. *Technovation*, pp. 33, pp. 154–162.

Macmillan, I. C., Kulow, D. M., & Khoylian, R. (1989). Venture capitalists' involvement in their investments: Extent and performance. *Journal of Business Venturing*, pp. vol. 4, issue 1, 27-47.

Manigart, S., Lockett, A., Meuleman, M., Wright, M. L., Bruining, H., Desbriéres, P., & Hommel, U. (2006). Venture Capitalists' Decision to Syndicate. *Entrepreneurship Theory and Practice*, p. 30(2.

Masulis, R. W., & Nahata, R. (2009). Financial contracting with strategic investors: Evidence from corporate venture capital backed IPOs. *Journal of Financial Intermediation*, pp. 18(4): 599-631.

Maula, M. (2007). Corporate venture capital as a strategic tool for corporations. In H. Landström, *Handbook of Research on Venture Capital* (p. Chater 15). Edward Elgar Publishing.

Maula, M. V. (2001). Corporate venture capital and the value-added for technology-based new firms. *Doctoral dissertation, Institute of Strategy and International Business. Helsinki University of Technology*.

Maula, M. V., Keil, T., & Zahra, S. A. (2013). Top management's attention to discontinuous technological change: Corporate venture capital as an alert mechanism. *Organization Science*, pp. 24(3): 926–947.

Maula, M., & Murray, G. (2002). Corporate Venture Capital and the Creation of US Public Companies: The Impact of Sources of Venture Capital on the Performance of Portfolio. In M. A. Hitt, R. Amit, C. E. Lucrier, & R. D. Nixon, *Creating Value: Winners in the New Business Environment* (pp. 161-183). Oxford, United Kingdom: Blackwell Publishing Ltd.

Maula, M., Autio, E., & Murray, G. (2006). Corporate Venture Capitalists and Independent Venture Capitalists: What do They Know, Who do They Know, and Should Entrepreneurs Care? *Venture Capital: An International Journal of Entrepreneurial Finance*, pp. 7(1): 3–21.

Maula, M., Keil, T., & Schildt, H. (2003). Corporate Venturing Modes and Their Impact on Corporate Learning. *Babson College, Babson Kauffman Entrepreneurship Research Conference (BKERC), 2002-2006.*

Maula, M., Keil, T., & Zahra, S. A. (2004). Explorative and exploitative learning fom corporate venture capital: A model of program level determinants. *Academy of Management Annual Meeting Proceedings*.

McNally, K. (1997). *Corporate Venture Capital: Bridging the Equity Gap in the Small Business Sector*. Routledge.

Megginson, W. L., & Weiss, K. A. (1991). Venture Capitalist Certification in Initial Public Offerings. *Journal of Finance*, pp. vol. 46, issue 3, 879-903.

Meuleman, M., Manigart, S., Lockett, A., & Wright, M. (2009). Private Equity Syndication: Agency Costs, Reputation and Collaboration. *Journal of Business Finance & Accounting*, pp. Vol. 36, Issue 5-6, pp. 616-644.

Miles, M. P., & Covin, J. G. (2002). Exploring the Practice of Corporate Venturing: Some Common Forms and Their Organizational Implications. *Entrepreneurship Theory and Practice*, pp. 26(3): 21-40.

Mohr, J. J., & Spekman, R. E. (1994). Characteristics of Partnership Success: Partnership Attributes, Communication Behavior, and Conflict Resolution Techniques. *Strategic Management Journal*, pp. 15(2): 135-152.

Nahata, R. (2008). Venture capital reputation and investment performance. *Journal of Financial Economics*, pp. vol. 90, issue 2, 127-151.

NAICS Association. (2021). Retrieved from https://www.naics.com/.

Nohria, N., & Gulati, R. (1996). Is Slack Good or Bad for Innovation? *The Academy of Management Journal*, pp. Vol. 39, No. 5, pp. 1245-1264.

