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Strategic venture investments for innovation: an international study of external and internal drivers of corporate venture capital

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Abstract

This paper takes the perspective of corporate venture capital (CVC) as a form of external R&D for established firms. The focus of the study is on the external and internal factors that affect the number of CVC investments made. By defining corporate firms' objective as strategic, it is possible to distinguish it from individual venture capital (IVC) funds that are driven by financial motives. Using longitudinal data comprised of 941 firms observed over 6 years, the hypotheses of different variables are tested. The analysis shows that the local bankruptcy law has a significant positive effect on the number of CVC investments made. This study also reveals that firms tend to diversify away from their primary sector in their CVC investing.

Keywords: Corporate venture capital; Corporate entrepreneurship, External R&D

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1 Introduction

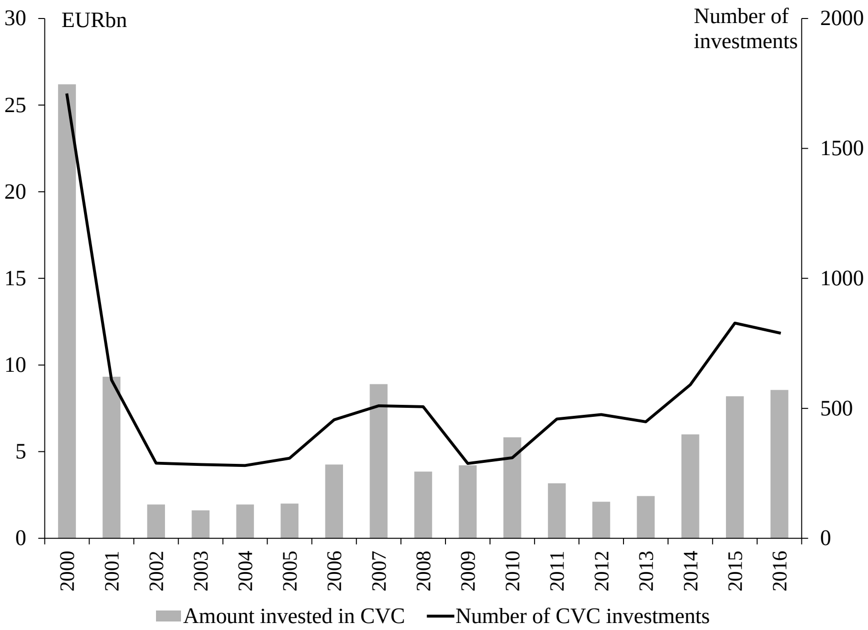
Venture capital (VC) has developed to an important form of financial intermediation that is structurally prepared to handle the challenges that are inherent to financing small entrepreneurial companies (Gompers & Lerner, 2001). The VC model emerged out of the need to find a viable way to finance high-risk enterprises that develop and commercialize novel technology (Gompers & Lerner, 2001). In addition to the traditional monitoring role of financial intermediation venture capitalists practice a hands-on approach that help portfolio firms professionalise their operations (Hellmann & Puri, 2002). This form of financing allowed entrepreneurial personnel to develop their inventions and ideas outside the boundaries of large firms (Da Gbadji *et al.* , 2015).

During the 1990s, corporate managers started to realise that a large number of ground-breaking ideas were commercialised in small entrepreneurial ventures, many of which were started by former employees (Gompers & Lerner, 2001). Established firms begun to shift their attention towards the innovation that originate outside of their boundaries and considered it a feasible alternative to their internal Research & Development (R&D) (Dushnitsky & Lenox, 2005a). The re-evaluation of the innovative process lead to an exploration of external alternatives such as joint ventures and research alliances (Gompers & Lerner, 2001). In light of the success of Individual Venture Capital (IVC) funds, large established firms started to mimic their behaviour by forming their own venture capital arms, which has been denoted Corporate Venture Capital (CVC) (Da Gbadji *et al.* , 2015).

During the last few years, there has been an upsurge in the global CVC activity and the number of active firms. Figure 1 shows the development of the CVC market over the last 17 years. The number of investments has in recent years reached levels not seen since the tech boom during the turn of the century. The number of CVC Investment has been strongly correlated with the waves of the business cycle but with higher peaks and lower troughs(Chesbrough, 2002). About 15% to 20% of the total commitments in the venture capital market are made by corporate affiliated funds (Da Gbadji *et al.* , 2015).

The financial significance of CVC motivate extensive research and several stud-

Figure 1: Amount invested in CVC and number of CVC investments, by year



The raw data was cleaned from one extreme value since it was more than 3 times larger than the second highest value and probably a result of database error. This particular observation was not related to a sample firm and consequently does not have an impact on the analysis.

ies have made large contributions to the understanding of this particular form of venture capital. Dushnitsky & Lenox (2006) examined the value creation of CVC and Colombo & Murtinu (2017) studied the financial performance in companies financed by CVC and IVC respectively. Gaba & Bhattacharya (2012) studied how managerial aspirations affect CVC investments and Wadhwa *et al.* (2016) measures the effect of CVC investments on firm innovation.

This paper explores the external and internal factors that drive the number of CVC investments. In this specific area of research, Basu *et al.* (2011) and Dushnitsky & Lenox (2005a) have studied the effect of firm and sector factors on CVC investments in the US market. Da Gbadji *et al.* (2015) took an international approach and examined how country factors affect firms' engagements in the CVC market. This study extends the existing literature through the analysis of a large global sample with recent data. The use of this research approach allows for extensive examination of the external factors that drive CVC investments, on both the sector and country level. There is also emphasis put on the relationship between new investments and the size and composition of the existing portfolio. Furthermore, this study challenges the regression methodology of the existing literature on this subject. The remainder of this paper is structured as follows. First, the existing literature is discussed that lead to formation of the hypotheses. Then, the data collection and methodology are described and after that, the results are presented. Finally, the results are discussed and compared to existing literature, which culminate in the subsequent conclusions.

2 Theory and hypotheses

For the understanding of how environmental factors affect CVC investment, it is crucial to first define the objectives of the investing firms. Chesbrough (2002) highlights that the rationales of firms are heterogeneous and usually differ from the pure financial objective of IVCs. Gompers & Lerner (1998) found that some strategic objective is generally required to compensate for the price premium CVC investors pays in comparison to IVCs. Dushnitsky & Lenox (2006) show that CVC investments generate higher value when the firms explicitly search for entrepreneurial innovation, rather than pursuing financial return. Even though some firms have made CVC investments just to get financial returns, especially when the market conditions have been favourable, the majority of CVC investments has been motivated by strategic objectives (Chesbrough, 2002; Dushnitsky & Shaver, 2009).

This paper takes the perspective of CVC investments as a part of the R&D strategy of firms. The theoretical hypotheses are built on strategic CVC investments and not on financial. Under this condition, the different opportunities and internal resources of firms should produce significant variation in the number of CVC investments made. Since the IVC investors are motivated by providing financial returns and lack the strategic objective of CVC investors the they should not be affected by these factors in the same manner. In other words, the underlying assumption of the hypotheses in the following subsections is that the CVC investments are driven by other factors than a strong venture capital market, in the sector or country of the firm, providing them with a financial opportunity. If a large share of firms make investments for pure financial reasons, the significance of the hypothesised factors would be reduced since they are built on a strategic objective. The distinction between CVC and IVC would become redundant if they were motivated by the same objectives.

The environmental factors are treated as exogenous to the firms, even though firms are undoubtedly a part of the sector and market in which they are active. This is done under the assumption that one firms influence on the sector or country is limited. Throughout the rest of this section, the existing literature on CVC investments is discussed and from that, the hypotheses are derived about the environmental variables on a sector, country and firm level. Table 1 shows the summary of the proposed hypotheses.

2.1 Sector level

Venture companies in several sectors have received financing from established firms (Dushnitsky & Lenox, 2005a). However, the firms making these investments do not always have the same operational focus as the companies in which they invest (Dushnitsky & Lenox, 2005a). Corporate firms have made venture capital investments to promote their current strategy, to explore alternative strategies and investments into companies that drive demand for the current product portfolio or improve operational efficiency (Chesbrough, 2002). As an example, a traditional manufacturing firm may invest in a company with technology that improves their supply chain or distribution function. Indeed, Klevorick *et al.* (1995) show that a number of technological improvements for firms originate outside their primary industry.

Even though there are strategic reasons for corporate firms in several sectors to pursue CVC investments, some characteristics separate traditional stable businesses from those who are active in a rapidly changing industry. Klevorick *et al.* (1995) show that several industries have experienced a rapid technological change while other industries have remained rather stable. In a transformational sector, with high uncertainty about the future, strategic mistakes are expensive and recovery from missed opportunities difficult (Eisenhardt, 1989). Corporate practices are generally more robust and structured in a stable sectors and depend on the ability to change and adapt in order to succeed in a high-velocity sectors (Eisenhardt & Martin, 2000). Hence, to remain competitive in a rapidly evolving sector, it becomes important to explore several strategies and means of innovation. Corporate venture capital is an attractive way of reducing the risk of innovation by spreading the investments over several new ventures (Sahaym *et al.* , 2010). In this context, investment in entrepreneurial firms can be thought of as building a portfolio of real options. Investments can provide corporate firms with the possibility but not the obligation to acquire the company and its technology in the future (McGrath & Nerkar, 2004). Consistent with option valuation theory, a higher variance brought on by technological change would increase the value of these options (McGrath & Nerkar, 2004).

Furthermore, Dushnitsky & Lenox (2005a) propose that in industries with rapid technological innovation, the incentive for research personnel to start their own business becomes large. The argument is built on the finding by Amit *et al.* (1995) that the cost of leaving their employment in the R&D department of a large corporation is compared to the value of creating your own business. In industries with large opportunities emerging from technological change, more R&D personnel will start their own business. This will cause the number of qualitative ventures to go up. As the potential value in new companies increases, corporate firms will become more inclined to invest (Dushnitsky & Lenox, 2005a). This leads to the first hypothesis that corporate firms active in a rapidly changing sector will make more CVC investments.

H1: Higher level of technological change in the firm's sector will increase the number of CVC investments made

One major difference between CVC funds and IVC funds is the corporate structure, which has been attributed as one of the success factors of IVC funds (Chesbrough, 2000). Instead of the limited partnership with finite time-span, corporate venture organizations are generally organized as subsidiaries with substantially less profit sharing (Gompers & Lerner, 1998). On the other hand, Gompers & Lerner (1998) find that CVCs can add value through strategic complementary assets, which is not possible for IVCs. Complementary assets are specialized manufacturing or marketing capabilities that are often specific to one sector (Gans & Stern, 2003). For venture companies it will become more attractive to form relationships with corporate firms that control these capabilities (Basu *et al.* , 2011).

Corporate investors can also benefit from an interorganisational learning process between itself and the venture (Dyer & Harbir, 1998). CVC investments can be made to gather information that can be useful to the other business units within the firm (Chesbrough, 2002). Accordingly, investments have been made to gain a window on new technologies, products or market opportunities (Dushnitsky & Lenox, 2006). With these potential benefits in mind, it makes sense from the corporate firm's perspective to invest in ventures that are tightly linked to their own business, so that they can extract valuable information and add value through complementary assets.

