Resource dependence: What do you need and when do you need it?

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Abstract
CVC investors in venture capital syndicates: need and opportunity
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State-of-the-art
The formation of equity-based ties between large corporations (corporate venture capital investors, or CVC) and privately-held, entrepreneurial ventures has been the subject of a debate in management literature. Adopting the perspective of investee ventures, some scholars have argued that CVC investors pose an acute risk as partners (Katila et al., 2008; Hallen et al., 2014), while others have wondered whether all corporate investors can be deemed equally as dangerous (Diestre & Rajagopalan, 2012). This research on the antecedents to CVC investments undoubtedly intersects with a broader stream of literature on the syndication of venture capital investments (e.g. Keil et al., 2010), and which explains partnerships in syndicates using the profiles of their members.

Research gap
Existing research leaves the following two caveats in our understanding of CVC investments. First, it treats CVC investors as a homogeneous group whose members are equally dangerous, thus overlooking their industry relatedness to portfolio companies, which is a main determinant of their perception by ventures and their shareholders. Secondly, existing research is still lacking in studying how syndication dynamics apply as antecedents to CVC investments. Given the peculiarity of their profiles as investors established in existing research, we ask: Do the dynamics of need and opportunity apply to CVC investments?

Theoretical arguments
We draw on the resource-based view and the research on defensive strategies (e.g. Katila et al., 2008), to contend that the knowledge resources held in a syndicate affect the relatedness between their portfolio companies and...
1. Introduction
When raising the financing they need from external investors, the management of entrepreneurial ventures solicit and choose from among different investors (Katila et al., 2008). Their decisions to accept certain ones as shareholders are motivated by the resources which these are capable of offering as well as pledging to offer. Corporate investors (CVC henceforth) constitute a peculiar, and dilemmatic class of private equity investors. On the one hand, they are the ones most likely capable of offering, in addition to financial backing, much needed resources that complement the operations of ventures, with significant positive implications for their performance (Ivanov & Xie, 2010; Park & Steensma, 2012). Corporate investments also carry social value to the extent that they increase the visibility of ventures in markets and enhance their legitimacy (Eisenhardt and Schoonhoven, 1996; Stuart et al., 1999). On the other, they are simultaneously the investors most likely to behave opportunistically and harm their investees by misappropriating their technologies (Katila et al., 2008). What determines managements’ decisions to shoulder this risk and have CVCs as investors, as result, is the extent to which they are dependent on their complementary resources.

The works that applied resource-dependence arguments to predict the formation of investment ties between ventures and CVC investors have been coarse in their analyses by treating CVCs as one homogenous group (Dushnitsky & Lenox, 2005; Katila et al., 2008). Yet, not all CVC investors can offer equal complementary value to their investees. Alvarez-Garrido and Dushnitsky (2015) show that the learning benefits for CVC-backed biotech ventures are discernable only when there is need for specific, highly-specialized tasks related to research and development operations, such as FDA approvals. Other studies have shown that the outcomes of CVC investments suffer in the absence of relatedness, or fit with investees (Gompers and Lerner, 1998; Wadhwa et al., 2013) Simultaneously, corporations are not equally risky as partners. Those that invest in industries that are wholly unrelated to their own might be explorative and harbour no intention, nor the absorptive capacity necessary, to
misappropriate technology (Cohen & Levinthal, 1990). In such instances, the objectives of CVC investments may be purely financial. CVC research has yet to define the relationship between the resource needs of ventures, and the particular profiles of corporate investors.

In this work, we argue that the business relatedness between CVC investors and entrepreneurial ventures is determined by the nature of latter’s dependence on the resources of the former. We thus study how need for tangible resources related to research and development operations and manufacturing determine the relatedness of CVC investors. Moreover, we contend that ventures can be dependent on corporate resources that are social in nature, and stem from the status and prominence of established corporations in markets. We test for their effects as determinants of the relatedness of CVC investors as well.

The following sections proceed as follows: first, we review the existing literature on the nature and importance of resources for entrepreneurial ventures. This we separate into sections on tangible and social resources. What follows this is a section where we develop our theoretical arguments and hypotheses. Then we explain the method we employed for testing, followed by a section reporting our results and finally, a discussion of these results.

**Resource dependence in entrepreneurial ventures**

In certain industries, substantial investments in physical assets such as manufacturing equipment and plants, resource and development operations, and marketing are crucial for the survival and growth of firms (Teece, 1986). Lacking such assets increases the vulnerability of firms, and threatens their survival. In order to reduce this uncertainty, ventures are compelled to establish relationships with other firms in order to acquire the resources which they need (Eisenhardt and Schoonhoven, 1996; Pfeffer & Salancik, 1978). This is nowhere more acute than in resource-poor young ventures, which suffer from deficits in their tangible and intangible resources. The magnitude of resources necessary to establish business operations can be a formidable barrier to entry for firms. This is well-known among researchers...
on organizational ecology, who refer to these predicaments as the liabilities of smallness and newness (Aldrich and Auster, 1986), and attribute to them and their implications the high mortality rate among nascent firms. Viewing this from the lens of resource-dependence theory, need for resources translates into dependence on the external environment, and more particularly, into being dependent on other organizations that possess and can provide those resources (Pfeffer & Salancik, 1978).