Norton, E., & Tenenbaum, B. H. (1993). Specialization versus diversification as a venture capital investment strategy. *Journal of Business Venturing*, pp. Volume 8, Issue 5, Pages 431-442.

Osbourne, M. J., & Rubinstein, A. (1994). *A course in game theory.* The MIT Press.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge University Press.

Pahnke, E. C., Katila, R., & Eisenhardt, K. M. (2015). Who Takes You to the Dance? How Partners' Institutional Logics Influence Innovation in Young Firm. *Administrative Science Quarterly*, pp. 1–38.

Pahnke, E. C., McDonald, R., Wang, D., & Hallen, B. L. (2015). Exposed: Venture Capital, Competitor Ties, and Entrepreneurial Innovation. *Academy of Management Journal (Forthcoming)*, pp. Columbia Business School Research Paper No. 15-81.

Pangarkar, N. (2003). Determinants of Alliance Duration in Uncertain Environments: The Case of the Biotechnology Sector. *Long Range Planning*, pp. 36(3): 269-284.

Parhe, A., Rosenthal, E. C., & Chandran, R. (1993). Prisoner's Dilemma Payoff Structure in Interfirm Strategic Alliances: An Empirical Test. *Omega*, pp. 21(5): 531-539.

Park, D. H., & Steensma, K. (2013). The selection and nuturing effects of corporate investors on new venture innovativeness. *Strategic Entrepreneurship Journal*, pp. 7: 311–330.

Park, H. D., & Steensma, K. (2012). When does corporate venture capital add value for new ventures? *Strategic Management Journal*, pp. 33(1):1 - 22.

Park, S. H., & Kim, D. (1997). Market valuation of joint venture: joint venture characteristics ad wealth gains. *Journal of Business Venturing*, pp. 12(2): 83-108.

Park, S. H., & Russo, M. V. (1996). When Competition Eclipses Cooperation: An Event History Analysis of Joint Venture Failure. *Management Science*, pp. 42(6): 875-890.

Park, S. H., & Ungson, G. R. (1997). The effect of national culture, organizational complementarity, and economic motivation on joint venture dissolution. *The Academy of Management Journal*, pp. Vol. 40, No. 2, pp. 279-307.

Parkhe, A. (1993). Strategic Alliance Structuring: A Game Theoretic and Transaction Cost Examination of Interfirm Cooperation. *The Academy of Management Journal*, pp. Vol. 36, No. 4, pp. 794-829.

Parkhe, A., Rosenthal, E. C., & Chandran, R. (1993). Prisoner's Dilemma Payoff Structure in Interfirm Strategic Alliances: An Empirical Test. *Omega*, pp. Vol. 21, No. 5, pp. 531-539.

PatentsView. (2021). Retrieved from https://patentsview.org/.

Pavitt, K. (1985). Patent statistics as indicators of innovative activities: Possibilities and problems. *Scientometrics*, pp. 7, pp. 77–99.

Plümper, T., & Neumayer, E. (2017). *Robustness Tests for Quantitative Research.* Cambridge University Press.

Podolny, J. M. (1994). Market Uncertainty and the Social Character of Economic Exchange. *Administrative Science Quarterly*, pp. Vol. 39, No. 3, pp. 458-483.

Profiting from technological innovation: implication for integration, collaboration, licensing and public policy. (1986). *Research Policy*, pp. Volume 15, Issue 6, Pages 285-305.

Pruitt, D. (1967). Reward structure and cooperation: The decomposed prisoner's dilemma game. *Journal of Personality and Social Psychology*, pp. 7: 21-27.

PwC and CB Insights. (2020). *Venture Capital Funding Report Q2 2020.* https://www.cbinsights.com/research/report/venture-capital-q2-2020/.

Rapoport, A., Chammah, A. M., & Orwant, C. J. (1965). *Prisoner's dilemma: A study in conflict and cooperation.* University of Michigan Press.