However, one must also consider the perspective of the venture company with whom the firm wants to form an investment relationship. As highlighted in (Dushnitsky & Shaver, 2009), entrepreneurial companies may be unwilling to from these valuable investment relationships due to fear of imitation and expropriation of their technology from the corporate investor. It has been shown that corporate imitators can outperform the original innovators if they are better positioned with complementary assets (Teece, 1986). The possibility to legally protect innovation and extract rents, through the use of patents, differs significantly between sectors (Cohen *et al.* , 2000). Under a weak intellectual property (IP) regime, it can become prohibitively expensive for ventures to form investor relationships with corporate firms since the risk of potential expropriation outweighs the benefits of complementary assets (Dushnitsky & Shaver, 2009). Venture companies who are unable to protect their innovation may opt to pursue a competitive strategy, sometimes backed by IVCs, rather than teaming up with a corporate partner (Gans & Stern, 2003). In sum, the prevailing intellectual property regime within a sector should influence the number of ventures seeking corporate backing, which in turn should affect the number of investments made.

H2: Higher ability to protects intellectual property in the firm's sector will increase the number of CVC investments made

2.2 Country level

The geographical environment where the firm is active can affect the decision to engage in CVC investments (Da Gbadji *et al.* , 2015). In this paper, the firm's home market is defined as the country in which they are headquartered. Large firms have the ability to make investments outside of the home market and even set up foreign investment companies, which can reduce the influence of local conditions. Da Gbadji *et al.* (2015) tests the hypothesis that poor local conditions drive international investments but find no significant results. They argue that extra costs from legal, geographical and cultural differences reduces efficiency. There has also been a local bias detected in IVC investments where the ability to obtain sufficient information has been argued as the cause (Cumming & Dai, 2010). The information asymmetry in international venture capital is usually larger than in cross-border M&A transactions, making them harder to execute (Wright *et al.* , 2005). This suggests that the external conditions in the firm's home market should affect its CVC activity.

The innovative environment on the the country level could have a similar effect as the technological change has on the sector level. Even though large firms compete mainly on a global level, they are presented with more investment opportunities if they are active in an innovative environment. Da Gbadji *et al.* (2015) found that firms present in this type of environment are able to capture larger strategic benefits. Gaba & Meyer (2008) examine CVC programs in the IT sector and find that firms are more likely to adopt this practice if they are close to a technological cluster. They argue that information spread throughout the firms in the geographical proximity of the cluster.

Through CVC investments, firms seek to spread the risk by investing in a portfolio of ventures with different technologies (Sahaym *et al.* , 2010). Managing such a portfolio is more efficient if it can be assembled from the geographical proximity of the firm where the cultural and legal boundaries are low, and where the cost of gathering information is limited. Altogether, this implies that firms who are located in a highly innovative environment should be more inclined to pursue CVC investments.

H3: Higher level of innovation output in the firm's home market will increase the number of CVC investment made

Minority protection regulate non-majority investors ability to exert control and the financial rights in portfolio companies and is therefore an important metric in venture capital investments (Garry D. *et al.* , 2005). Improved regulation increase minority investors probability to get a board seat in the company (Cumming *et al.* , 2010). This is an important aspect for IVC and CVC investors alike. However, as previously mentioned, one of the particular benefits of CVC investment is to gain a window into new technologies. Minority control can increase this flow of information and improve the knowledge sharing between firms and ventures. Thus, it should enhance the economic value of the investments made.

The difference in compensation scheme between CVCs and IVCs also play a role with respect to minority protection. Most CVC programs reward their personnel on a fixed rate basis which significantly reduces their incentive to take on risk (Dushnitsky & Shapira, 2010). Gaba & Bhattacharya (2012) highlights that managerial tolerance for risk is one of the determining factors in the firm's decision to engage in CVC investments. Hence, reducing the uncertainty of investments, through increased minority protection, should have a greater positive impact on the investment behaviour of the comparably risk averse corporate investor.

H4: Increased minority protection in the firm's home market will increase the number of CVC investments made

Local bankruptcy law plays an important role in determining the likelihood that R&D personnel become self-employed (Armour & Cumming, 2008). Reducing the burden of a potentially failed venture can result in more personnel who opt to start their own business. This can be tied into the earlier discussion about the trade-off between starting a new venture or remaining employed in a firm. In a favourable environment, it can become harder to retain the personnel with the most promising ideas and CVC investment can become a predominant way of gaining access to their innovations. Favourable conditions for entrepreneurs can also enable firms to spin-off divisions as independent ventures.

H5: More favourable bankruptcy law in the firm's home market will increase the number of CVC investments made

2.3 Firm level

Sahaym *et al.* (2010) highlights that most corporate firms who engage in strategic CVC investments aim to create a portfolio of venture companies. While making their investments, firms learn about the technologies of the target company and its peers and about the venture capital market in general. The industry insights acquired makes it easier to find and evaluate other ventures. Eisenhardt & Martin (2000) emphasize how the repeated practice create dynamic capabilities for this particular activity within the company. Once the decision to start a CVC program has been made, the firm will start to acquire human resources and build the structures needed for this activity. This in itself can create a path-dependence to the practice since it is in the interest of the CVC personnel and the management team responsible to continue the investing activity. After the first investment, the hurdle to make further investments becomes significantly reduced since the required resources are already put in place. Collectively, this suggests that the historical investment activity should have a positive impact on future investment.

Table 1: Proposed hypotheses

Hypothesis	Direction	Result
Sector hypotheses		
H1: Higher level of technological change in the firm's sector will increase the number of CVC investments made	+	
H2: Higher ability to protects intellectual property in the firm's sector will increase the number of CVC investments made	+	
Country hypotheses		
H3: Higher level of innovation output in the firm's home market will increase the number of CVC investment made	+	
H4: Increased minority protection in the firm's home market will increase the number of CVC investments made	+	
H5: More favourable bankruptcy law in the firm's home market will increase the number of CVC investments made	+	
Firm hypotheses		
H6: Higher number of historical investments, making up the current portfolio, will increase the number of CVC investments made	+	
H7: Higher portfolio concentration to the primary sector of the firm will increase the number of CVC investments made	+	

H6: Higher number of historical investments, making up the current portfolio, will increase the number of CVC investments made

Dushnitsky & Lenox (2006) found that firms who invest for strategic reasons generate higher value. This can be explained by the value that knowledge-sharing and complementary assets create. The success of previous investments should make management teams more inclined to continue investments. Gompers & Lerner (1998) find support of the hypothesis that CVC programs with an explicit strategic focus are more stable over time. One measure of strategic focus is the share of investments made into the primary industry. Following this reasoning leads to the final hypothesis that firms with a sector focus will continue to make more CVC investments.

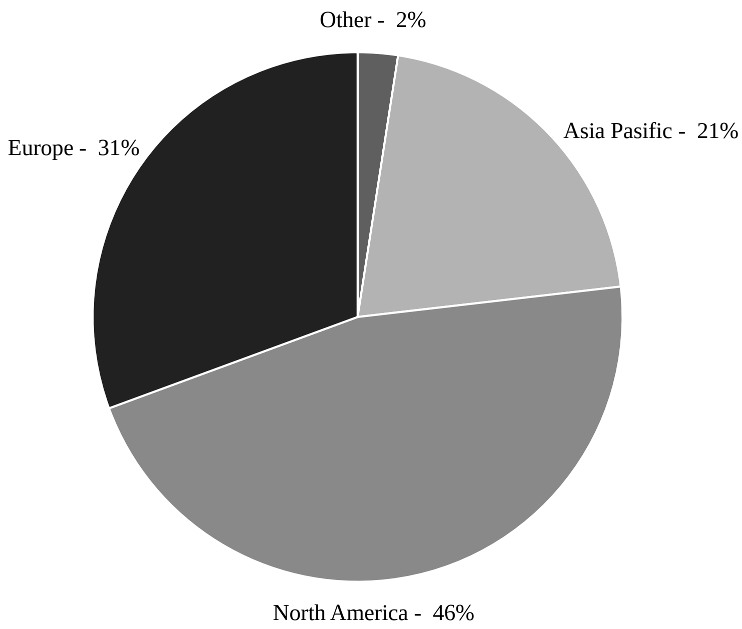
H7: Higher portfolio concentration to the primary industry of the firm will increase the number of CVC investments made

3 Data collection

The firm-sample was constructed from the constituent of the S&P 1200 global index active in the period 2011-2016. This created a longitudinal fixed panel comprised of 941 firms. The S&P 1200 global index include the world's largest public firms and captures about 70% of the global market capitalisation (S&P Dow Jones indices LLC, 2017). Large firms are more likely to engage in CVC investment (Chesbrough, 2002). This does not induce bias to the research if an explicit control for firm size is performed (Basu *et al.* , 2011). Picking a sample where firms are likely to invest in CVC does not mean that the sampling is done on the dependent variable since only about 17% of the sample firms made investments in the time-period (Basu *et al.* , 2011). The sample firms are located in all continents except for Africa. Figure 2 visualise the distribution of the sample firms over regions. It shows that almost half of the firms in the sample are located in North America.

Figure 3 shows that the number of sample firms that made CVC investments are distributed approximately in the same way.

Figure 2: Sample firms, by region (N=941)

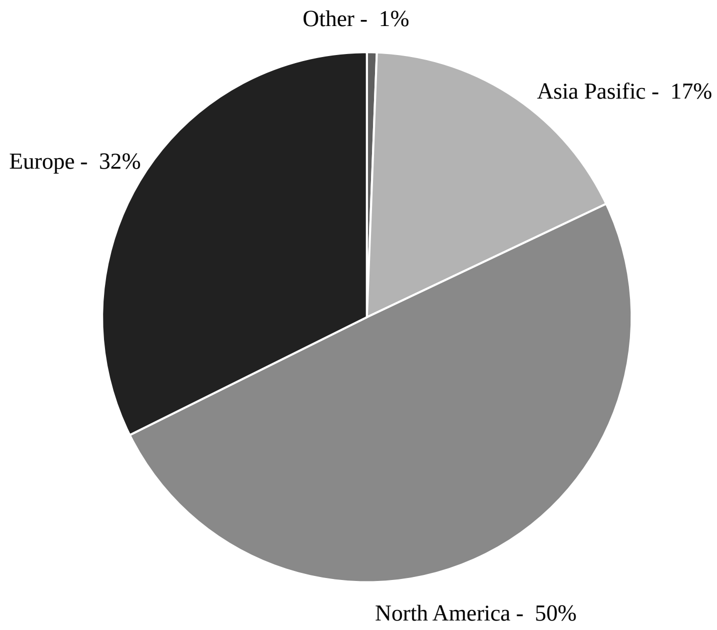


3.1 Dependent variables

The focus of this paper is the investments in venture capital by corporate firms. The primary dependent variable used is the *Number of deals*, which measures the number of CVC investments made yearly. In additional regressions, the variables *Value of deals*, *Average deal size*, *Country deals* and *Sector deals* are used on the dependent side. For a complete variable definition, please refer to Table 2.

Since this paper takes the perspective of CVC investments as strategic R&D, it is the formation of the inter-firm relationship that is of interest. Venture capital investments are generally made in a series of stages but this study limits the observations to the first investment made (Hellmann, 2006). Hellmann (2006) also find that there are several ways to construct a similar contractual relationship using preferred shares, convertible debt or a combination of debt and equity. Since

Figure 3: Sample firms that made CVC investments 2011-2016, by region (N=167)



this matter lies outside the scope of this paper, these is no distinction made between investments classified as equity or debt, although the vast majority of the investments in the data are classified as equity investments.

The data source for CVC investments is the VentureXpert database available through Thompson Reuters. Use of this database has become a common practise in previous studies on corporate venture capital (Dushnitsky & Lenox, 2005a; Gompers & Lerner, 1998; Basu *et al.* , 2011). The data has been collected in collaboration with international venture capital associations (Dushnitsky & Lenox, 2005a). Finding independent data on venture capital is difficult and most research has relied on data supplied by industry organisations (e.g., VentureXpert & VICO dataset) (Colombo & Murtinu, 2017).