In the private equity market, receiving investment by established corporations (CVC) can offer an opportunity for ventures to gain access to needed resources, which traditional venture capital firms, per their nature as financial investors, are unable to provide. CVC investments are direct equity investments made by established companies in privately held entrepreneurial ventures (Maula, 2007). The seminal work of Katila et al. (2008) studied whether greater resource need — and therefore greater dependence — by entrepreneurial ventures on large corporations increases the likelihood of the formation of investment relationships between the two. They examined three types of resources that may drive this dependence: financial, manufacturing, and marketing. Their results gave support to the tenets of resource dependence theory: ventures that operate in manufacturing-intensive industries are significantly more likely to receive investments from CVC investors, rather than from traditional venture capital firms. Beyond dependence as an antecedents of their formation, research has investigated drivers of the actual value which corporate investors and portfolio companies derive from these relationships. This strand of literature suggests resource complementarity as an important determinant of this value. Different scholars have conceptualized complementarity differently in literature. In a survey by Maula et al. (2009) of 91 CEOs of CVC-backed high-technology ventures based in the United States, they define complementary relationships as the ones in which “the deployment of the resources of one party enhances the marginal effectiveness of the resources of the party.” (p. 275), and inquire about its importance in predicting the learning benefits CEOs consider as having realized from their CVC investors. Their results show that complementarity is a precondition for learning. The
story from the perspective of investors is very similar. A survey of managers from 23 different CVC units by Weber et al. (2016) suggests that the returns they realize from CVC investments are contingent on the degree of strategic relatedness, or resource complementarity, which they share with their portfolio companies. Taken together, these studies suggest that while ventures are more likely to partner with CVC investors in situations of resource need, they nevertheless must partner with those in possession of the complementary resources necessary to overcome the predicaments caused by their limited size and age.

Empirical evidence on the impact of relatedness on the value investors and investees derive from these relationships is found in several studies. Gompers and Lerner (1998) were the earliest to study the performance of CVC-backed ventures and to compare them to IVC-backed ventures. The former ventures performed better than their IVC-backed counterparts but this superior performance is evident only when strategic overlap exists between the corporate investors’ lines of business and those of their investees. A related finding is found in Hill et al. (2009), whose study of the determinants of the performance of corporate venturing units relied on both survey and archival data of 95 such units. They find a nonlinear relationship between the relatedness of investment activities to the parent corporates and financial performance; a moderate degree of relatedness being optimal. Their analysis also lends support, albeit weakly, to a positive relationship between relatedness and strategic implications for investors. Relatedly, Wadhwa & Kotha (2006) find relatedness to have a significant and positive effect on knowledge creation through CVC activities. Studies that investigated the learning outcomes from the perspective of portfolio companies suggest a similar effect. For instance, Alvarez-Garrido & Dushnitsky’s (2015) research on CVC investments in biotechnology ventures found the positive learning outcomes of the latter contingent on the applicability of certain, highly-specialized industry requirements, such as FDA approvals. A related finding in Keil et al. (2008) indicates that neither intra-industry nor inter-industry investments yield positive innovation performance. Only investments in somewhat related ventures (more than a 1-digit match in SIC Codes, and less than a 3-digit
match) produced positive innovation results. Given this evidence, it is also well understood that some ventures establish ties to CVC investors for other purposes than to acquire financial resources, a notion not without support in existing research. For instance, Katila et al.’s (2008) findings regarding the resource dependence on large corporations found financial need, rather than any other corporate-specific complementary resource, the strongest determinant of tie formation to CVC investors. Investors, on their part, are not always strategically-oriented when they invest in smaller ventures. Chesbrough’s (2002) typology of corporate objectives in VC investments shows that learning is not necessarily pursued in these activities, and that corporates may assume passive roles as investors. These studies help explain the prevalence of CVC investments in ventures with which no strategic overlap exists.

In the above sections we focused on the need for tangible resources in entrepreneurial ventures and how complementary CVC investors can help them in meeting those needs. Ventures, however, can also obtain social benefits from being affiliated with established corporations. The relative social standing of organizations, such as their legitimacy and market power, is considered an intangible resource with significant implications for their performance (Eisenhardt and Schoonhoven, 1998). Through CVC investments, corporates transfer some of these resources to their investees (Reschke et al., 2017). The performance implications of obtaining such social resources were investigated by Stuart et al. (1999). Focusing on market response to equity investment by established corporations in biotechnology ventures, Stuart et al. show by controlling for the effect of their actual quality that ventures with equity investments from established corporations increase the IPO performance of portfolio companies. This valuation premium consequent on CVC investment in IPO ventures is estimated in Chemmanur and Loutskina (2009) to be around 35% on average relative to ventures going public from the same industry. Stuart et al. (1999) explain this effect by arguing that stock markets perceive such investments as endorsements of the ventures and their underlying technologies. They conjecture that investors interpret CVC investments favourably as signals of the quality of the underlying ventures: corporate equity investors must have
vetted these ventures carefully before investing and deemed it worthwhile to invest. CVC investments therefore act to reduce the information disadvantage suffered by external, potential investors. As Ritter and Welch (2002) point out, investors in public markets face a “lemons problem” in that they are at an information disadvantage to issuers. The latter can address this deficit in information by sending signals of quality to market actors, and one way to do this is to invite more reputable shareholders into their shareholdership, such as prominent VC investors (Ragozzini & Blevins, 2016) and prestigious underwriters (Gulati & Higgins, 2003), and incumbent corporations (Stuart et al., 1999).

The need for the social resources of established corporates is exacerbated in markets where many ventures are going public or getting acquired. Such events draw the attention of investors and potential buyers towards what may be perceived as successful ventures. Research by Ragozzino and Reuer (2007) shows that IPO events send informational signals that attract potential acquirers to the ventures going public, increasing as a result their likelihood of acquisitions right after an IPO. This may also further complicate the strategic positioning of ventures that are still privately-held in those industries. Eisenhardt and Schoonhoven (1996) posit that their increased obscurity in ‘crowded markets’ puts ventures in strategically vulnerable positions, whereby multiple substitutive technologies may coexist but be unsustainable in the long run. Forming partnerships with high-status organizations can improve visibility to market actors such as suppliers, customers, and other investors and generally increase ventures’ chances for survival when competitive intensity is high (Baum and Oliver, 1991). Although CVC investments can be expected to achieve this for ventures, the literature has yet to examine this issue.