Reuer, J., & Ariño, A. (2007). Strategic alliance contracts: Dimensions and determinants of contractual complexity. *Strategic Management Journal*, pp. 28(3): 313-330.

Ring, P. S., & Van de Ven, A. H. (1994). Developmental Processes of Cooperative Interorganizational Relationships. *The Academy of Management Review*, pp. Vol. 19, No. 1, pp. 90-118.

Russo, M., & Cesarani, M. (2017). Strategic Alliance Success Factors: A Literature Review on Alliance Lifecycle. *International Journal of Business Administration*, pp. Vol. 8, No. 3.

Röhm, P. (2018). Exploring the landscape of corporate venture capital: a systematic review of the entrepreneurial and finance literature. *Management Review Quarterly*, pp. vol. 68, issue 3, No 2, 279-319.

Sahlman, W. (1990). The Structure and Governance of Venture-Capital Organizations. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*.

Sahlman, W. A. (1990). The structure and governance of venture-capital organizations. *Journal of Financial Economics*, pp. Volume 27, Issue 2, Pages 473-521.

Sapienza, H. J., Manigart, S., & Vermeir, W. (1996). Venture capitalist governance and value added in four countries. *Journal of Business Venturing*, pp. vol. 11, issue 6, 439-469.

Saunders, M. N., & Lewis, P. T. (2016). *Research Methods for Business Students.* Pearson Education Limited.

Schumpeter, J. (1942). *Capitalism, Socialism and Democracy.* Harper and Row.

Scotchmer, S. (2004). *Innovation and Incentives.* The MIT Press.

Siegel, R., Siegel, E., & MacMiallan, I. C. (1988). Corporate venture capitalists: Autonomy, obstacles, and performance. *Journal of Business Venturing*, pp. vol. 3, issue 3, 233-247.

Sklavounous, N. S., Rotsios, K. P., & Hajidimitriou, Y. A. (2015). The impact of age, interdependence and perceived risk of opportunism on inter-partner trust in international strategic alliances. *Procedia Economics and Finance*, pp. 19, 175-183.

Soda, G., Usai, A., & Zaheer, A. (2004). Network memory: The influence of past and current networks on performance. *Academy of Management Journal*, pp. 47: 893-906.

Sorenson, O., & Stuart, T. E. (2001). Syndication networks and the spatial distribution of venture capital investments. *American Journal of Sociology*, pp. 106: 1546–1588.

Sorenson, O., & Stuart, T. E. (2008). Bringing the Context Back In: Settings and the Search for Syndicate Partners in Venture Capital Investment Networks. *Administrative Science Quarterly*, pp. 53(2): 266–294.

Souitaris, V., & Zerbinati, S. (2014). How do Corporate Venture Capitalists do Deals? An Exploration of Corporate Investment Practices. *Strategic Entrepreneurship Journal*, pp. 8(4): 321-348.

Souitaris, V., Zerbinati, S., & Liu, G. (2012). Which iron cage? Endo- and exo-isomorphism in corporate venture capital programs. *Academy of Management Journal*, pp. 55(2): 477–505.

Spralls, S. A., & Hunt, S. D. (2011). Extranet use and building relationship capital in interfirm distribution networks: The role of extranet capability. *Journal of Retailing*, pp. 87(1), 59-74.

Stock, J. H., & Watson, M. W. (2015). *Introduction to Econometrics.* Pearson.

Sykes, H. B. (1990). Corporate venture capital: Strategies for success. *Journal of Business Venturing*, pp. vol. 5, issue 1, 37-47.

Sørensen, M. (2007). How Smart Is Smart Money? A Two-Sided Matching Model of Venture. *The Journal of Finance*, pp. 62(6): 2725–2762.

The Wall Street Journal. (2019, May). *Uber Jackpot: Inside One of the Greatest Startup Investments of All Time*. Retrieved from https://www.wsj.com/articles/uber-jackpot-inside-one-of-the-greatest-startup-investments-of-all-time-11557496421

Tian, X. (2012). The Role of Venture Capital Syndication in Value Creation for Entrepreneurial Firms. *Review of Finance, Forthcoming*, pp. vol. 16, issue 1, 245-283.