The completeness of this data set, especially outside of the US, has been raised as an issue by previous studies (Colombo & Murtinu, 2017; Da Gbadji *et al.* , 2015; Dushnitsky & Lenox, 2005a). It is difficult to assess the completeness of this data without knowing the actual number of investments made. Da Gbadji *et al.* (2015)

attempt to correct for this issue by supplementing the data using membership lists of local venture capital organisations as a proxy for venture capital activity. They find several entities that were not present in the VentureXpert database but they did not establish if these firms actually made investments. Thus, they run the risk of overestimating the importance of CVC investments. In (Da Gbadji *et al.* , 2015), the dependent variable changed for only one of the observations between the two points of measure that were three years apart. It is reasonable to assume that membership status is less volatile than actual investment activity and thus this approach would be less effective in capturing the effects from changing conditions.

This study uses the existing data available in the VentureXpert database to allow for examination of changing condition. However, the data completeness issue should be considered when interpreting the results of this study. The VenturеXpert investment data was matched with the sample firms using the additional data available in Thompson Reuters and 167 investing firms were identified. This represent 17.7% of the sample firms which is in line with (Basu *et al.* , 2011) that found a share of 17% in the US market but lower than the 29% found by Da Gbadji *et al.* (2015). This was an expected result since (Da Gbadji *et al.* , 2015) use a different methodology.

3.2 Sector variables

The sample firms were divided into sectors using the industry classification benchmark (ICB) constructed by FTSE Russel (FTSE Russel, 2017). With the data available in Thompson DataStream, the sample firms were categorised into 10 separate sectors. Henceforth, the terms sector and industry will be used interchangeably to refer to a division of the firms on this particular level. These ICB categories will also be used to create the sector variables.

The variable *Technological change* was created using the methodology of Basu *et al.* (2011). The ratio of R&D expenditure to sales on the sector level is used as a proxy since it is highly correlated to innovation output (Acs & Audretsch, 1988). This industry data was collected from the EU Industrial R&D Investment Scoreboard (European Comission: JRC, 2016). This dataset include yearly information on the world's largest firms. Since this database also use the ICB classification, the firm observations could be mapped to the right sector for this study. Mathematically, the variable was calculated as an observation weighted average of the firms that were mapped to one sector.

The variable that measures the current intellectual property regime on the sector level is called *IPregime*. This variable is constructed using the Carnegie Mellon Survey (CMS) on industrial R&D and measures the ability to protect innovation with patents (Cohen & Klepper, 1996). This measure has been used in several previous studies on CVC investment (Basu *et al.* , 2011; Dushnitsky & Lenox, 2005a). There is a significant risk that the findings of the CMS study could have become obsolete since the survey was administered between 1991 and 1993. Ceccagnoli & Rothaermel (2008) compares the data from the CMS with the previous Yale survey on the same topic conducted by Levin *et al.* (1987) in 1981 and find an overall increase in the ability to protect innovation and some changes between industries. Nevertheless, this measure is included in this study, even though it is problematic, since there is no recent version of this study and, as explained in the theory section, it holds significance to the understanding of the relationship between corporate firms and entrepreneurial ventures. Furthermore, since this variable is time-invariant it will be absorbed by the fixed-effects in most regression models so this issue will not bias the general findings of this study.

Construction of this variable was performed in a two-step process. First, the subsector observations of the CMS study were mapped to the right industry category using the ICB framework (FTSE Russel, 2017). Secondly, the final variable was calculated as the observation weighted average of all the subsectors mapped to one sector. Not all sectors are included in the CMS study and sector data was only available for 663 firm observations.

3.3 Country variables

The country variables used in this study are sub-components of the Global Innovation Index (GII). This index is produced in collaboration between Cornell

University, INSEAD and world intellectual property organisation (Cornell University *et al.* , 2017). The country variables are included to measure how the conditions in the firm's home market affects its investment in CVC. Similarly to (Da Gbadji *et al.* , 2015), this study uses proxies to test the legal regulation and innovation output on the country level.

The first sub-component included is the variable *Patents* that is a relative measure of the patent applications in the country and is used as a proxy of innovative output. The variable *Resolving insolvency* is a relative measure of the prevailing bankruptcy law in the country. The variable measures how easy insolvency can be resolved and the ability for failed entrepreneurs to get out of debt. Finally the variable *Minority protection* was included, which is a relative measure of the protection of minority investors. The country variables from GII are constructed as an index taking on a value between 0-100. (Cornell University *et al.* , 2017).

3.4 Firm variables

The first firm-level variable included is the *Existing portfolio* that measures the influence of the current venture portfolio on additional CVC investments. The positive effect originate from the knowledge-acquisition and structures created by previous investments. The information gained from making an investment will lose its relevance over time. Likewise, the firm's commitment to the investment practice will weaken as time passes from its last investment. Consequently, the influence of historical investments on further acquisitions is expected to shrink over time. An analogues argument can be drawn to the diminishing impact of previous patents on future R&D innovation presented in (Blundell *et al.* , 1995). Accordingly, this study make use of an adjusted version of their formula to calculate this effect:

$$ExistingPortfolio_{it} = NewInvestments_{it} + (1 - \delta) \times ExistingPortfolio_{it-1} \quad (1)$$

The decreasing importance of historical investments are represented by the δ parameter in Formula (1) and adjustment of this parameter changes the speed of reduction. Sahlman (1990) find that the average holding period for venture capitalists is around five years. The positive impact on innovation from CVC investments also disappears after five years (Dushnitsky & Lenox, 2005b). The informational relevance and investment commitment for the firm should be limited beyond this point. Consequently, this study set the parameter to $\delta = 0.5$, which implicitly means that historical investments only have a limited impact on new acquisitions after five years.

Additionally, the variable *Sector Focus* was included as a proxy for strategic focus. This variable was calculated as the fraction of CVC investment that has been made into the same sector as the investing firm. Mathematically, the variable is calculated as the depreciated sum of investments in the primary sector divided by the depreciated sum of all investments using Formula (2).

$$Sectorfocus = \frac{NewSectorInvestments_{it} + (1 - \delta) \times SectorPortfolio_{it-1}}{NewInvestments_{it} + (1 - \delta) \times ExistingPortfolio_{it-1}} \quad (2)$$

To calculate this variable, the deal data was classified into the same sector categories as the sample-firms. The companies in the investment data from VentureXpert are classified into sectors using the Thompson Reuters Business Classification (TRBC). This methodology is very similar to the ICB framework in this study except for one material difference. TRBC uses Consumer cyclical and non-cyclical while ICB distinguishes between consumer services and consumer good. This discrepancy was adjusted manually, using the framework maps of both classifications, before matching the investment data to the sample companies. Both of these firm variables are lagged by one year to reflect the opening value of the year before making any investments.

3.5 Control variables

Several variables were included to control for effects that could bias the result if left unobserved. The purpose of this study is to find the external and internal factors that drive the demand for strategic CVC investments and differentiate it from IVC investments. Basu *et al.* (2011) found that the size of the regular VC market has a positive impact on CVC investments. Firms could make CVC investments simply because of a large supply of opportunities and not for strategic reasons. To adjust for this effect, control variables that regulate the supply of investments on the country and sector level were included. On the country level the variable *Venture capital deals* was included, which is a sub-component of the GII and was calculated in the same way as the independent country variables. On a sector level, the variable *Capital intensity* was included. The capital intensity has been showed to decrease formation of small firms and thus reducing the supply of investments in that sector (Acs & Audretsch, 1988). The capital intensity on the sector level was calculated from the EU Industrial R&D Investment Scoreboard with the same methodology as the *Technological change* variable.

A number of firm-level variables were also included to control for firm specific effects. First, consistent with previous research, the variable *Firm size* was included (Dushnitsky & Lenox, 2005b; Basu *et al.* , 2011; Da Gbadji *et al.* , 2015). The *Firm Size* variable was calculated as the total assets of the firm. Large firms are more inclined to pursue all types of innovation since they can spread the costs throughout their organisations (Cohen & Klepper, 1996). Secondly, the variable *EBITDA* is included as a measure of the firm's ability to make discretionary spending. Building on the pecking order theory, firms are more likely to make investments if they have access to an internally generated cash flow when the information asymmetry is high (Myers & Majluf, 1984). The value of CVC investments are inherently difficult to assess by outside investors making it more expensive to raise debt or equity to finance these investments (Myers & Majluf, 1984). The *EBITDA* variable was calculated as the earnings before interest and taxes plus depreciation and amortisation.

The relationship between internal R&D and CVC investments is somewhat ambiguous. On the one hand, internal R&D can increase the absorptive capacity of external research (Pisano, 1991) and by extension CVC investment. On the other hand, as discussed in Dushnitsky & Lenox (2005b), there is a substitution effect between external and internal R&D since they compete for the firm's limited financial resources. Parallel to Dushnitsky & Lenox (2005b), this study makes use of 3-year historical R&D spending to create a variable that measures the *Absorptive capacity* of individual firms. Firm-level financial data were downloaded from Thompson DataStream and the natural logarithm was taken to correct for the inherent skewness of these measures (Dushnitsky & Lenox, 2005a). In the regression models, the firm-level controls are lagged by one year. A complete variable definition can be found in Table 2.

3.6 Model specification

In this specific area of research, there is no clear consensus on the appropriate model for the regression analysis in order to generate the most relevant results. Dushnitsky & Lenox (2005a) use an OLS regression on the natural logarithm of the amount invested, Da Gbadji *et al.* (2015) use a Probit model to estimate the probability that firms start a CVC program; and Basu *et al.* (2011) fit a negative binomial model on the number of investments made. The primary methodology used in this study is the negative binomial model on the *Number of deals.* This measure is tightly related to strategic R&D since it explains the number of investment relationship the firms establishes. Number of investments also incorporates the fact that an investor making several small deals is more active, in the strategic innovation sense described in the theory, compared to the firm making one large deal. To contrast the findings of this count model, this study provides complementary estimations of the impact on *Value of deals*, *Average deal size* and the number of deals in the sector and country.

With this particular type of investment data, including a significant amount of firms that did not make investments, it is necessary to solve for the "zero value problem" in a OLS log-specification (Hausman *et al.* , 1981). Dushnitsky & Lenox (2005a) accommodates this issue by making the regression on $(1+Valueofdeals)$. This approach was also used in the complementary regressions of this study. The large number of zeros creates a different issue when working with the count data instead, but one that can be solved in a more elegant manner. The large number of zeros cause the data to become overdispersed, meaning that the variance is significantly greater than the mean. This issue effectively precludes the use of the

Table 2: Variable definition

Variable	Definition	Source
Dependent variables		
Number of deals	Yearly number of CVC investments by firm	VentureXpert
Sector deals	Yearly number of CVC investments by firm in the primary sector	VentureXpert
Country deals	Yearly number of CVC investments by firm in the home market	VentureXpert
Value of deals	Log of yearly value of CVC investment by firm (EURk)	VentureXpert
Average deal size	Log of average yearly CVC investment by firm in CVC (EURk)	VentureXpert
Country variables		
Resolving insolvency	Relative measure of bankruptcy law in country (index 0-100)	GII
Patents	Relative measure of patent output in country (index 0-100)	GII
Minority protection	Relative measure of minority protection in country (index 0-100)	GII
Venture capital deals	Relative measure of venture capital market in country (index 0-100)	GII
Sector variables		
IP regime	Relative measure of ability to protect innovation with patents in sector (%)	CMS survey
Technological change	Technological change in sector measured as R&D to sales (%)	EU industrial scoreboard
Capital intensity	Capital intensity in sector measured as CAPEX to sales (%)	EU industrial scoreboard
Firm variables		
Existing portfolio	Depreciated value of historical number of investments, lagged by one year	VentureXpert
Sector focus	Depreciated value of historical number of investments in sector divided by total, lagged by one year	VentureXpert
Total assets	Log of total assets of firms, lagged by one year (EURk)	DataStream
EBITDA	Log of earnings before interest and taxes plus depreciation and amortisation in firm, lagged by one year (EURk)	DataStream
Absorptive capacity	Log of three year average R&D expense in firm, lagged by one year (EURk)	DataStream

ordinary Poisson distribution that is otherwise commonly used to model count data (Lee *et al.* , 2012). The negative binomial model solves the overdispersion issue by allowing the Poisson distribution parameters to vary between firms (Hausman *et al.* , 1981). This model also allows for control of firm-specific effects (Hausman *et al.* , 1981). The overdispersion issue was tested by fitting a negative binomial model and testing the hypothesis that the overdispersion parameter is equal to zero, which would be the case with a Poisson distribution. A likelihood ratio test rejects this hypothesises on the one percent level, reinforcing the belief that the negative binomial model is a more appropriate on this particular data.

