



Paper to be presented at the DRUID 2012

on

June 19 to June 21

at

CBS, Copenhagen, Denmark,

## **Mix and Match: Corporate Diversification and CVC Portfolio Strategies**

**Laura Toschi**

University of Bologna  
Department of Management  
laura.toschi@unibo.it

**Federico Munari**

University of Bologna  
Department of Management  
federico.munari@unibo.it

**Paul Nightingale**

SPRU, The Freeman Centre  
University of Sussex  
p.nightingale@sussex.ac.uk

### **Abstract**

The literature on venture capital (VC) has investigated the determinants of portfolio composition and the effects it has on both the investors' and the investee companies' performance. However, with Corporate Venture Capital (CVC), one might expect the relationship to be different as investments in entrepreneurial ventures are strategic means for corporations to learn about new markets and/or technologies. In this paper we analyze the strategic use of CVC by exploring the relationship between the corporate strategy of the parent firm and her CVC portfolio strategies. The analysis uses data on a sample of 234 US public corporate investors in the period 1996-2006 and shows how the level of corporate diversification of the parent firm influences the scope of her CVC funds, and how this differs depending on whether one considers corporate diversification and portfolio selection from a market or a technology perspective.

## **1. Introduction**

A critical issue in organizational studies is the understanding of what type of mechanisms firms can refer to for developing new competencies (Roberts and Berry, 1985). Established firms often invest in external entrepreneurial ventures for facilitating the access to new markets and technologies (Dushnitsky, 2006; Wadhwa and Kotha, 2006).

The goal of our work is to shed new light on the use of Corporate Venture Capital (CVC) and figure out how firms structure their CVC funds, as a part of their overall corporate strategy, and which factors may influence their decisions. CVC refers to minority equity investments by established firms in a portfolio of entrepreneurial ventures that seek capital for growing their businesses (Gompers and Lerner, 1998; Chesbrough and Tucci, 2004; Dushnitsky and Lenox, 2005a, 2005b). We chose to focus on CVC because, after independent VCs, it represents the second most prevalent group of investors in the market for entrepreneurial financing (Keil, 2002; Maula, 2007) and, in the field of corporate venturing, it is becoming a central mechanism for the renewal of established corporations (Schildt et al., 2005; Dushnitsky and Lenox, 2006).

Surprisingly, although research has shed light on several aspects related to CVC such as (a) the practice of CVC (Dushnitsky, 2006), (b) how CVC can facilitate investor innovation and access complementary technologies, create new businesses and enter new markets, increase market value and financial returns (Siegel et al., 1988; Zahra and Covin, 1995; Zahra, 1996; Brody and Ehrlich, 1998; Maula et al., 2003; Keil, 2004; Ernst et al., 2005; Dushnitsky and Lenox, 2005a, 2005b, 2006; Wadhwa and Kotha, 2006; Dushnitsky and Lenox, 2005a; Allen and Hevert, 2007; Hill et al., 2009), (c) who makes CVC investments and why (Basu et al., 2011), (d)

which factors can influence the use of CVC (Sahaym et al., 2010) and (e) the tension between corporate investors and investee companies (Katila et al., 2008; Maula et al., 2009), many basic questions remain still unanswered. One fundamental set of questions relates to the composition of CVC funds in relation with the parent firm. In this paper, we make an attempt to address this neglected research domain by exploring some of the possible determinants of CVC fund composition. In particular, previous studies have ignored whether and how corporate- and industry-level features affect the investor choice to finance some companies rather than others. In this study, we consider one corporate-level factors and one industry-level factor for explain variance in the composition of CVC funds.

More precisely, this paper intends to examine (a) how the levels of diversification of the corporate investor impact on the level of diversification of the CVC funds and (b) how the competitive environment of the corporate investor, in terms of technological intensity, moderates the previous relations. We do so, by systematically distinguishing market-based and technology-based perspectives in order to take into account the evidences that CVC is generally exploited to accessing both new markets and new technologies (Dushnitsky, 2006) and that the firm's technological base tends to be wider than the firm's product mix (Patel and Pavitt, 1997; Gambardella and Torrisi, 1998). As a consequence, the relationship between corporate and CVC fund diversification under a market perspective could be different from the case of diversification based on technology.