Tian, X., & Wang, T. Y. (2014). Tolerance for Failure and Corporate Innovation. *Review of Financial Studies, Forthcoming*, p. 27(1).

Timmons, J. A., & Bygrave, W. D. (1986). Venture capital's role in financing innovation for economic growth. *Journal of Business Venturing*, pp. vol. 1, issue 2, 161-176.

Tsai, W. (2000). Social capital, strategic relatedness and the formation of intraorganizational. *Strategic Management Journal*, pp. Vol. 21, No. 9, pp. 925-939.

Ueda, M., & Hirukawa, M. (2008). Venture Capital and Industrial 'Innovation'. *SSRN Electronic Journal*.

Uzuegbunam, I., Ofem, B., & Nambisan, S. (2019). Do Corporate Investors Affect Entrepreneurs' IP Portfolio? Entrepreneurial Finance and Intellectual Property in New Firms. *Entrepreneurship Theory and Practice*, pp. 43(4), 673–696.

Varma, S., Awasthy, R., Narain, K., & Nayyar, R. (2015). Cultural determinants of alliance management capability : an analysis of Japanese MNCs in India. *Asia Pacific Business Review*, pp. 21(3), 424-448.

Veal, A. J., & Darcy, S. (2014). *Research methods in sport studies and sport management: A practical guide.* Routledge.

Verbeek, M. (2004). *A Guide to Modern Econometrics.* John Wiley & Sons Ltd.

Von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior.* Princeton University Press.

Wadhwa, A., & Basu, S. (2013). External Venturing and Discontinuous Strategic Renewal: An Options Perspective. *Journal of Product Innovation Management*, pp. 30(5), 956–975.

Wadhwa, A., & Kotha, S. (2006). Knowledge creation through external venturing: Evidence from the telecommunications equipment manufacturing industry. *The Academy of Management Journal*, pp. Vol. 49, No. 4, pp. 819-835.

Wadhwa, A., Phelps, C., & Kotha, S. (2016). Corporate venture capital portfolios and firm innovation. *Journal of Business Venturing*, pp. vol. 31, issue 1, 95-112.

Wang, L., & Wang, S. (2012). Economic Freedom and Cross-Border Venture Capital Performance. *Journal of Empirical Finance*, p. Vol. 19.

Wang, L., & Zajac, E. J. (2007). Alliance or acquisition? A dyadic perspective on interfirm resource combinations. *Strategic Management Journal*, pp. 28(13), pp. 1291 - 1317.

Watson, J. (2013). *Strategy: An Introduction to Game Theory* . W. W. Norton & Company.

White, S., & Lui, S. S.-Y. (2005). Distinguishing costs of cooperation and control in alliances. *Strategic Management Journal*, pp. vol. 26(10), pages 913-932.

Winters, T. E., & Murfin, D. L. (1988). Venture capital investing for corporate development objectives. *Journal of Business Venturing*, pp. vol. 3, issue 3, 207-222.

Woolridge, J. M. (1994). A Simple Specification Test for the Predictive Ability of Transformation Models. *Review of Economics and Statistics*, pp. 76, pp: 59–65.

Woolridge, J. M. (2012). *Introductory Econometrics A Modern Approach.* Cengage Learning.

WorldBank. (2021). Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

Wright, M., & Lockett, A. (2003). The Structure and Management of Alliances: Syndication in the Venture Capital Industry. *Journal of Management Studies* , pp. 40(8):2073-2102.

Yang, H., Lin, Z. (., & Peng, M. W. (2011). Behind acquisitions of alliance partners: exploratory learning and network embeddedness. *Academy of Management Journal*, pp. 54(5), 1069-1080.