In sharp contrast to the separated view on the model specification, the previous literature is unanimous in the choice between random- or fixed-effect on the firm level. Basu *et al.* (2011); Dushnitsky & Lenox (2005a); Da Gbadji *et al.* (2015) make use of the random-effects specification and the motivation goes along similar lines. First, the fixed-effect specification would eliminate all the firms who did not make investments in a negative binomial model (Basu *et al.* , 2011). Secondly, time-invariant variables would be absorbed by a fixed-effect model (Dushnitsky & Lenox, 2005a; Basu *et al.* , 2011). Consequently, the use of a random-effects model makes sense for practical reasons.

The random-effects specification relies on the assumption that the random-effects are not correlated with any of the independent variables (Wooldridge, 2010). If this assumption holds, the random-effects specification is preferred since it produces tighter standard errors (Wooldridge, 2010). However, if this assumption is violated the random-effects model will produce biased estimators (Wooldridge, 2010). The fixed-effect specification will produce unbiased estimations even is this assumption is violated (Wooldridge, 2010). This implies that the estimators would be similar under the assumption that there is no correlation between the random-effects and the independent variable. The hypothesis of similar estimators can be tested by a Hausman specification test (Hausman, 1978). Performing this test on the complete model leads to a rejection on the one percent significance level of this hypothesis. Even though a random-effects specification would be practical on this data, this study use fixed-effects models to reduce the risk of biased estimators.

To allow for comparison to previous studies, a random-effects version of Table 6 is included in Table 18 of the appendix.

4 Results

4.1 Summary statistics

This section provides the summary statistics of the data included in this study. First, we look at the data divided by industries. Figure 4 shows the sample-firms divided by sectors and Figure 5 shows the sector distribution of sample-firms that made investments. The industry allocation is fairly similar. Figure 6 shows the industries that received CVC financing from 2000 to 2016. More than half of the investments in CVC were made into the Telecommunication and Technology sector. Health Care is another industry that have received a significant amount of CVC investment while during the same period there was almost no CVC investments made into Utilities.

The summary statistics in Tables 3, 4 & 5 are divided by firms that invested in the sample-period, firms that invested during the decade before the sample-period but not in the actual sample-period, and firms that did not make CVC investments at all during this time. The independent country variables have the highest mean value in Table 4 among the firms that had made investments before the sample period and lowest among the firms who did not make any CVC investments at all. The *Technological change* variable is as expected higher among the firms that made investments in the sample and these firms are active in industries with a stronger *IP regime* compared to the rest of the sample. The average investing firms made around one deal per year but one firm managed to complete 36 investments. The firms that did not invest are on average smaller, with a lower *EBITDA* and have less *Absorptive capacity*. The *Sector focus* is higher among the firms that invested in the sample-period compared to those that made investments before the sample-period. The pairwise correlation between the variables is available in Table 19 of the appendix.

Figure 4: Sample firms, by sector (N=941)

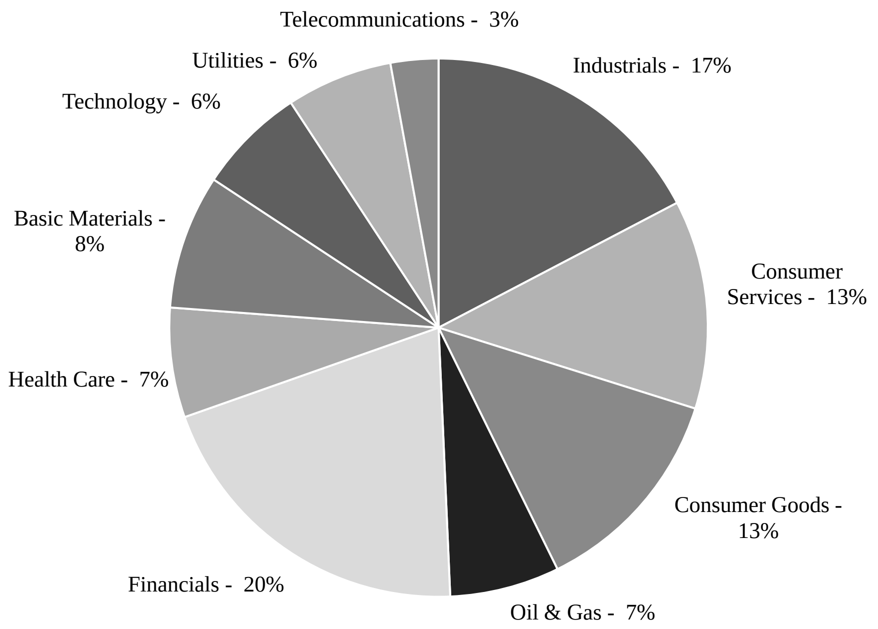


Figure 5: Sample firms that made CVC investments 2011-2016, by sector (N=167)

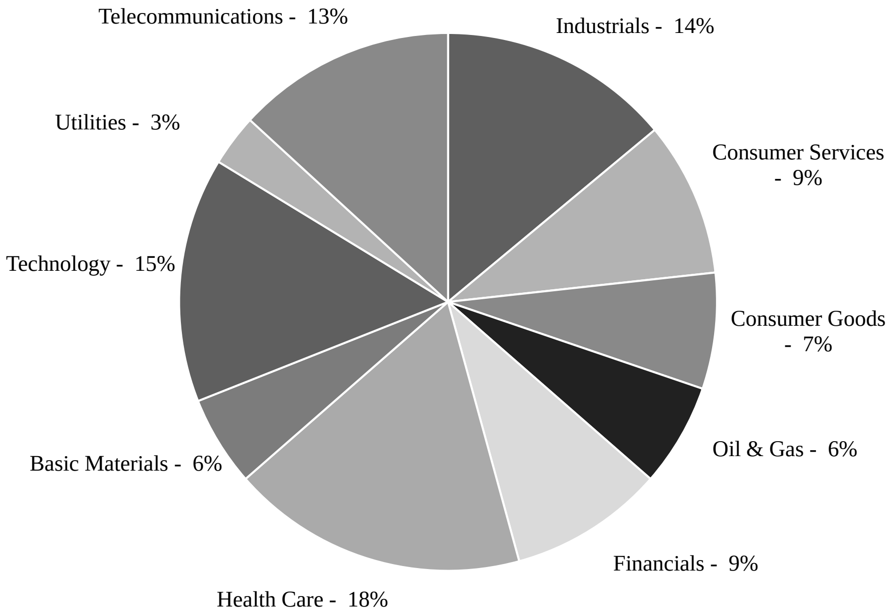


Figure 6: Companies that received CVC investments 2000-2016, by sector (N=9126)

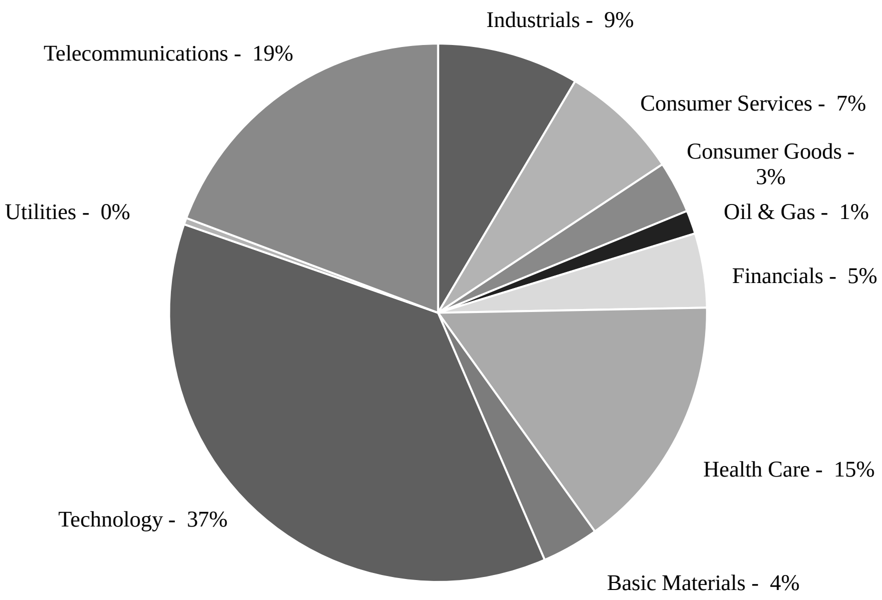


Table 3: Summary statistics of sample firms that made CVC investments during 2011-2016

Variable	Obs	Mean	SD.	Min	Max
Number of CVC deals	1002	1.06	3.14	0.00	36.00
Resolving insolvency	990	85.86	10.21	50.40	98.30
Patents	990	70.99	30.62	9.80	100.00
Minority protection	990	69.30	12.62	30.00	96.70
Technological change	1002	4.70	4.01	0.38	13.12
IP regime	726	32.15	9.91	12.08	44.80
Capital Intensity	1002	5.94	3.57	0.10	14.84
Venture capital deals	990	70.01	32.21	2.60	100.00
Existing portfolio	1002	1.75	5.32	0.00	57.83
Sector focus	761	0.40	0.42	0.00	1.00
Total assets	1002	17.34	1.23	14.14	21.19
EBITDA	976	15.10	1.17	11.07	17.73
Absorptive capacity	1002	8.98	6.32	0.00	16.08

Table 4: Summary statistics of sample firms that made CVC investments during 2000-2010, but not 2011-2016

Variable	Obs	Mean	SD.	Min	Max
Number of CVC deals	240	0.00	0.00	0.00	0.00
Resolving insolvency	240	87.07	8.46	50.40	98.30
Patents	240	78.18	24.21	9.80	100.00
Minority protection	240	70.65	11.69	30.00	86.70
Technological change	240	3.86	3.26	0.38	13.12
IP regime	186	29.71	9.65	12.08	44.80
Capital Intensity	240	5.70	3.18	0.10	14.84
Venture capital deals	240	73.78	30.23	2.60	100.00
Existing portfolio	240	0.03	0.09	0.00	0.79
Sector focus	240	0.30	0.41	0.00	1.00
Total assets	240	17.01	1.18	14.05	19.18
EBITDA	237	14.78	1.05	12.38	17.13
Absorptive capacity	240	9.58	6.04	0.00	15.39

Table 5: Summary statistics of sample firms that did not make CVC investments during 2000-2016