2. Theory and hypothesis development

The aforementioned study of Katila et al. (2008) tests for the need for manufacturing resources in the venture capital context, and find that ventures with greater need for manufacturing resources are more likely to establish investment relationships with CVC investors. While their
study did not discriminate among the corporates with whom ventures partner, it is not unreasonable to expect that strategic need for manufacturing resources involves a degree of asset specificity, which further increases the likelihood of more related matching between corporate investors and the less endowed ventures.

Hypothesis 1: Ventures with increased need for manufacturing resources are more likely to form investment relationships with more related corporations

The level of R&D intensity of an industry is associated with its asset specificity such that the greater the former, the more companies produce technology that is specific to that industry (Shleifer & Vishny, 1992). The more specialized nature of these technologies and the stricter range for their applicability raises the risk associated with their development, which carries an impact on the partnership behavior of developer companies. From a resource-based perspective, these conditions should compel companies to seek partners with whom synergistic combinations of resources mitigate the risk underlying the research and development process. These partnerships enable ventures to overcome the debilitating liabilities of their young age and small size (Baum et al., 2002; Eisenhardt & Schoonhoven, 1990), that threaten their survival.

In addition the physical resources associated with R&D operations, ventures that operate in technology-intensive contexts seek to acquire the knowledge of their partners. Here, greater relatedness allows firms to better value, assimilate, and apply the knowledge of partners, and is a main determinant of their absorptive capacity (Cohen & Levinthal, 1990; Lane & Lubatkin, 1998). Wadhwa and Basu (2013) find relatedness significantly associated with the resource commitment of corporate investors in portfolio companies. They attribute this effect to two sources of uncertainty facing corporate investors: their uncertainty towards the potential of ventures, and that towards their ability to absorb the knowledge they obtain by way of forming such relationships. The greater their relatedness, therefore, the lower these uncertainties, the
greater the dollar amount of their initial investments in ventures as a result. As the authors point out, financial resource commitment denotes the commitment of other resources.

Hypothesis 2: Ventures with increased need for research and development resources are more likely to form investment relationships with more related corporations.

The resource needs of ventures vary according to their stage of development. Those in their very early stages confront issues related to the recruitment of highly-skilled human capital and standardization of basic processes (Hellmann & Puri, 2002). The technologies underlying their founding may be revolutionary with market potential but still in the testing phase. Gompers (2002) conjectured, based on early data on CVC investment trends that revealed that these are most prevalent during this pre-commercialization stage, that it is in this innovation-intensive stage that corporate investments are most beneficial to young ventures. Recent research has lent support to this claim. Kim and Park (2017) examine the implications of early CVC investment on the innovation performance in a sample of 473 VC-backed ventures. They find that the subsample of ventures which received CVC funding during their first three years of life filed for significantly more patents. The authors attribute this effect to two mechanisms which CVC investors are uniquely able to undertake: 1. The offering of resources that complement the innovation activities of portfolio companies. And 2. Their softer influence imprints ventures with an orientation that is conductive to innovation (Kim & Park, 2017). When they test for this on ventures that received CVC funding in later stages of development, the authors report no significant impact on innovation performance. This is unsurprising given that progressing through stages of development implies a maturation of firms' technologies and a transition in focus to market operations. This is consistent with Katila et al.'s (2008) assumption about the maturity of ventures being a form of defense in its own right. They argue that in late stage ventures "it is easier to protect a more mature technology that is more fully embodied in a product from possible appropriation." As they mature, ventures’ uncertainty regarding their
own technologies is reduced, and with it their need for innovation-related complementary resources.

Hypothesis 3: The positive relationship between ventures’ resource needs and relatedness of corporate investors is weaker for more developed ventures

In the previous sections we hypothesized about the impact of need for tangible resources on the partnering behavior of ventures towards corporate investors. In this section, we discuss need for intangible resources and develop hypotheses about its behavioral impact. We focus in particular on the transfer of social resources from corporate investors to investees as a consequence of an equity investments, and which as we explained above, has positive implications for the performance of ventures through enhancing its legitimacy, or endorsing it, from the perspective of public markets. We contend that ventures’ need for these social resources is in part determined by conditions in markets for corporate control: public markets and takeover markets.

We reason that the uncertainty external investors perceive towards investing in ventures drives the latter’s need for the social resources of more prominent corporations. And that this uncertainty is increased in markets where assessing the quality of ventures is particularly difficult. Such is the case when markets are crowded with similar ventures that compete for public financing. Eisenhardt and Schoonhoven (1996) that in these settings, it is particularly important for ventures to distinguish themselves from competitors, and that affiliations with prominent corporates can help them accomplish this. Therefore we expect that markets that witness greater intensities of firms going public and acquisitions increase the need of ventures for corporate endorsement. We further expect that not all CVC investors are equal purveyors of these social resources. Investments by prominent, but also closely related organizations in business, send more powerful signals to investors regarding the quality of underlying ventures than those by likewise prominent organizations, but ones that operate in distant industries. We
explain this by citing the rationale with which which Stuart et al. (1999) conceive their endorsement effect. This is related to the content which external investors read in these signals, and which conveys a quality assessment of the underlying ventures. Such quality assessments carry greater credibility, and influence, when senders possess the knowledge and experience necessary before they can be perceived as “experts in the due diligence process.” Stuart et al. (1999) were mindful of this distinction, and follow-up on their reasoning: “at least in the domain in which they have garnered recognition.” Although they found no significant effect for equity investments by prominent, and technology-related organizations, on market valuations when the biotech ventures in their sample went public, this does not necessarily disprove the need for these endorsements from the perspective of the ventures.