Yang, Y., Narayanan, V., & De Carolis, D. M. (2014). The relationship between portfolio diversification and firm value: The evidence from corporate venture capital activity. *Strategic Management Journal*, p. 35(13).

Yang, Y., Narayanan, V., & Zahra, S. (2009). Developing the selection and valuation capabilities through learning: The case of corporate venture capital. *Journal of Business Venturing*, pp. vol. 24(3), pages 261-273.

Yoshino, M. Y., & Rangan, S. U. (1995). *Strategic Alliances: An Entrepreneurial Approach to Globalization.* Harvard Business School Press.

Yu, Y., Umashankar, N., & Rao, V. (2015). Choosing the right target: Relative preferences for resource similarity and complementarity in acquisition choice. *Strategic Management Journal*, p. 37(8).

Zhang, L., Gupta, A. K., & Halen, B. L. (2017). The Conditional Importance of Prior Ties: A Group-Level Analysis of Venture Capital Syndication. *The Academy of Management Journal*, p. 60(4).

APPENDENCIES

Appendix I.1: SIC-codes description for the ITC-industry

SIC-3	DESCRIPTION (SIC-3)	SIC-4	DESCRIPTION (SIC-4)
357	Computer and Office Equipment	3571	Electronic Computers
357	Computer and Office Equipment	3572	Computer Storage Devices
357	Computer and Office Equipment	3575	Computer Terminals
357	Computer and Office Equipment	3577	Computer Peripheral Equipment, Not Else. Class.
357	Computer and Office Equipment	3578	Calc. and Accounting Mach., except Elec. Com.
357	Computer and Office Equipment	3579	Office Machines, Not Elsewhere Classified
366	Communications Equipment	3661	Telephone and Telegraph Apparatus
366	Communications Equipment	3663	Radio and TV Broadcasting and Comm. Equip.
366	Communications Equipment	3669	Communications Equipment, Not Else. Classified
367	Electronic Components and Accessories	3671	Electron Tubes
367	Electronic Components and Accessories	3672	Printed Circuit Boards
367	Electronic Components and Accessories	3674	Semiconductors and Related Devices
367	Electronic Components and Accessories	3675	Electronic Capacitors
367	Electronic Components and Accessories	3576	Electronic Resistors
367	Electronic Components and Accessories	3677	Electronic Coils, Transformers, other Inductors
367	Electronic Components and Accessories	3678	Electronic Connectors
367	Electronic Components and Accessories	3679	Electronic Components, Not Elsewhere Classified
481	Telephone Communications	4813	Telephone Comm., except Radiotelephone
483	Radio and TV Broadcasting Stations	4832	Radio Broadcasting Stations
483	Radio and TV Broadcasting Stations	4833	Television Broadcasting Stations
484	Cable and other Pay Television Services	4841	Cable and other Pay Television Services
489	Communication Services, Not El. Class.	4899	Communications Services, Not El. Class.
737	Computer Programming, Data Pro-cessing, and Other Computer Rel. Serv.	7372	Prepackaged Software

Source: NAICS Association (2021)

Appendix I.2: SIC-codes description for the life science industry

SIC-3	DESCRIPTION (SIC-3)	SIC-4	DESCRIPTION (SIC-4)
283	Drugs	2833	Medicinal Chemicals and Botanical Products
283	Drugs	2834	Pharmaceutical Preparations
283	Drugs	2835	In Vitro and In Vivo Diagnostic Substances
283	Drugs	2836	Biological Products, except Diagnostic Subst.
384	Surgical, Medical, and Dental Instrumental and Supplies	3841	Surgical and Medical Instruments and Apparatus
384	Surgical, Medical, and Dental Instrumental and Supplies	3842	Orthopaedic, Prosthetic, and Surgical Appliances and Supplies
384	Surgical, Medical, and Dental Instrumental and Supplies	3843	Dental Equipment and Supplies
384	Surgical, Medical, and Dental Instrumental and Supplies	3844	X-ray Apparatus and Tubes and Related Irradiation Apparatus
384	Surgical, Medical, and Dental Instrumental and Supplies	3845	Electromedical and Electrotherapeutic Apparatus
873	Research, Development, and Testing Services	8731	Commercial Physical and Biological Research
873	Research, Development, and Testing Services	8733	Non-commercial Research Organizations