Variable	Obs	Mean	SD.	Min	Max
Number of CVC deals	4404	0.00	0.00	0.00	0.00
Resolving insolvency	4356	84.81	12.66	17.70	98.30
Patents	4356	66.74	33.10	0.40	100.00
Minority protection	4356	70.08	12.25	30.00	96.7
Technological change	4404	2.86	2.54	0.38	13.12
IP regime	3066	29.87	9.95	12.08	44.80
Capital Intensity	4404	4.88	3.03	0.10	14.84
Venture capital deals	4352	67.34	33.64	0.10	100.00
Existing portfolio	4404	0.00	0.00	0.00	0.00
Sector focus	0	0.00	0.00	0.00	0.00
Total assets	4403	16.77	1.51	13.49	21.87
EBITDA	4246	14.27	1.06	9.47	18.17
Absorptive capacity	4404	5.41	5.93	0.00	15.86

Table 6: Cond. firm-fixed-effect negative binomial reg.; DV: Number of Deals

	H	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE
Resolving insolvency	+	0.0320**			0.0323**	0.0277*
		(0.0104)			(0.0105)	(0.0110)
Patents	+	0.0010			0.0013	0.0018
		(0.0038)			(0.0038)	(0.0037)
Minority protection	+	-0.0070			-0.0062	-0.0040
		(0.0072)			(0.0071)	(0.0072)
Technological change	+		0.1369*		0.1381	0.0812
			(0.0583)		(0.0706)	(0.0865)
Capital intensity			0.0319		0.0272	-0.0501
			(0.0564)		(0.0592)	(0.0661)
Venture capital deals		0.0069			0.0074	0.0092*
		(0.0041)			(0.0042)	(0.0044)
Total assets		0.1699	0.2639	-0.0158	0.2892	0.0146
		(0.2127)	(0.2067)	(0.2389)	(0.2212)	(0.2639)
EBITDA		-0.0357	0.0078	-0.0634	-0.0181	-0.0784
		(0.1500)	(0.1495)	(0.1608)	(0.1483)	(0.1622)
Absorptive capacity		-0.0277	-0.0722	-0.0308	-0.0618	-0.0497
		(0.0440)	(0.0467)	(0.0503)	(0.0511)	(0.0614)
Existing portfolio	+			0.0026	-0.0167	-0.0096
				(0.0096)	(0.0105)	(0.0101)
Sector focus	+			-0.0012		-0.1265
				(0.3408)		(0.3483)
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		734	739	586	734	586
Standard error		oim	oim	oim	oim	oim
Wald χ^2 test		34.50***	24.84**	6.87	39.47***	24.78
Log likelihood		-604.13	-613.86	-527.93	-601.60	-519.35
Degrees of fdm.		12	10	10	15	16

Standard errors in parentheses

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

4.2 Main regressions

In Table 6, the first regression results with *Number of deals* as the dependent variable are presented. If not explicitly stated otherwise, the model specifications are firm-fixed-effects. Year dummies are included in all regression to control for time specific effects, but coefficients are not reported in the tables. The constant is also suppressed for presentation purposes.

In Model (1) of Table 6, the independent country variables together with control variables are included. The only significant variable is *Resolving insolvency* and this variable retains its significance throughout all of the regression models. The country variables are the sub-components of the same country index and the correlation matrix in Table 19 indicate that there is significant correlation between these variables. Two robustness tests were performed to ensure that multicollinearity is not an issue in the regressions. First, a test of the Variance Inflation Factor (VIF) was conducted resulting in values below 2 for the all country variables. Secondly, including the variables separately did not give significance to any other variable except for the control variable *Venture capital deals*.

In Model (2) of Table 6, the sector variables are tested on the dependent variable *Number of deals*. The variable *Technological change* is estimated to have a significant positive effect on the number of CVC investments by firms. The variable *IP regime* is dropped from the regression since it is time-invariant. [1] The variables *IP regime* is only included when interacted with other variables. From the limited analyses made, there is no support to the significance of *IP regime* on the number of CVC investments made.

In Model (3) of Table 6, the firm-level portfolio variables are tested. None of these two variables proves to have a significant effect on the number of CVC investments made. Although not presented here, these variables were also included separately yielding the same result. The Wald χ^2 test of the model coefficients

[1] The estimation of a conditional fixed-effect negative binomial model does not automatically remove time-invariant variables from the regression since the estimation relies on a specific relationship between the fixed-effects and the overdispersion parameter. However, this model specification is preferred in this case because of computational benefits. The regression estimates using conditional fixed-effects relies on assumptions in (Hausman *et al.* , 1981). Further deliberation on this topic can be found in the papers of Guimarães (2008) and Allison & Waterman (2002).

does not reject the null hypothesis that all included variables are equal to zero.

In Model (4) & (5) of Table 6, two versions of the complete model are tested, with the difference being the inclusion of the variable *Sector focus*. The result of the hypothesised variables are economically similar in both of these models. The main difference is that including *Sector focus* reduces the sample size significantly. In contrast to Model (2), the variable *Technological change* is no longer significant on the 5% significance level in Model (4) [P-value 0.051]. The Wald χ^2 test of the model is significant in Model (4) but not in Model (5), probably due to the reduction of the sample. Hence, in the interaction specifications of Model (6) to (15), the variable *Sector focus* is dropped unless it is interacted with another variable.

In Table 7 the interaction models between the *Existing portfolio* and country variables are presented. The firm-level control variables are excluded from the tables for presentation purposes. The interesting result is found in Model (7), where *Minority protection* is interacted with *Existing portfolio*. The firm's *Existing portfolio* has a statistically negative effect on the number of investments made, but this effect is reduced for firms who operate in countries with a strong *Minority protection*. In this specification, we also find support of the positive impact from *Technological change*.

Table 8 presents the interactions between the independent variables and the sector variable *Technological change*. There is further support of the positive impact of *Technological change* on CVC investment in these specifications. Model (11) indicate that the positive impact of *Technological change* is reduced among firms who already have a high value of the *Existing portfolio*. Model (15) show that there is a similar negative interaction effect of having a high *Sector focus* in rapidly changing technological environments.

Table 9 presents the results of regression models with the dependent variable *Country deals* that only includes investments made in the firms' home market. The results are almost identical to the regressions on the total sample of investments. The same hypothesised variables are significant and in the same direction.

Further exploration of CVC investments is done by testing the independent

Table 7: Cond. firm-fixed-effect negative binomial reg.; DV: Number of Deals

	H	(6) FE	(7) FE	(8) FE	(9) FE	(10) FE
Resolving insolvency	+	0.032**	0.037***	0.044***	0.032**	0.036*
		(0.010)	(0.011)	(0.012)	(0.010)	(0.014)
Patents	+	0.001	0.001	0.001	0.001	0.002
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Minority protection	+	-0.006	-0.013	-0.009	-0.006	-0.003
		(0.007)	(0.008)	(0.007)	(0.007)	(0.008)
Technological change	+	0.138	0.161*	0.135	0.138	-0.006
		(0.071)	(0.072)	(0.071)	(0.071)	(0.206)
Existing portfolio	+	-0.017	-0.090***	0.286	-0.024	-0.035
		(0.010)	(0.027)	(0.154)	(0.039)	(0.095)
Capital intensity		0.027	0.030	0.044	0.026	-0.068
		(0.059)	(0.058)	(0.062)	(0.059)	(0.118)
Venture capital deals		0.007	0.007	0.007	0.007	0.005
		(0.004)	(0.004)	(0.004)	(0.004)	(0.006)
Existing port. X Minority prot.	+		0.001**			
			(0.000)			
Existing port. X Resolving ins.	+			-0.003		
				(0.002)		
Existing port. X Patents	+				0.000	
					(0.000)	
Existing port. X IP regime	+					0.000
						(0.003)
Firm controls [a]		Yes	Yes	Yes	Yes	Yes
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		734	734	734	734	552
Standard error		oim	oim	oim	oim	oim
Wald χ^2 test		39.47***	48.51***	42.11***	39.41***	30.73*
Log likelihood		-601.60	-597.52	-599.83	-601.58	-439.52
Degrees of fdm.		15	16	16	16	16

[a]Firm controls include: Total assets, EBITDA & Aborptive capacity

Standard errors in parentheses

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

Table 8: Cond. firm-fixed-effect negative binomial reg.; DV: Number of Deals

	H	(11) FE	(12) FE	(13) FE	(14) FE	(15) FE
Resolving insolvency	+	0.032** (0.010)	0.033** (0.010)	0.033* (0.015)	0.031** (0.010)	0.027* (0.011)
Patents	+	0.001 (0.004)	-0.004 (0.006)	0.001 (0.004)	0.001 (0.004)	0.003 (0.004)
Minority protection	+	-0.008 (0.007)	-0.006 (0.007)	-0.006 (0.007)	0.008 (0.010)	-0.005 (0.007)
Technological change	+	0.164* (0.073)	0.073 (0.092)	0.142 (0.167)	0.286** (0.106)	0.261* (0.115)
Existing portfolio	+	0.061 (0.039)	-0.019 (0.011)	-0.017 (0.011)	-0.020 (0.011)	-0.011 (0.010)
Sector focus	+					0.850 (0.552)
Capital intensity		-0.003 (0.060)	0.018 (0.060)	0.027 (0.059)	0.028 (0.060)	-0.035 (0.064)
Venture capital deals		0.008 (0.004)	0.008 (0.004)	0.007 (0.004)	0.008 (0.004)	0.008 (0.004)
Technological chg. X Existing portfolio	+	-0.008* (0.004)				
Technological chg. X Patents	+		0.001 (0.001)			
Technological chg. X Resolving insolvency	+			-0.000 (0.002)		
Technological chg. X Minority protection	+				-0.002 (0.001)	
Technological chg. X Sector focus	+					-0.207* (0.090)
Firm controls [a]		Yes	Yes	Yes	Yes	Yes
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		734	734	734	734	586
Standard error		oim	oim	oim	oim	oim
Wald χ^2 test		44.97***	40.60***	39.46***	42.38***	30.67*
Log likelihood		-599.55	-600.94	-601.60	-599.87	-516.73
Degrees of fdm.		16	16	16	16	17

[a]Firm controls include: Total assets, EBITDA & Aborptive capacity

Standard errors in parentheses

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

variables against *Sector deals* in Table 10. This dependent variable only includes CVC investments that are made into the primary sector of the firm. In these specifications the variable *Sector portfolio* is included that is constructed in the same way as *Existing portfolio*, but only includes previous investments in the primary sector. These two portfolio variables were included separately due to strong multicollinearity. Contrary to prediction, the result of this model shows that a higher concentration of the portfolio to the primary sector leads to fewer investments in that sector. Model (19) indicate that there is also the same negative effect from the absolute value of *Sector portfolio*.

4.3 Additional analysis and robustness control

To extend on the previous analysis and to test the robustness of the findings, several additional analyses were performed that can be found in the appendix of this thesis. In this section, the main results from these analyses are presented. First, in Tables 12, 13 & 14, the main regression specifications were tested on the *Value of deals* instead of the *Number of deals*. This is done through a panel OLS regression with firms fixed-effects. The results confirms the previous finding that *Resolving insolvency* has a positive effect also on the amount invested in CVC.

Additionally, the same models were tested on the dependent variable *Average deal* in Table 15, 16 & 17. There is no support found that any of the independent variables have a significant effect on the *Average deal* size. However, there is a significant positive effect from the control variable *Absorptive capacity* on the *Average deal*. Please note that the sample size was significantly reduced in these models since only the firm-year observations where firms made investments are included.