Hypothesis 4a: Greater IPO intensity in an industry is associated with a greater likelihood of tie formation between ventures and more related corporate investors

Late stage ventures are mature companies with well-defined products, technologies, and business models. Their underlying technologies have reached a level of maturity and relevance for incumbent corporations to justify such risky and costly activities as their absorption into the equity of the larger firms. Financial backing by venture capital firms sends yet another quality signal to markets, which increases the likelihood of their targeting by acquirors (Ragozzino and Reuer, 2001). Previously we argued that intensity in public equity markets increase ventures’ need to partner with more related investors. We also expect that certain aspects of the corporate takeover market play a role in determining the attractiveness of the industry profiles of different corporate investors.

Hypothesis 4b: Greater takeover intensity in an industry is associated with a greater likelihood of tie formation between ventures and more related corporate investors
Previously we contended that early stage ventures face greater uncertainty towards upstream operations, such as innovation and manufacturing. In their later stages, we argue that their strategic positioning in markets becomes a major source uncertainty for ventures. This in turn we expect increases their need for intangible complementary resources, which stands in contrast with the need for tangible complementary resources, which we previously predicted to be particularly relevant in the early stages of development. And as a result we expect that late stage ventures are more responsive to market conditions.

Hypothesis 5: The positive relationship between ventures’ social resource needs and relatedness of corporate investors are stronger for more developed ventures

3. Method
We test the aforementioned hypotheses using a sample encompassing all corporate venture capital investments in high-tech industries recorded the VentureXpert data (Thomson Reuters) in the years between 1995-2015. The database reports a total of 11,638 rounds of investment involving 6,395 unique ventures. We first excluded rounds with “Undisclosed Firm” listed as investors since it will not be possible to investigate their relatedness to portfolio companies. In addition, we dropped from our sample rounds of investment that included more than one CVC investor since computing average figures of their industry classification codes is not suited to our matching method of analysis of relatedness between corporate investor and investee. VentureXpert’s data offers no information on CVC investors beyond flagging them as corporate investments and listing the name of the legal entity that provisions investments. These names are typically those of subsidiaries of large corporations that are not readily identifiable in the dataset. So we collected information on each CVC investor in two steps: first, we identified the parent corporations using the names of their subsidiaries when the names revealed the identities of the parents. When subsidiary names were ambiguous, we used the S&P Global database to identify the parents. In a second step, we used the Compustat and Thomson One databases to find the industry classification code of the parent.
organization. Yet in spite of our best efforts, 174 investors remained unidentifiable either because no further information was found about them, or because multiple possible parent corporates made them difficult to define with certainty. This yielded a final sample of 5,490 rounds of investment in 3,085 portfolio companies.

**Dependent variable:** Our dependent variable is industry (business) relatedness between corporate investor and venture. We used the 4-digit Standard Industry Classification codes (SIC codes) of both corporate and venture and recorded a full match when the two codes match perfectly. With a three digit match the two organizations were deemed less related, but even less so in cases of two-digit, and one-digit matches, respectively. In cases of no matches on any digit level the two companies were deemed wholly unrelated. Thus, scores of (1, 0.75, 0.5, 0.25, and 0) were given to their respective degrees of closeness, with greater scores reflecting greater relatedness\(^1\). This relatedness measure was modeled after that used in Hill et al. (2009). Alternatively, Dushnitsky & Shaver (2009) use NAICS codes to indicate industry overlap, recording a value of 1 when the codes of corporate investors and investees match and 0 otherwise.

**Independent variables:**

**Manufacturing intensity:** The manufacturing intensity of an industry is calculated by dividing the value of the fixed assets of its public firms by their total assets, then calculating the natural log of the average of those figures for every year of interest in our study. We

\(^1\) We are well aware of the issues raised by Robins and Wiersema (1995) concerning the validity of measuring business relatedness or diversity through constructing indicators based on industry classification code systems. Such utilization, they argue, rests on strong assumptions regarding the strategic relationships between the different horizontal categories, and which have not been substantiated sufficiently. Likewise, the vertical distances between lower- and higher-level categories are assumed to be equal, which also aggravates issues of measurement validity. Other management scholars have sought to address the deficit of this method by suggesting, for instance, rooting them in the extent to which the capabilities required of human resources in a domain are similar (Farjoun, 1994). To address those validity concerns, we intend to incorporate a more robust measure, based on revenue data and suggested by Robin and Wiersema, in a future stage.
identified industries using their 4-digit SIC codes and used these codes and measurement year to match the computed figures to our sample of investment rounds.

**R&D intensity:** We follow Gompers (1995) in measuring the intensity of research and development activities in an industry. Accordingly, this is either the ratio of R&D expenditures to total assets, or R&D expenditures to sales. Gompers used this measure in the private equity context to study VC firms’ adaptation to turbulent technological environments. Annual figures of public firm expenditures on R&D and their sales turnover were obtained from COMPUSTAT. Then yearly averages of expenditure and turnover are calculated per 4-digit SIC code in our sample. These we matched to each investment round in our sample using the portfolio company’s industry and year of investment.