Source: NAICS Association (2021)

Appendix II.1: Sample ventures by industries

INDUSTRY	FREQ.	PERC.	CUM.
Information and Communication Technology	10,306	73.36%	73.36%
Life Science	3,742	26.64%	100%
Total	14,048		

Appendix II.2: Sample ventures by SIC-codes

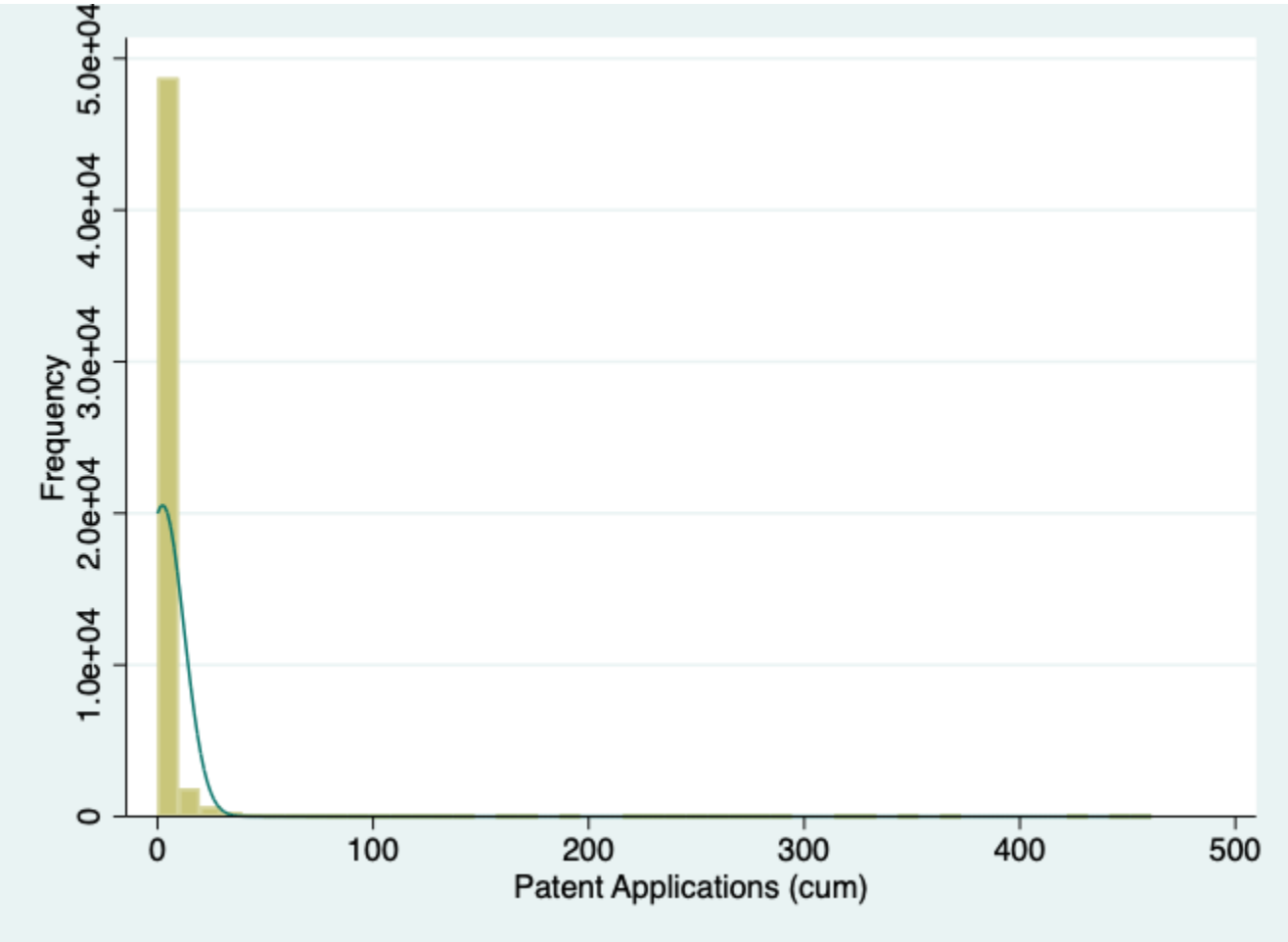
SIC-3	DESCRIPTION	FREQ.	PERC.	CUM.
737	Computer Programming, Data Processing, and Other Computer Related Services	8,843	62.95%	62.95%
873	Research, Development, and Testing Services	1,266	9.01%	71.96%
283	Drugs	1,256	8.94%	80.90%
384	Surgical, Medical, and Dental Instrumental and Supplies	1,220	8.68%	89.58%
367	Electronic Components and Accessories	710	5.05%	94.63%
489	Communication Services, Not Elsewhere Classified	220	1.57%	96.20%
366	Communications Equipment	218	1.55%	97.75%
357	Computer and Office Equipment	169	1.20%	98.95%
481	Telephone Communications	71	0.51%	99.46%
483	Radio and TV Broadcasting Stations	56	0.40%	99.86%
484	Cable and other Pay Television Services	19	0.14%	100.00%
Total		14,048		