As briefly mentioned before, the conditional fixed-effects negative binomial model has been criticized for not being a true fixed-effects model since it would be possible to estimate a coefficient for a time-invariant independent variable. To check the robustness of the regression analysis, the suggested solution in (Allison & Waterman, 2002) was implemented. First, a Poisson model was estimated that do not have the same shortcoming with respect to the fixed-effects specification. Sec-

Table 9: Cond. firm-fixed-effect negative binomial reg; DV: Country deals

	H	(16) FE	(17) FE	(18) FE	(19) FE	(20) RE
Resolving insolvency	+	0.0359*			0.0364*	0.0449*
		(0.0167)			(0.0170)	(0.0195)
Patents	+	0.0003			0.0017	0.0003
		(0.0057)			(0.0058)	(0.0059)
Minority protection	+	-0.0130			-0.0129	-0.0147
		(0.0103)			(0.0107)	(0.0115)
Technological change	+		0.1748*		0.1364	-0.0852
			(0.0857)		(0.1191)	(0.1627)
Capital Intencity			0.0705		0.0841	-0.0788
			(0.0778)		(0.0881)	(0.1110)
Venture capital deals		0.0143*			0.0138	0.0158*
		(0.0066)			(0.0071)	(0.0077)
Total assets		0.3813	0.4543	0.2776	0.4684	0.2412
		(0.2912)	(0.2760)	(0.3642)	(0.3011)	(0.3895)
EBITDA		-0.0742	-0.0215	-0.2391	-0.0430	-0.2933
		(0.2163)	(0.2173)	(0.2201)	(0.2131)	(0.2165)
Absorptive capacity		-0.1360	-0.1738*	-0.0711	-0.1593*	-0.0241
		(0.0735)	(0.0724)	(0.0730)	(0.0808)	(0.0835)
Existing portfolio	+			-0.0005	-0.0155	-0.0081
				(0.0128)	(0.0135)	(0.0123)
Sector focus	+			-0.2715		-0.3944
				(0.5079)		(0.4907)
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		508	508	405	508	405
Standard error		oim	oim	oim	oim	oim
Wald χ^2 test		30.40**	21.68*	8.23	32.32**	23.90
Log likelihood		-356.36	-361.51	-306.44	-355.06	-298.73
Degrees of fdm.		12	10	10	15	16

Standard errors in parentheses

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

Table 10: Cond. firm-fixed-effect negative binomial reg; DV: Sector deals

	H	(21) FE	(22) FE	(23) FE	(24) FE
Resolving insolvency	+			0.0428** (0.0145)	0.0463** (0.0149)
Patents	+			0.0009 (0.0046)	0.0019 (0.0039)
Minority protection	+			-0.0087 (0.0098)	-0.0087 (0.0086)
Technological change	+			-0.1091 (0.2151)	-0.1567 (0.1719)
Captial intensity				0.0707 (0.1488)	0.1401 (0.1382)
Venture capital deals				0.0108 (0.0060)	0.0121* (0.0058)
Total assets		-0.1794 (0.3807)	-0.2762 (0.3860)	0.0526 (0.3426)	0.1141 (0.3520)
EBITDA		-0.3434 (0.1970)	-0.3520 (0.1969)	-0.1171 (0.2129)	-0.1488 (0.1898)
Absorptive capacity		0.0651 (0.1653)	0.0412 (0.1801)	0.1495 (0.1395)	0.1524 (0.1452)
Existing portfolio	+	-0.0069 (0.0087)		-0.0195 (0.0128)	
Sector focus	+	-2.1648*** (0.4767)	-2.1555*** (0.4892)		
Sector portfolio	+		-0.0006 (0.0135)		-0.0360** (0.0136)
Year dummies		Yes	Yes	Yes	Yes
Number of obs		377	377	450	450
Standard error		oim	oim	oim	oim
Wald χ^2 test		34.89***	34.63***	30.14*	38.62***
Log likelihood		-266.36	-266.67	-307.72	-305.63
Degrees of fdm.		10	10	15	15

Standard errors in parentheses

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

ondly, the overdispersion issue was corrected manually by adjusting the standard errors upwards with the square root of the ratio between the goodness-of-fit and the degrees of freedom. This test confirmed the result that *Resolving insolvency* has a positive effect on the number of CVC investments made.

However, it raised doubt about the sector variables. The sector variables *Technological change* and *Capital intensity* were significant on the 5-percent level in the opposite direction to the predicted one, even after adjusting the standard errors. The other variables remained insignificant in this specification.

Moreover, this particular data contains several companies that made zero investments, although there is probably large differences in the inclination to pursue CVC investments among these firms. A zero inflated model was considered, but deemed inappropriate, since it assumes two separate data generating processes. There is no fundamental reason that a separate zero-generating process would exist in this case.

Basu *et al.* (2011) fit a Tobit regression on the amount invested that corrects for the lower-limit censoring. The Tobit model does not allow for a fixed-effects specification, and thus it is difficult to make comparisons in this case since we previously found that the estimators are not consistent under a random-effects specification. To check if censoring in general is an issue with the current data, a random-effects OLS panel regression was compared to a random effect panel Tobit regression on the complete model of *Value of deals*. The significance levels and direction of the coefficients were the same in both regressions. In the Tobit model, both the estimated coefficient and the standard errors were inflated, which is a common difference between Tobit and OLS regressions (Wooldridge, 2010).

Additionally, Da Gbadji *et al.* (2015) suggest that there could be a difference between CVC programs with a financial or a corporate parent organisation. The main regressions were performed with financial firms excluded, which yielded the same significant coefficients. This finding is in line with the result of (Hellmann *et al.* , 2008; Da Gbadji *et al.* , 2015), that there is no significant difference since banks also invest with strategic objectives.

Table 11: Results of hypotheses

Hypothesis	Direction	Result
Sector hypotheses		
H1: Higher level of technological change in the firm's sector will increase the number of CVC investments made	+	Partial support
H2: Higher ability to protects intellectual property in the firm's sector will increase the number of CVC investments made	+	Rejected
Country hypotheses		
H3: Higher level of innovation output in the firm's home market will increase the number of CVC investment made	+	Rejected
H4: Increased minority protection in the firm's home market will increase the number of CVC investments made	+	Rejected
H5: More favourable bankruptcy law in the firm's home market will increase the number of CVC investments made	+	Strong support
Firm hypotheses		
H6: Higher number of historical investments, making up the current portfolio, will increase the number of CVC investments made	+	Rejected
H7: Higher portfolio concentration to the primary sector of the firm will increase the number of CVC investments made	+	Rejected

5 Discussion

In this section, the results presented in the previous section are analysed and compared to the existing literature. Table 11 summarise the result of the analysis section. This discussion will naturally lead towards the conclusions of this study and towards identification of areas for further research.

5.1 Sector analysis

In the theory section, two main hypotheses were proposed about the sector specific variables. First, that *Technological change* has a positive impact on the number of CVC investments made. There is partial support for this hypothesis in the main regressions on *Number of deals*. In the additional regressions on *Value of deals*, the *Technological change* variable is not significant. Basu *et al.* (2011) found that technological change has a positive impact on the number of investments made in the US market. However, this difference could be the result of the model specification since the same result can be found in the random-effects regressions in Table 18 of this paper. *Technological change* has no positive effect on the number of CVC investments made into the primary sector.

The regression analysis also raises questions about the efficacy of *Capital intensity* as a control variable. This variable is not significant in the negative direction as expected. In the random-effects specification in the appendix, it is actually significant in a positive direction. The same result was found in (Basu *et al.* , 2011), although it was never discussed. The theory in (Acs & Audretsch, 1988) suggest that small firms in capital intense sectors are less likely to form due to the capital amount required. However, the variable *Capital intensity* is measured at the sample-firm level even though the variable affects the number of entrepreneurial ventures in the sector. The summary statistics reveal that only 30% to 40% of CVC investment go into the primary sector. Thus, it is quite possible that firms in capital intense industries search for innovation outside their primary industry when the supply of entrepreneurial firms in their own sector is low.

The number of investments outside the primary sector could also be a result of the current intellectual property regime in the sector. Dushnitsky & Shaver (2009) found that when the ability to protect intellectual property is low, firms are more likely to invest outside the primary sector. This was the second hypothesis that a strong *IP regime* will drive CVC investments. Since this paper,contrary to previous studies, mainly use models with fixed-effects, the time-invariant variable *IP regime* is dropped from the majority of the regressions. Thus, it is hard to evaluate the influence of this variable on CVC investments since it is a part of the fixed-effects. Even if an analysis was possible, the outdated nature of this dataset would have made it treacherous to make any decisive conclusions. Another variable that has been assumed to be time-invariant is the importance of complementary assets in specific industries, which should impact CVC investments in the opposite direction (Dushnitsky & Lenox, 2005a). If these two variables are truly time-invariant, then they are both captured by the fixed-effects in this study.

The theoretical foundation suggest that *Technological change*, and other sector variable, can affect both the supply of venture companies and the investment demand from firms in the same sector simultaneously. This relationship is further complicated since the majority of investments are made outside the primary sector. From the summary statistics we found that the investing sample-firms were spread over several sectors while a majority of the CVC investments were received by companies in the *Technology* and *Telecommunications* sector. This suggests that firms in other industries make some of the investments into these sectors.

The number of investments could then be driven by the sector variable in either the investing or receiving sector. The variable *Technological change* has a positive impact on *Number of deals* but not on the number of deals in the sector. This indicate that the positive effect arises from the affect on the investing firm. Nevertheless, when investments are affected by factors in several industries at once, it becomes hard to interpret the effect and to distinguish the effects from IVC. An interesting topic for further research would be to investigate the interaction between CVC investors and entrepreneurs in different sectors thoroughly. A comprehensive understanding of this relationship would facilitate the investigation of the sector variables that affect CVC investments.

In sum, it is hard to determine the effects from the sector variables conclusively. There is some indication that *Technological change* has a positive effect on CVC investments. The lack of an efficient control variable makes it hard to distinguish this potential positive effect from IVC. The robustness checks in a previous section introduce further ambiguity to this variable.

5.2 Country analysis

The hypotheses formed in the theory section partly relies on a home market bias or otherwise the local conditions would become insignificant. Figure 7 in the appendix shows the number of national investments and the number of transactions that are classified as cross-border investments. The strict definition of cross-border investments in this paper is the number of investments that are made outside the firm's home market even if they are made by a local subsidiary. The share of national investments has fluctuated between 50% to 60% of the total investments. This suggest that the home market conditions should have a significant impact on CVC investments. The regression analysis on total investments and investments made in the firms' home market yielded the same economic result.

Regarding the conditions in the firms' home market there were three different hypotheses derived from the existing literature in the theory section. Table 11 show that two of these hypotheses were rejected after the analysis. There is no evidence that the variable *Patents* has a significant impact on the number of CVC investments made. This implies that there is no positive effect from proximity to technological invention or from the cluster-effect, in excess of the regular venture capital market.

Furthermore, there is no support that *Minority protection* in the firm's home market affect the number of CVC investments made, at least not individually. *Minority protection* interacted with the variable *Existing portfolio* is found to have a positive effect on the number of investments made. Thus, *Minority protection* proves to be important for firms with a large existing portfolio. This finding is in line with the predicted result from the theory. The positive effect from *Existing portfolio* partly originate from the knowledge from portfolio companies that can be used for further investments. This constructive flow of information is enhanced if the firm is present in a country with a strong *Minority protection*. Thus, there is a fundamental explanation for this interaction effect.