**IPO intensity:** This variable is meant to capture the intensity of IPO intensity in an industry. It is calculated as the natural log of 1 plus the proportion of VC-backed exits via IPO in a given year from the total number of exits in that industry, year. From Thomson One, we obtained data on all exit events of private equity-backed ventures during the years of our sample. For every industry (identified using 4-digit SIC codes), we counted the total number of exits each year including those via IPOs, trade sales, secondary sales, write offs, and buybacks. Then we calculate the proportion of IPO exit from that sum. We lagged the measure one year, so that each investment round in our sample was fitted with IPO figures from the previous year. This method is consistent with previous research that employed this measure (Lindsey, 2008), and has higher values denoting more IPO exits in an industry in a given year.

**Takeover intensity:** Similarly measured per 4-digit SIC code, year. Following Lindsey (2008), we compute this variable by adding 1 to the proportion of VC-backed exits via trade sales to other corporations in an industry, year, then taking the natural log of this proportion. This variable was also lagged for one year.

**Moderator variable:**

**Maturity (stage of development):** Entrepreneurial ventures undergo a gradual process of development along which particular stages are delineated based on their meeting
of observable operational milestones. The National Venture Capital Association thus regards ventures as either in their: “Startup/Seed”, “Early Stage”, or “Expansion”, “Later Stage”, “buyout/acquisition” or as “Other”. We excluded investment rounds in ventures classified as being of the latter two categories as they not meaningful for our resource need arguments. Ventures classified as being in the first category (startup/seed) includes ventures which have been only recently incorporated with no products or services on the market. The research and development work in the second category (early stage) of ventures has produced a pilot product and issues related to commercialization become germane. Expansion stage ventures have established market operations and demonstrable cash flow seeking to grow in scale. While later stage ventures are more mature than the previous three and may even be profitable (MacMillan et al., 2008).

Control Variables:

It is important in conducting this analysis to control for other factors that may affect the relatedness of ventures to corporate investors. Most importantly, we control for the availability of CVC financing in an industry. Moreover, we include a control the number of VC shareholders in ventures given existing research on their role (Hallen et al., 2014). We also incorporated in our model a control variable for round number as a proxy for the financial need of ventures.

CVC availability: This variable is meant to capture the supply of CVC in an industry. The greater this supply, the more opportunities ventures have to receive CVC funding. This measure we compute by calculating the proportion of transactions done by CVC investors to all VC transactions for every industry-year in our sample. Industries were identified using 4-digit SIC codes. Those included in our sample are high-tech industries in which at least one company received one round of financing by venture capital investors. This yielded 27 unique industries/sectors. After calculating these data, we matched them to investment rounds in our sample after lagging them for one year, such that the CVC availability figure associated with an investment reflects CVC activity of the previous year in that industry. An alternative measure used by Hallen et al. (2014) utilizes investment amounts instead of their count to
proxy for VC availability. Since this data were unavailable to us, we chose the former method with the count figures, and which has been used in Ivanov and Xie (2010).

**Number of VC shareholders:** We control in our model for the count of independent venture capital investors which had invested in the focal ventures in the round previous to the round under observation. This method is similar to that used in the defenses literature (Katila et al., 2008; Hallen et al., 2014). Accordingly, aspects related to syndicate composition in round \( (x) \) are predicted using independent variables measured at previous rounds \( (x-n) \). Our rationale in controlling for this rests on what the existing literature on CVC suggest as the impact IVC shareholders can have on the behavior of their investees. For once, the process of raising subsequent investment rounds and selecting the participating investors is one in which the existing venture capital shareholders are actively involved. Their influence is unsurprising given the legitimate power they enjoy as shareholders, and which is manifested in their voting rights on the boards of directors of their portfolio companies (Wright & Lockett, 2003). They exercise this power to maximize returns to their external investors within timeframes that are prescribed at the time of raising their investment funds. Achieving these goals ensures their ability to raise future investment funds and thus their survival as private equity firms (Jaaskelainen, 2012). Hallen et al. (2014) find that they can facilitate tie formation between portfolio companies and large corporations. Their work is an extension of earlier research on the defensive mechanisms that enable small companies to guard against any potential opportunistic behavior by large corporates, thus facilitating tie formation through CVC investment (Katila et al., 2008). The theory which Hallen et al. propose rests on social dynamics in arguing that VC firms’ possess the ability to retaliate against the opportunistic behavior of partners by damaging their reputation in the community of investors. The greater the number of existing VC shareholders in a venture, the more we expect them to be capable of mounting a social defence of their ventures, enabling thus more relatedness between ventures and corporates. Also, in later stages of investment, and depending on their number and the size of their individual equity stakes, existing VC investors are likely to have collectively accumulated a significant ownership stake in ventures. A closely related CVC investor joining
the syndicate at this stage would most likely hold marginal equity in ventures with limited rights and therefore command meager influence over their investees. In these circumstances entrepreneurs need not worry about any loss of autonomy as a consequence of investment by a strategic investor, since their control is inversely correlated with the number and equity stakes of VC shareholders.

**Round number:** We included the ordinal number of the investment round as a control in our model. The stage of development of ventures does not always correspond to sequence of investment rounds they receive. Some mature companies raise their first round of VC financing at a later stage in order to expand or diversify existing operations, all while others receive several investment rounds without advancing from one stage of development to the next. Whereas some existing studies use round number as a proxy for the maturity of ventures (e.g. Katila et al., 2008), we use investors’ classification of development stage for that, and include round number as a better control for capital need on the venture level, although the two are undoubtedly correlated. We nevertheless cite the work of Dimov and De Clercq (2004) to support our rationale in using this control variable. Their study employs both round number and stage of development as two predictors of the the likelihood of syndicating investment deals. In finding a significant positive effect for the former, and a significant negative effect for the latter, the authors argue that in later rounds there is greater need for capital, support a financial rationale for syndication.