Appendix III: Raw files from PatentsView

Table	Table Description	Data Element Name	Definition	Example	Years Present	Type
application	Information on the applications for granted patent.	id	application id assigned by USPTO	02/002761	all	varchar(36)
		patent_id	patent number	D345393	all	varchar(20)
		type				
		number	unique applicaiton identifying number	2002761	all	varchar(64)
		country	country this application was filed in	US	all	varchar(20)
		date	date of application filing	21-12-1992	all	date
		series_code	application series; "D" for some designs	2	all	varchar(20)
Table	**Table Description**	**Data Element Name**	**Definition**	**Example**	**Years Present**	**Type**
patent	Data concerning granted patents	id	patent this record corresponds to	3930271	all	varchar(20)
		type	category of patent. Usually "design", "reissue", etc.	utility	all	varchar(100)
		number	patent number	3930271	all	varchar(64)
		country	country in which patent was granted (always US)	US	all	varchar(20)
		date	date when patent was granted	06-01-1976	all	date
		abstract	abstract text of patent	A golf glove is disclosed h...	all	mediumtext
		title	title of patent	Golf glove	all	mediumtext
		kind	WIPO document kind codes	A	all	varchar(10)
		num_claims	number of claims	4	all	int(11)
		filename	name of the raw data file where patent information is parsed from	pftaps19760106_wk01.zip	all	varchar(120)
		withdrawn	whether a patent has been withdrawn or not	pftaps19760106_wk01.zip	all	varchar(120)
Table	**Table Description**	**Data Element Name**	**Definition**	**Example**	**Years Present**	**Type**
rawassignee	Raw assignee information as it appears in the source XML files	uuid	unique id	0000p94wkezw94s8cz7dbxlvz	all	varchar(36)
		patent_id	patent number	5856666	all	varchar(20)
		assignee_id	unique assignee ID generated by the disambiguation algorithm	eaa92f175be7bfb71011f17eafb1e71f	all	varchar(36)
		rawlocation_id	assignee's location.	orskbf54s58e97lkmw8na5rpx	all	varchar(128)
		type	assignee type	2	2002 and After	int(4)
		name_first	first name, if assignee is individual	Thomas	all	varchar(64)
		name_last	last name, if assignee is individual	Bushey	all	varchar(64)
		organization	organization name if assignee is organization	U.S. Philips Corporation	all	varchar(256)
		sequence	order in which assignee appears in patent file	0	all	int(11)
Table	**Table Description**	**Data Element Name**	**Definition**	**Example**	**Years Present**	**Type**
uspatentcitation	Citations made to US granted patents by US patents	uuid	unique id	000007b7c0x3n9iy1othb9hz7	all	varchar(36)
		patent_id	patent number	9009250	all	varchar(20)
		citation_id	identifying number of patent to which select patent cites	8127342	all	varchar(20)
		date	first day of the month the cited patent (citation_id) was granted	01-02-2012	all	date
		name	name of cited record	Boynton et al.	all	varchar(64)
		kind	WIPO document kind codes (http://www.uspto.go	B2	2002 and After	varchar(10)
		country	country cited patent was granted (always US)	US	all	varchar(10)
		category	who cited the patent (examiner, applicant, other etc)	cited by patent	2002 and After	varchar(64)
		sequence	order in which this reference is cited by select patent	622	all	int(11)