There is strong evidence that the local bankruptcy law has a positive effect on the number of investments made, even after controlling for the IVC market in the country. The variable *Resolving insolvency* is found to have a significant positive effect on both the *Number of deals* and *Value of deals*. This confirms the finding in Da Gbadji *et al.* (2015) that local bankruptcy law is significant in determining the CVC activity. The fundamental explanation for this positive effect originates in the number of skilled R&D personnel who opt to start their own business under favourable bankruptcy conditions. Since this is mainly a supply effect, the increasing size of the market should be captured by the control variable *Venture capital deals*. There are two reason why this variation could be separate from IVC.

First, the changing bankruptcy law does not only affect the size of the venture market but also the quality. When the cost of failure is high, only the R&D personnel who cannot find employment will opt to start their own business. Conversely, when the cost of failure is low, more of the skilled personnel will also become entrepreneurs. Under this condition, firms can find it difficult to retain their personnel and will be pushed towards CVC to find innovation.

Secondly, established firms sometimes encourage entrepreneurial behaviour by spinning-off their own divisions into venture companies to spur innovation (Sykes, 1990). In this case, the firm becomes a venture capital investor from the start. This action will only be possible if the R&D personnel is willing to accept the risk of entrepreneurship. This risk is reduced under a favourable bankruptcy law.

5.3 Firm analysis

Table 11 shows that neither of the firm variables *Existing portfolio* or *Sector focus* are significant in the positive direction in the main regressions. One model indicate a negative effect from the *Existing portfolio* that is mitigated by the level of *Minority protection*. There is no support that *Sector focus* increases the number of CVC investments and including this variable in the regressions reduces the significance of the model, probably an effect of reduced observations. Basu *et al.* (2011) found a weak positive effect from the investment history on the number of new investments made. They calculate this variable somewhat differently but the results herein does not support their finding.

The most prominent result regarding the portfolio variables can be found in the regressions with the dependent variable *Sector deals*. Rather than the expected positive effect, the analysis shows a significant negative effect on new CVC investments from both the *Sector focus* and *Sector portfolio*. The summary statistics revealed that there was a large number of investments between sectors. The result here suggest that firms are actively diversifying away from the primary sector. Sahaym *et al.* (2010) found that firms use CVC to spread their risk over a portfolio of technologies. Investing outside of the primary sector could be a way of further spreading the innovative risk. This could also be explained by the result in (Klevorick *et al.* , 1995) that several firms find innovation outside of their primary sector. Thus, diversification can be a third possible explanation for the large number of investments outside the primary sector.

There is also one striking result from the control variable *Absorptive capacity* on the firm level. In the regression with the dependent variable *Average deal size*, there is a strong positive effect from the absorptive capacity, which is measured as the 3 year average R&D expense. This is some support that R&D expenditure is complementary to CVC investments.

6 Conclusions

This paper provides further understanding of the external and internal factors that affect firms' strategic investment in CVC. The strategic objective is found to be the main distinguishing factor between CVC and IVC. This study questions the adequacy of the random-effects methodology of previous studies and use a fixed-effects methodology for the analysis. This raises doubt about the positive effects from the technological change in the sector and the investment history of the firm found in (Basu *et al.* , 2011).

The sector analysis reveal a complex relationship between the investing firms and the entrepreneurial ventures. Sector conditions can affect both the portfolio firm and the venture company simultaneously. Increased understanding of this inter-firm relationship is required to determine the effect of external factors clearly. The sector variables have a further dubious effect on CVC investments since a majority of the investments are made outside the primary sector. The investments across sectors could be a result of the supply of ventures in different sectors or that the fear of expropriation limits the number of potential investment opportunities. The investments over several sectors suggest that the significance of complementary assets is limited, at least under the sector specific definition.

The cross-sector investments could also be driven by risk mitigation, since the analysis shows that firms tend to diversify away from the primary sector. Thus, sector focus of the portfolio proves to be a weak indicator of the firms' strategic approach to CVC investments. The hypothesis that the existing portfolio would have a positive impact on the number of CVC investments was also rejected. Analysis of the average deal size shows that historical R&D expenditure increases the size of CVC investments.

The majority of the CVC investments were made in the firms' home market suggesting that there is a strong local bias. This implies that the country variables should be comparably more important than the sector variables. This study confirms the finding in (Da Gbadji *et al.* , 2015) that a favourable bankruptcy law within the country increases the number of CVC investments made, even after controlling for the size of the local venture capital market. The proposed explanation for this effect is the improved conditions for entrepreneurship it creates. This enable firms to spin-off divisions into venture companies and enhances the quality of the venture pool. The hypotheses that a strong minority protection or high level of innovative output would have a positive impact on CVC investments were rejected. Analysis of data including only national investments reveal the same economic results as the overall regressions.

The implications of the results are twofold. First, it highlights the importance of local bankruptcy law for innovation. Improving the legal environment does not only improve entrepreneurial conditions but also the innovative opportunities for established firms through CVC. For entrepreneurial companies it appears to be possible to get financing from firms in several sectors. The analysis shows that firms actually prefer to limit their CVC exposure to the primary sector. Thus, ventures companies that search with broader industry approach can increase their probability to find financing.

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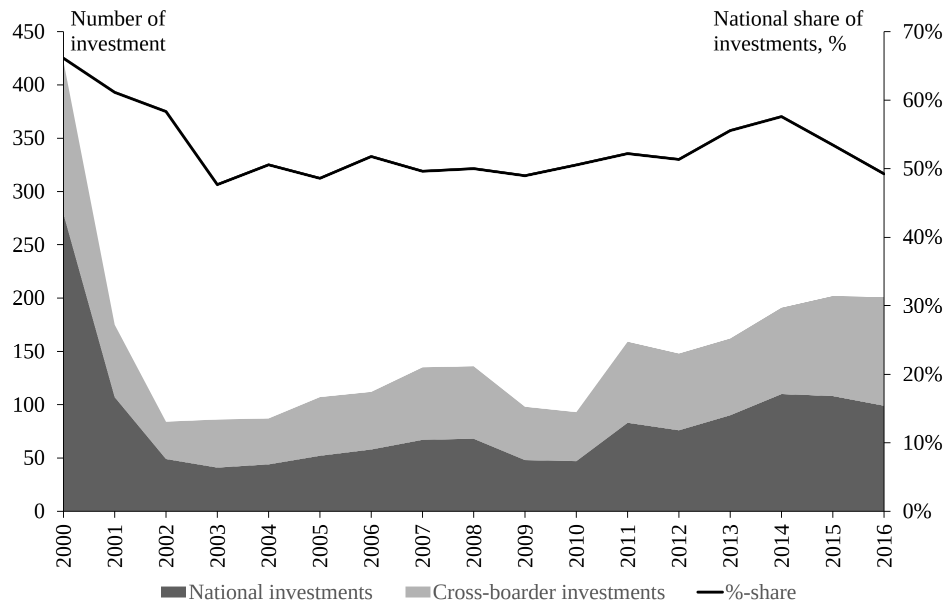
A Appendix

A.1 Figures

Figure 7: Number of national investments made by sample-firms and the share of total investments



The data includes investments made by sample-firms. Cross-border investments includes all investments outside the firms home market even if it is done by a local subsidiary.

A.2 Tables

Table 12: Firm-fixed-effects (within) regression; DV: Value of deals

	H	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE
Resolving insolvency	+	0.0162** (0.0056)			0.0159** (0.0055)	0.0750* (0.0331)
Patents	+	-0.0011 (0.0017)			-0.0011 (0.0017)	-0.0066 (0.0077)
Minority protection	+	-0.0022 (0.0042)			-0.0021 (0.0041)	-0.0153 (0.0188)
Technological change	+		-0.0340 (0.1176)		-0.0466 (0.1176)	-0.6530 (0.3764)
Capital Intensity			0.0300 (0.0438)		0.0210 (0.0436)	0.0709 (0.1961)
Venture capital deals		0.0026 (0.0022)			0.0026 (0.0022)	0.0122 (0.0125)
Existing portfolio	+			0.0370 (0.0421)	0.0791 (0.0548)	0.0434 (0.0431)
Sector focus	+			0.0963 (1.0127)		0.1641 (1.0191)
Total assets		0.1319 (0.1383)	0.1593 (0.1408)	0.9016 (0.7224)	0.1068 (0.1326)	0.7022 (0.7182)
EBITDA		-0.0087 (0.0602)	0.0050 (0.0593)	-0.2390 (0.3787)	-0.0107 (0.0599)	-0.3586 (0.3975)
Absorptive capacity		-0.0167 (0.0212)	-0.0156 (0.0207)	-0.0470 (0.0906)	-0.0179 (0.0210)	-0.0248 (0.0997)
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		5396	5459	980	5396	979
Standard error		cluster	cluster	cluster	cluster	cluster
R-squared		0.007	0.003	0.009	0.009	0.030
F-test		1.546	1.214	0.851	1.319	1.510

Standard errors in parentheses

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

Table 13: Firm-fixed-effects (within) regression; DV: Value of deals

	H	(6) FE	(7) FE	(8) FE	(9) FE	(10) FE
Resolving insolvency	+	0.0159** (0.0055)	0.0159** (0.0055)	0.0144** (0.0054)	0.0159** (0.0055)	0.0161* (0.0074)
Patents	+	-0.0011 (0.0017)	-0.0011 (0.0017)	-0.0009 (0.0017)	-0.0012 (0.0017)	0.0003 (0.0020)
Minority protection	+	-0.0021 (0.0041)	-0.0021 (0.0041)	-0.0013 (0.0041)	-0.0021 (0.0041)	-0.0021 (0.0052)
Technological change	+	-0.0466 (0.1176)	-0.0474 (0.1182)	-0.0490 (0.1171)	-0.0472 (0.1175)	-0.1521 (0.1747)
Existing portfolio	+	0.0791 (0.0548)	0.0920 (0.0615)	-0.8500 (0.5857)	0.0602 (0.1289)	0.8101 (0.4927)
Capital Intensity	+	0.0210 (0.0436)	0.0209 (0.0436)	0.0145 (0.0434)	0.0208 (0.0436)	-0.0029 (0.0474)
Venture capital deals		0.0026 (0.0022)	0.0026 (0.0022)	0.0026 (0.0022)	0.0026 (0.0022)	0.0038 (0.0025)
Existing port. X Minority prot.	+		-0.0002 (0.0010)			
Existing port. X Resolving ins.	+			0.0104 (0.0065)		
Existing port. X Patents	+				0.0002 (0.0011)	
Existing port. X IP regime	+					-0.0240 (0.0161)
Firm controls [a]		Yes	Yes	Yes	Yes	Yes
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		5396	5396	5396	5396	3809
Degree fdm.		14	15	15	15	15
Standard error		cluster	cluster	cluster	cluster	cluster
R-squared		0.009	0.009	0.011	0.009	0.014
F-test		1.319	1.255	1.341	1.309	1.211