**Year fixed effects:** Corporate interest in making CVC investments fluctuates with time. Three ‘waves’ of CVC activities have been documented as the magnitude of CVC surged during the past three decades (Dushnitsky, 2006). The increasing popularity of CVC investment activities in recent years may be considered as part of a fourth wave. To control for this cyclicality, which is fueled in part by activity in the overall private equity market by also by other macroeconomic stimuli, we include year fixed effects in our model.

4. Results
Table 1 presents some descriptive statistics of the variables and their intercorrelations. Each observation in our sample represents one round of investment in a venture involving at most one CVC investor in addition to independent venture capital investors. The mean score of our dependent variable, industry match is 0.24, with a little over two thirds (~68%) of ventures in our sample having had wholly unrelated CVC investors (a score of 0). Of the remaining observations, roughly 4.9% had a 1-digit match, 4.4% a 2-digit match, ~11.6% a 3-digit match, and a further 11.3% a perfect industry match with their CVC investor. The low mean of industry match echoes existing findings in the research on CVC investments. Using NAICS codes to measure industry overlap, Dushnitsky and Shaver (2009) find that 7% of the venture-CVC dyads in their sample operated in the same industry. This is also consistent with the view from the corporate investor perspective that suggests that corporates make use of this mode of venturing when technologies are distant from their own (Van de Vrande et al., 2009). This is also in line with the view that entrepreneurial ventures can be apprehensive about the intentions of corporate investors, with the increased relatedness of CVC investors further exacerbating this perception. On average, three independent venture capital investors were shareholders in these ventures. We included in our sample investment rounds in ventures that were described by investors as being in their “startup/seed”, “early stage”, “expansion”, or “later stage”. We excluded those described as “buyout/acquisition” rounds or “other”. The mean development stage in our sample was 2.9, and mean round number was 3.8. The intercorrelations table shows a high negative correlation (-0.7969) between the variables measuring IPO and takeover intensities. This is expected since the two variables are mutually exclusive per industry/year; an IPO event necessarily implies a non-acquisition event, which lowers the possible count of unique acquirers. To ensure the validity of our results, we follow up our analysis with two additional robustness checks: first, we analyze each variable separately in a model which includes all the other variable except the other market variable. Then we utilize a STATA command to orthogonalize the variables, and then include the orthogonalized versions in a separate analysis.
In Table 2 we present the result of estimating an ordinal logistic model. Given that our dependent is an ordinal variable with five categories (0, 0.25, 0.50, 0.75, 1) that are ordered from 0 (no relatedness), to 1 (same industry), we considered this estimation method suitable for conducting our analysis. Model 1 includes the effects of control variables on the industry match between CVC investors and investees in our sample. We included a control variable for round number to ensure that relative need for capital within the sample is accounted for in our model. We found it statistically significant, and negative in sign, at (p < 0.05). Need for financing, per se, does not discriminate among CVC investors based on the additional, complementary resources the parent corporates may have, so while a nonsignificant effect on relatedness may also have been conceivable, a negative effect means that when are in need for capital, ventures are inclined to acquire it from unrelated corporates, thereby avoiding exposure to opportunistic behavior. Furthermore, the number of existing IVC shareholders had a significant and positive effect on CVC relatedness (b = 0.06, p < 0.01). This effect can be interpreted using a resource lens and a power relations lens. Venture capital syndicates pool the resources of their members (Ferrary, 2010). Therefore larger syndicates contain greater social capital, and facilitate to entrepreneurs more introductions to corporates in their industries. The power lens builds on the work of Hallen et al. (2014) on social defences. Larger syndicate can offer ventures greater social protection from misbehavior by corporate investors, therefore enabling the formation of riskier ties with more related ones. The control for the supply of CVC in an industry is positive and highly significant (p = 0.000). This shows that the abundance of CVC financing in an industry increases the likelihood of its ventures establishing ties with more related corporate investors. Even though our CVC supply measure (CVC availability) does not discriminate among corporate originators of this supply, we nevertheless expect that since CVC, as a vehicle for strategic learning, is not equally effective in all industries (Dushnitsky & Shaver, 2009), its supply in accommodating industries tends to be sourced from corporates that are active in that industry. Lastly, the control for the number of years since ventures received their first investment did not have a statistically significant effect on relatedness.
Model 2 of the ordered logistic regression tests for the effects of tangible resource needs on relatedness. Industry level proxies for resource need in our model are manufacturing intensity and research and development intensity. The first has been shown by earlier research to influence positively the likelihood of tie formation with CVC investors (Katila et al., 2008). Our analysis reveals that it is moreover a significant determinant of the relatedness profile of corporate investors. The coefficient for manufacturing intensity is positive and significant (b = 0.25, p < 0.05). This result supports our first hypothesis. Our second hypothesis predicted that industries with increased R&D intensity lead to greater relatedness between portfolio companies and CVC investors. The coefficient of R&D intensity is highly significant and positive (b = 0.60, p = 0.000). Confirming our intuitions, these results improve the current understanding of resource dependence on established corporations to the extent that this dependence is directed towards corporates that are more related to ventures. Since complementarity is essential for knowledge appropriation (Cohen & Levinthal, 1990), R&D-related complementary assets are more specific than production-related assets, it is therefore not surprising to find that R&D-intensiveness has a stronger effect in predicting relatedness than manufacturing intensity.