Source: PatentsView (2021)

Appendix IV: Patent applications (cumulative) distribution



Mean = 2.354; variance = 97,7175

Appendix V: Hypothesis test for one corporate investor (category 2) versus multiple corporate investors (category 3)

```
. test _Icategory_2 == _Icategory_3 /* Test for significance in difference */

 ( 1)  _Icategory_2 - _Icategory_3 = 0

       F(  1,  8418) =   14.19
            Prob > F =    0.0002
```

Appendix VI: Regression Results for Prior Ties (actual numbers: #)

D.V. Patent applications (cum) $(ln)_{i,t+1}$	**MODEL 9.1**	**MODEL 9.2**	**MODEL 9.3**	**MODEL 9.4**	**MODEL 9.5**
Independent variables					
Prior ties (#)		0.107		0.107	-0.005
		(0.079)		(0.284)	(0.089)
Industry relatedness			-0.137	-0.131	-0.210
			(0.162)	(0.284)	(0.281)
Prior ties (#) × Industry relatedness					0.090
					(0.078)
Venture-level controls					
Total investment amount (ln)	0.132	0.122	0.162	0.126	0.111
	(0.162)	(0.157)	(0.230)	(0.157)	(0.153)
Funding round	0.154***	0.154***	0.154***	0.154***	0.153***
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Venture age (ln)	0.201*	0.202*	0.203*	0.204*	0.211*
	(0.095)	(0.095)	(0.095)	(0.095)	(0.095)
Patent stock (ln)	0.005	0.007	0.006	0.008	0.006
	(0.023)	(0.023)	(0.022)	(0.022)	(0.023)
CVC-level controls					
CVC equity share (ln)	-0.487**	-0.478**	-0.487**	-0.474**	-0.500**
	(0.205)	(0.201)	(0.205)	(0.201)	(0.183)
Weighted average assets (ln)	0.705***	0.730***	0.705***	0.721***	0.710***
	(0.184)	(0.181)	(0.184)	(0.182)	(0.183)
CVC experience (ln)	0.040	0.040	0.040	0.040	0.041
	(0.117)	(0.118)	(0.117)	(0.117)	(0.117)
Mics. controls					
Combinations (#)	-	-0.010	-	-0.010	-0.009
		(0.007)		(0.007)	(0.007)
Constant	-12.78***	-12.90***	-12.78***	-11.96***	-11.78**
	(3.515)	(3.429)	(3.515)	(3.657)	(3.705)
Observations	2,427	2,427	2,427	2,427	2,427
Ventures	587	587	587	587	587
Robust standard errors	yes	yes	yes	yes	yes
Fixed effects	yes	yes	yes	yes	yes
Prob. > F	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parenthesis; ***p<0.01, **p<0.05, *p<0.1

Note: 1) the "Prior ties"-variable is the actual number of prior ties between the corporate investors; 2) the "combinations"-variable is the maximum number of possible combinations between the corporate investors; and 3) "the industry relatedness"-variable is the degree of industry relatedness (continuous variable).