[a]Firm controls include: Total assets, EBITDA & Aborptive capacity

Standard errors in parentheses

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

Table 14: Firm-fixed-effects (within) regression; DV: Value of deals

	H	(11) FE	(12) FE	(13) FE	(14) FE	(15) FE
Resolving insolvency	+	0.0158** (0.0054)	0.0154** (0.0055)	0.0013 (0.0109)	0.0150** (0.0056)	0.0748* (0.0332)
Patents	+	-0.0011 (0.0017)	-0.0076** (0.0028)	-0.0010 (0.0017)	-0.0014 (0.0017)	-0.0063 (0.0077)
Minority protection	+	-0.0027 (0.0041)	-0.0015 (0.0041)	-0.0020 (0.0041)	0.0074 (0.0053)	-0.0153 (0.0188)
Technological change	+	-0.0269 (0.1187)	-0.1534 (0.1341)	-0.5263 (0.4061)	0.1617 (0.1466)	-0.5515 (0.4721)
Existing portfolio	+	0.2996* (0.1507)	0.0733 (0.0546)	0.0769 (0.0542)	0.0692 (0.0532)	0.0440 (0.0433)
Sector focus	+					0.7017 (1.5539)
Capital intensity		0.0197 (0.0430)	0.0244 (0.0436)	0.0217 (0.0436)	0.0284 (0.0436)	0.0721 (0.1967)
Venture capital deals		0.0026 (0.0022)	0.0029 (0.0023)	0.0022 (0.0022)	0.0028 (0.0022)	0.0121 (0.0125)
Technological chg. X Existing port.	+	-0.0268 (0.0161)				
Technological chg. X Patents	+		0.0017* (0.0008)			
Technological chg. X Resolving ins.	+			0.0055 (0.0043)		
Technological chg. X Minority prot.	+				-0.0028* (0.0013)	
Technological chg. X Sector focus	+					-0.1210 (0.3205)
Firm controls [a]		Yes	Yes	Yes	Yes	Yes
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		5396	5396	5396	5396	979
Degree fdm.		15	15	15	15	16
Standard error		cluster	cluster	cluster	cluster	cluster
R-squared		0.012	0.011	0.012	0.012	0.030
F-test		1.409	1.367	1.253	1.489	1.416

[a]Firm controls include: Total assets, EBITDA & Aborptive capacity

Standard errors in parentheses

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

Table 15: Firm-fixed-effects (within) regression; DV: Average deal size

	H	(16) FE	(17) FE	(18) FE	(19) FE	(20) RE
Resolving insolvency	+	-0.0212 (0.0193)			-0.0225 (0.0197)	-0.0271 (0.0202)
Patents	+	0.0029 (0.0042)			0.0033 (0.0043)	0.0027 (0.0043)
Minority protection	+	-0.0091 (0.0119)			-0.0083 (0.0117)	-0.0105 (0.0119)
Technological change	+		0.0590 (0.2372)		0.0666 (0.2529)	-0.2063 (0.3317)
Capital Intensity			0.0572 (0.1303)		0.0615 (0.1408)	0.1769 (0.1610)
Venture capital deals		0.0014 (0.0077)			0.0015 (0.0085)	0.0021 (0.0091)
Existing portfolio	+			-0.0112 (0.0125)	-0.0150 (0.0165)	-0.0104 (0.0143)
Sector focus	+			-0.0512 (0.5152)		0.1178 (0.5610)
Total assets		-0.3441 (0.4034)	-0.3337 (0.4147)	0.0684 (0.4609)	-0.3005 (0.4079)	0.0558 (0.4173)
EBITDA		0.4406 (0.2691)	0.4475 (0.2772)	0.4142 (0.3122)	0.4675 (0.2685)	0.4547 (0.3233)
Absorptive capacity		0.1418*** (0.0406)	0.1501*** (0.0344)	0.1680*** (0.0296)	0.1529*** (0.0393)	0.1514*** (0.0433)
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		287	288	266	287	265
Standard error		cluster	cluster	cluster	cluster	cluster
R-squared		0.114	0.099	0.127	0.118	0.159
F-test		2.881**	3.537***	4.583***	3.024***	3.138***

Standard errors in parentheses

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

Table 16: Firm-fixed-effects (within) regression; DV: Average deal size

	H	(21) FE	(22) FE	(23) FE	(24) FE	(25) FE
Resolving insolvency	+	-0.0225 (0.0197)	-0.0247 (0.0203)	-0.0240 (0.0239)	-0.0232 (0.0203)	-0.0474 (0.0319)
Patents	+	0.0033 (0.0043)	0.0033 (0.0042)	0.0034 (0.0043)	0.0028 (0.0047)	0.0045 (0.0056)
Minority protection	+	-0.0083 (0.0117)	-0.0056 (0.0123)	-0.0077 (0.0121)	-0.0080 (0.0116)	0.0032 (0.0122)
Technological change	+	0.0666 (0.2529)	0.0505 (0.2546)	0.0680 (0.2540)	0.0642 (0.2541)	0.1478 (0.3142)
Existing portfolio	+	-0.0150 (0.0165)	0.0179 (0.0378)	-0.0526 (0.1758)	-0.0261 (0.0397)	0.0875 (0.1528)
Capital Intensity		0.0615 (0.1408)	0.0598 (0.1411)	0.0577 (0.1408)	0.0606 (0.1404)	0.0926 (0.2374)
Venture capital deals		0.0015 (0.0085)	0.0015 (0.0085)	0.0016 (0.0084)	0.0015 (0.0085)	0.0091 (0.0087)
Existing port. X Minority prot.	+		-0.0005 (0.0005)			
Existing port. X Resolving ins.	+			0.0004 (0.0020)		
Existing port. X Patents	+				0.0001 (0.0003)	
Existing port. X IP regime	+					-0.0032 (0.0051)
Firm controls [a]		Yes	Yes	Yes	Yes	Yes
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		287	287	287	287	211
Degree fdm.		14	15	15	15	15
Standard error		cluster	cluster	cluster	cluster	cluster
R-squared		0.118	0.120	0.118	0.118	0.163
F-test		3.024***	2.942***	2.900***	3.116***	4.391***

[a]Firm controls include: Total assets, EBITDA & Aborptive capacity

Standard errors in parentheses

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

Table 17: Firm-fixed-effects (within) regression; DV: Average deal size

	H	(26) FE	(27) FE	(28) FE	(29) FE	(30) FE
Resolving insolvency	+	-0.0248 (0.0200)	-0.0209 (0.0197)	-0.0589 (0.0312)	-0.0222 (0.0199)	-0.0261 (0.0197)
Patents	+	0.0037 (0.0043)	-0.0057 (0.0053)	0.0047 (0.0044)	0.0033 (0.0042)	0.0016 (0.0046)
Minority protection	+	-0.0055 (0.0117)	-0.0075 (0.0114)	-0.0082 (0.0114)	-0.0095 (0.0202)	-0.0083 (0.0119)
Technological change	+	0.0339 (0.2600)	-0.0338 (0.2636)	-0.5797 (0.3867)	0.0540 (0.2765)	-0.5003 (0.4215)
Existing portfolio	+	-0.0795 (0.0439)	-0.0153 (0.0162)	-0.0147 (0.0155)	-0.0147 (0.0170)	-0.0067 (0.0149)
Sector focus	+					-1.0503 (0.7930)
Capital Intensity		0.0577 (0.1399)	0.0462 (0.1406)	0.0699 (0.1349)	0.0621 (0.1419)	0.1948 (0.1592)
Venture capital deals		0.0014 (0.0085)	0.0020 (0.0085)	0.0003 (0.0084)	0.0015 (0.0086)	0.0020 (0.0091)
Technological chg. X Existing port.	+	0.0076 (0.0052)				
Technological chg. X Patents	+		0.0012 (0.0008)			
Technological chg. X Resolving ins.	+			0.0072 (0.0038)		
Technological chg. X Minority prot.	+				0.0002 (0.0021)	
Technological chg. X Sector focus	+					0.2639 (0.1495)
Firm controls [a]		Yes	Yes	Yes	Yes	Yes
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		287	287	287	287	265
Degree fdm.		15	15	15	15	16
Standard error		cluster	cluster	cluster	cluster	cluster
R-squared		0.124	0.124	0.139	0.118	0.175
F-test		3.174***	3.337***	2.887***	2.850***	3.071***

[a]Firm controls include: Total assets, EBITDA & Aborptive capacity

Standard errors in parentheses

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

Table 18: Firm-random-effects negative binomial reg.; DV: Number of Deals

	H	(31) RE	(32) RE	(33) RE	(34) RE	(35) RE
Resolving insolvency	+	0.0289** (0.0088)			0.0266** (0.0087)	0.0195* (0.0092)
Patents	+	0.0014 (0.0030)			0.0025 (0.0030)	0.0009 (0.0033)
Minority protection	+	-0.0007 (0.0064)			-0.0003 (0.0064)	-0.0051 (0.0066)
Technological change	+		0.2102*** (0.0364)		0.2184*** (0.0405)	0.1124* (0.0452)
Capital intensity			0.1478*** (0.0333)		0.1719*** (0.0351)	0.0786* (0.0368)
Venture capital deals		0.0041 (0.0029)			0.0041 (0.0030)	0.0018 (0.0032)
Total assets		0.1400 (0.1378)	0.3403** (0.1277)	0.1377 (0.1556)	0.3709** (0.1317)	0.2211 (0.1595)
EBITDA		0.4077** (0.1363)	0.2808* (0.1280)	0.1257 (0.1442)	0.3000* (0.1300)	0.0708 (0.1437)
Absorptive capacity		0.1034*** (0.0192)	0.0287 (0.0210)	0.0081 (0.0222)	0.0386 (0.0222)	-0.0079 (0.0253)
Existing portfolio	+			0.0138 (0.0075)	-0.0155 (0.0083)	0.0052 (0.0083)
Sector focus	+			0.3940 (0.2621)		-0.0302 (0.3037)
Year dummies		Yes	Yes	Yes	Yes	Yes
Number of obs		5396	5459	980	5396	979
Standard error		oim	oim	oim	oim	oim
Wald χ^2 test		113.19***	147.48***	23.41**	162.45***	39.35***
Log likelihood		-1278.92	-1279.72	-950.04	-1259.48	-939.99
Degrees of fdm.		12	10	10	15	16

Standard errors in parentheses

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

Table 19: Pairwise correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Number of CVC deals	1.00												
(2) Resolving insolvency	0.03	1.00											
	(0.06)												
(3) Patents	0.05*	0.37*	1.00										
	(0.00)	(0.00)											
(4) Minority protection	0.00	0.39*	-0.06*	1.00									
	(0.81)	(0.00)	(0.00)										
(5) Technological change	0.15*	0.07*	0.16*	-0.02	1.00								
	(0.00)	(0.00)	(0.00)	(0.18)									
(6) Capital intensity	0.07*	0.01	-0.02	-0.02	-0.17*	1.00							
	(0.00)	(0.33)	(0.11)	(0.14)	(0.00)								
(7) Venture capital deals	0.03	0.12*	0.12*	0.42*	0.07*	-0.01	1.00						
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.50)							
(8) Existing portfolio	0.85*	0.03	0.05*	-0.00	0.14*	0.07*	0.03	1.00					
	(0.00)	(0.05)	(0.00)	(0.83)	(0.00)	(0.00)	(0.05)						
(9) Sector focus	0.09*	-0.05	0.11*	-0.02	0.62*	-0.03	0.09*	0.08*	1.00				
	(0.00)	(0.15)	(0.00)	(0.64)	(0.00)	(0.27)	(0.00)	(0.01)					
(10) Total assets	0.08*	-0.13*	-0.06*	-0.15*	-0.19*	-0.22*	-0.14*	0.08*	-0.15*	1.00			
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)				
(11) EBITDA	0.17*	-0.11*	0.01	-0.12	-0.09*	0.12*	-0.04*	0.18*	-0.06	0.75*	1.00		
	(0.00)	(0.00)	(0.39)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)			
(12) Absorptive capacity	0.13*	0.09*	0.24*	-0.10*	0.39*	0.30*	-0.11*	0.13*	0.29*	-0.14*	0.09*	1.00	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		
(13) IP regime	0.04	-0.01	0.02	-0.08*	0.46*	0.07*	-0.04	0.04	0.37*	0.03	-0.02	0.41*	1.00
	(0.03)	(0.68)	(0.33)	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)	(0.00)	(0.05)	(0.17)	(0.00)	

P-value in parentheses

* $p < 0.01$