We study such topics on a sample including 234 public corporations engaged in CVC investments in the United States over the period 1996-2006, as identified by the commercial database *VentureXpert*. Results from our regression analyses find the existence of a negative relationship between corporate and CVC fund diversification,

if analyzed under a market perspective. Conversely, when the aim is to seek out new technologies, our results suggest a positive relationship. We also find that technology intensity moderates the relationship between corporate and CVC fund market diversification, such that any negative effect of corporate market diversification on CVC fund market diversification is weakened as technology intensity increases, but it has not effect on the technology side.

This work provides significant contributions to several research areas of the existing literature. First of all, we contribute to the VC literature, by investigating how the structure of CVC funds, in terms of diversification among portfolio companies, is affected by factors specific to corporate investors. If, on one hand, the determinants of a traditional VC fund's composition have been widely analyzed considering the characteristics of the fund, the entrepreneur, the transaction and the environment (Cumming, 2006), on the other hand, equity investments by corporate (non financial) investors introduce additional elements to consider. We show that empirical analyses on CVC fund composition need also to include factors related to the "parent firm" sponsoring the CVC fund. We argue that the level of corporate diversification is a key characteristic in the study of CVC fund composition.

Second, our study extends prior research on CVC, as we open the Pandora box to explain how corporations structure their CVC funds for better responding to their environments and achieving their strategic intents. No studies, to our knowledge, have previously investigated this issue. An exception is the work by Sahaym et al. (2010) where the authors analyze the size of CVC activity (in terms of number of deals), but aggregating the data at the industry level.

Third, we contribute to the literature on diversification. Indeed, we consider the relationship between corporate and CVC fund diversification by adopting both a

market and a technology lens. It is widely accepted the idea that CVC investment is a strategic tool for corporations to achieve different types of benefits that can be categorized under these two perspectives. As far as the former, CVC can be useful for facilitate the access to new markets, extend current lines of products, develop complementary products, create new businesses or enter new distribution channels. As far as the technology side, CVC investment allows corporations to open a window on emerging technologies and, more generally, enhancing innovation (Brody and Elrich, 1998; Keil, 2004; Ernst et al., 2005; Dushnitsky and Lenox, 2006).

Finally, we try to understand whether and how industry-specific factors have a moderating effect on the main relationships investigated. The idea is to highlight under which external conditions corporations tend to create CVC investments with a more or less diversified configuration, in respect to their level of corporate diversification.

These aspects have important managerial implications as they point out that the strategic configuration of CVC funds is affected, on the one hand, by firm-level features (market and technological diversification) and, on the other hand, by external conditions (the level of technological intensity of the firm's core industry).

The rest of the paper is organized as follows. We briefly summarize the previous literature on CVC. Then, we formulate our hypotheses. A description of the data sources, sample and variables follows. Finally, we present the results and we outline the main conclusions and implications for future research.

## **2. Theory**

In highly competitive industries, the speed and complexity of changes create many uncertainties for organizations and force them to continuously search for new growth

opportunities and innovative ideas. In these contexts, established organizations are, thus, under pressure to improve their knowledge and competencies and often rely on several mechanisms for accessing external resources (Roberts and Berry, 1985; Ahuja, 2000; Dushnitsky and Lenox, 2005a, 2005b; Wadhwa and Kotha, 2006; Keil et al., 2008). At this purpose, Roberts and Berry (1985) proposed a matrix embracing different investment mechanisms which firms can choose, depending on the type of relation between the new business and the firm's current markets and technologies: alliances, joint ventures, equity investments, acquisitions.

While acquisitions, alliances and joint ventures have been extremely studied CVC received little attention and has only recently attracted renewed interest (Dushnitsky, 2006; Basu et al., 2011). However, the importance of CVC is resulting evident. First, CVC has become a viable and valuable strategy for incumbent firms worldwide for enhancing innovation and developing new businesses. Big corporations such as Xerox, Lucent, Nokia, Novartis, Pfizer and Intel have created their VC arms by setting up investment programs motivated by the search for strategic benefits, such as learning and new-knowledge creation. Second, as described by Chesbrough (2002: 4), “[Q]uarterly corporate venture-capital investments in start-ups rose from \$468 million at the end of 1998 to \$16.2 billion at the beginning of 2000”, representing 15% of the whole VC market. Despite the recent economic downturn that forced many firms to reduce their CVC investments, they have, however, maintained a regular commitment to their venturing programs (Ernst and Young, 2008; Dushnitsky and Lavie, 2010). These data suggest the importance of CVC as a form of equity investment and strengthen the need to deeply study it as a valuable form of inter-firm relationships.