In models 3 and 4, we interact resource needs with the variable denoting the stage of development of ventures. Our aim in doing this is to examine if the impact resource needs have on partnerships with CVC investors are contingent on the level of maturity of ventures. We first interact manufacturing intensity with stage of development in model 3, then R&D intensity with stage of development in model 4. The first interaction term is marginally significant at (p < 0.010) and positive. However, we must exercise caution in our interpretation of this effect and subsequent interaction effects in our study given what Ai & Norton (2003) suggest in relation to interaction effects in nonlinear models: “The interaction effect cannot be evaluated simply by looking at the sign, magnitude, or statistical significance of the coefficient on the interaction term when the model is nonlinear.” (p. 129). Instead, the sign and magnitude
can change depending on the values of all the other covariates in the model. And statistical significance cannot be surmised using a t-test on the coefficient of the interaction term. As a remedy they propose computing the cross derivative of the expected value of the dependent variable to estimate the interaction effect, then plotting the marginal effects. Using the margins command in STATA, we computed the interaction effect of venture maturity over the marginal effect of manufacturing intensity on the relatedness of CVC investors at the four different levels of the interaction variable (maturity = 1 2 3 4). These values stand for (startup/seed, early stage, expansion, and later stage), respectively. This test confirmed what Ali and Norton suggest about significance levels in nonlinear models. The marginal effect of manufacturing intensity fluctuated between statistical significance and non-significance and between positive and negative signs when interacted with different maturity levels. We include a plot of this interaction effect in Figure 1. The plot shows that overall, venture maturity moderates the effect of manufacturing intensity negatively in early stage ventures (stage 1 and 2) such that the marginal effect of manufacturing is no longer statistically significant. Its moderating effect increases in impact with the maturity of ventures, becoming marginally significant (p < 0.10) in stage 3 and even more strongly significant in stage 4 (p < 0.05). In net effect, manufacturing intensity has no effect on the relatedness of CVC investors in immature ventures, all while it leads to greater relatedness in mature ventures. We applied the same method in Model 4 to test for how venture maturity interacts with research and development intensity to affect relatedness. The plot in Figure 2 shows these results. In this case, the interaction terms were highly significant (p = 0.000), which indicates its impact as a moderator variable, supporting our third hypothesis. Computing the interaction terms for every maturity level of companies revealed that maturity weakens the effects of R&D intensity on relatedness. In other words, the more mature the ventures, the weaker the positive impact R&D intensity has on the likelihood of ties with more related CVC investors. In model 5 we examine the impacts of public and takeover market conditions to test our fourth hypotheses. We predicted that the intensity of activities in these markets increases ventures’ need for intangible corporate resources, and that this should increase the likelihood of relationships with more related corporate investors.
The main effect of IPO intensity is positive and significant at (p = 0.000). The effect of takeover intensity, however, although significant at (p < 0.01), is negative, which is contrary to our expectations. In the discussion section we speculate about what may be driving this negative effect. But overall, we consider these results as supporting our hypothesis regarding public markets (4a), but offering no support for our hypothesis on takeover markets (4b). Then we tested in models 6 and 7 for the interaction effects of maturity and market conditions by dedicating a model for each market under study. First we examined public markets in model 6 following the same method we explained earlier on interaction effects in nonlinear models. The interaction terms were all highly significant (p < 0.01) with the marginal effect of IPO intensity strengthened with each advancement from a stage of development to the next, as is shown in Figure 3. We conclude that the maturity of ventures positively moderates the effect of IPO intensity. Ventures in their later stages are likely to form more related ties with corporate investors in response to conditions in public markets. Then we tested for the interaction of maturity and intensity in acquisition activities. The majority of interaction terms were significant at p = 0.000 with a few significant at p < 0.05. Maturity, therefore, strengthens the marginal impact of takeover intensity on CVC relatedness, which is negative in effect as we have shown earlier. The more mature the ventures, the more takeover intensity will decrease the likelihood of their forming ties with related CVC. These interaction effects are shown in Figure 4.

5. Discussion
Establishing ties with large corporations through CVC investments is one way entrepreneurial ventures acquire much needed resources for their survival and growth. These relationships have been used previously as contexts for studying the social implications of resource dependence given that the significant resource disparities between the two sides, and therefore the power imbalance they involve, make them particularly suitable as cases for analysis. So far, this research has tested and confirmed that resource need leads to a greater likelihood that ventures will establish ties to CVC investors. And that this is particularly true when these resources are nonfinancial and so difficult to acquire from traditional venture
capital firms. Against the backdrop of this work, we offer a closer examination of what resources ventures need as well as when they are most likely to need them. We also went beyond existing research by examining how this need determines the particular profiles of CVC investors with whom ventures partner. We focused on the need for complementary resources related to R&D operations and manufacturing, and hypothesized that ventures will partner with more industry related CVC investors as a result of these needs. Our results support these expectations, which also imply that absence these needs, ties with less related CVCs are driven by financial need.

We contribute to the literature on CVC by bridging the gap between it and the research on informational economics (Gulati & Higgins, 2003; Ragozzino and Reuer, 2007; Stuart et al., 1999), and other intangible social resources that affiliation with prominent organizations can transfer to ventures with significant implications for their survival and performance (Baum & Oliver, 1991; Eisenhardt and Schoonhoven, 1998). In this study, we assume that managers are cognizant of the social implications of CVC investment in their ventures. They will therefore seek to send quality signals to external markets by partnering with corporates in their domain that carry enough credibility to send this signal, which we take to be the corporations that are more related to their operations. Further, we examine the drivers of their decisions to seek these social resources and information signals, which we argued are relate to their strategic positions in their industry domains. In more competitive industries, where similar, VC-backed ventures exit successfully to public markets, ventures may be more incentivized to obtain social resources to increase their visibility. Our results supported this hypothesis; increased IPO activity in an industry leads ventures to form ties with more related corporate investors.

We encountered an unexpected finding in analysing the effect of takeover intensity. We had hypothesized that they operate in a similar way to IPOs, but our results show that they carry the opposite impact on CVC relatedness. In retrospection, we wondered if more acquisitions in an industry actually improve the visibility of its still-independent ventures, or if their increased intensity carries a universal endorsement effect to all ventures that operate in that industry.
These are possibilities. But we also tapped into the literature on information asymmetry to study the impact CVC investments in ventures may have on the likelihood of their subsequent acquisition. An aforementioned study by Ragozzino and Reuer (2007) found that IPO events reduce the information asymmetry suffered by potential acquirers. We speculate that CVC investments by other corporations, on the other hand, may increase it. We motivate this with the following: the information asymmetry which a potential acquirer has vis-a-vis the entrepreneurial venture is significantly greater than that of the corporate invested in the venture (Brau et al., 2003). Risk of adverse selection when acquiring a venture, as a result, is greater for the former. Furthermore, the valuation of ventures raises yet another source of uncertainty for a potential acquirer. Undoubtedly, the invested CVC shareholder is better able to assess the quality of the venture, yet they are incentivized, given their equity ownership, to overstate this value in order to increase their return on investment, which in turn can be dissuasive to potential buyers, and reducing as a result the venture’s chances of receiving multiple offers for takeover, which research suggests maximizes returns to sellers (Franks, Harris, and Titman, 1991). These dynamics are further complicated by the findings of multiple studies of acquisitions following CVC activities that suggest that corporates rarely acquire their portfolio companies (Benson & Ziedonis, 2009). A statement of a corporate venture capitalists cited in Keil (2000, p. 126) explains this from a CVC investor’s perspective: “Acquiring our own [venture capital] portfolio companies would be a pretty stupid thing. First we drive the price for the venture up ourselves. Then we acquire it.” In other words, investing in a venture raises the cost of its acquisition, making a takeover transaction less justified for the investor. The work of Burkart (1995) offer a different theoretical grounding of this issue in financial economics. The so-called “winner’s curse” forces holders of equity stakes (referred to as toehold stakes in that literature) to raise the valuations of their ventures by overbidding as the only rational behavior in these cases, irrespective of their intentions regarding an acquisition of the ventures. Corporates also risk damaging their reputations as investors in the private equity community if they are perceived as acquisitive investors. Souitaris and Zerbinati (2014) offer anecdotal evidence to this effect. When CVC investors are unlikely to acquire their investees,
they may simultaneously reduce the likelihood of acquisitions by other potential buyers. For
the latter, the increased valuations which we explained above, coupled with being at an
informational disadvantage relative to the invested corporate, which hampers their ability to
accurately evaluate ventures, produce this effect. We therefore reason that greater
relatedness of corporate investors to portfolio companies increases the impact of the signals
which CVC investments carry for external potential acquirers to the extent that they increase
the latter’s uncertainty towards ventures. Returning to our results, this may explain ventures’
avoidance of more related CVC investors in intensive takeover markets, as obtaining
investment from distant corporations is unlikely to send the same, negative signal to potential
acquirers.

Our study also contributes to existing research by highlighting the role of the stage of
development of ventures as a moderator of these needs. Prior research controlled for the
maturity of ventures or conceptualized it as a mode of defense that enables ventures to form
ties with corporate investors. For us, maturity is a major determinant of the type of
complementary resources which ventures need and seek to acquire from corporate investors.
Our results suggest that need for complementary resources associated with R&D operations
attenuates with maturity, increasing as a result the likelihood of ties with more distant CVC
investors. Conversely, need for resources associated with manufacturing increases in
importance with maturity, increasing as a result the likelihood of ties with more related
corporate investors. Maturity also increases the need for social resources and corporate
endorsement in IPO-intensive markets. This was consistent with our expectations since later
stage ventures harbor greater concern about their market positions than ventures in their early
stages of development. Accordingly, we find the former more eager to obtain these resources
from more related corporate investors, all while increased competition is a weaker determinant
of relatedness for the latter.
Appendix

Works cited


<p>| Table 1 |
|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| industryMa−h | Manufac−y | RD_int−y | IPO_in−y | Takeov−y | Develo−e | RoundN−r | Number−s | CVC_av−y |
|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| industryMa−h | 1                      |                        |                        |                        |                        |
| Manufac−y | 0.0087                 | 1                      |                        |                        |                        |
| RD_int−y | 0.2105                 | 0.0223                 | 1                      |                        |                        |
| IPO_in−y | 0.1093                 | -0.0491                | 0.131                  | 1                      |                        |
| Takeov−y | -0.1105                | -0.0049                | -0.0448                | -0.7969                | 1                      |
| Develo−e | -0.0372                | 0.0382                 | -0.0552                | -0.1193                | 0.1182                 | 1                      |
| RoundN−r | -0.0281                | 0.0361                 | 0.0381                 | -0.1188                | 0.0899                 | 0.4964                 | 1                      |
| Number−s | 0.02                   | 0.0311                 | 0.0198                 | -0.1384                | 0.1042                 | 0.4685                 | 0.6402                | 1                      |
| CVC_av−y | 0.0327                 | 0.0469                 | 0.0354                 | 0.2086                 | -0.1258                | 0.1163                 | -0.0617               | 0.0647                | 1                      |</p>
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Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 1
Figure 2

Average Marginal Effects of Manufacturing\_intensity with 95\% CIs

Figure 3

Average Marginal Effects of RD\_intensity with 95\% CIs
Figure 4

Average Marginal Effects of IPO_intensity with 95% CIs

Figure 4

Average Marginal Effects of Takeover_intensity with 95% CIs