The investment decisions of VCs have long been of interest in entrepreneurship and financial literature. Some studies have considered how and why VC firms pursue different strategies when undertaking portfolio investments. These studies highlighted the existence of high variance among VC funds in terms of size and level of diversification (along several dimensions such as industry, country and stage of development) which can be explained by a series of factors related to the VC investors' characteristics (focus of investment, experience), the VC funds' characteristics (type of fund, fund duration, fund-raising, and the number of VC fund managers), the ventures' characteristics (stage of development, technology, and geographic location), the nature of the financing transactions (staging, syndication, and capital structure) and market conditions (Gupta and Sapienza, 1992; Norton and Tenenbaum, 1993; Kannianen and Keuschnigg, 2003; Fulghieri and Sevilir, 2005; Cumming, 2006). While all these studies have made important contributions to advance our understanding on how VC firms decide about their portfolios, to our knowledge, there is no study investigating the same issue in the CVC field. The main reason explaining the need to analyze CVC as a different and autonomous form of financing is the presence of the parent firm (i.e. the corporation creating the fund) in the financing process, which presents corporate-level features to be considered within the pool of factors affecting fund composition.

Furthermore, in the literature on CVC it is widely accepted the idea that corporate investors differ significantly from traditional VCs (Maula and Murray, 2002; Maula et al., 2005). Whereas traditional VCs focus on financial returns and aim to obtain rapid organizational growth, CVCs are strategic investors in search for different types of benefits: accessing new markets and monitoring emerging technologies (Zahra, 1996; Dushnitsky and Lenox, 2005a), acquiring complementary

resources and enhancing reputation and visibility (Block and MacMillan, 1993; Dushnitsky, 2006; Birkinshaw et al., 2002; Maula, 2007), improving the network of contacts, both within the financial and the business industry, and searching for alliance partners among their investee companies (Sykes, 1990; McNally, 1997). However, we know very little about how corporations structure their CVC funds for obtaining these benefits.

In order to address these gaps, we propose a theoretical model (Figure 1) suggesting that the corporate strategic decisions on how constitute CVC funds depend on firm-level factors, mainly corporate diversification. Moreover, the extent to which corporate characteristics influence CVC fund composition depends on industry conditions, such as the level of technological intensity of the main industry of the corporate investor. Finally, we define the nature of diversification along two dimensions to deeply capture potential differences deriving from the existence of two macro categories of strategic benefits for corporations: market- and technology-based.

[Insert Figure 1 around here]

## **2. Research hypotheses**

To investigate the relationship between corporate and CVC fund diversification, we refer to previous studies that decomposed diversification into market and technological domains (Patel and Pavitt 1994, 1997; Gambardella and Torrisi, 1998). The former implies greater weight on commercialization or production, the latter refers to the development of new capabilities in technological assets.

A set of managerial studies highlighted the existence of forces affecting both technological and market diversification and factors that separately impact on each of them (Candwell et al., 2004). Other studies investigated the presence of firm

performance differences deriving from these types of diversification showing a positive effect for greater focus in market operations and a negative influence for greater focus in technological operations (Gambardella and Torrison, 1998). This is confirmed by the empirical evidence that firms within one industry need to develop technologies in various domains for the development of more complex products and production processes (Granstrand and Sjolander, 1990, 1992; Kodama, 1992 and 1995; Granstrand et al., 1992).

Furthermore, as previously pointed out, corporations rely on CVC for pursuing strategic objectives that range from market- to technology-based motivations. Thus, it is plausible to conjecture that, in the context of CVC, the distinction between market and technology diversification, both at the corporate and fund level, matters and needs to be taken into account.

### ***3.1. The effect of corporate diversification on CVC fund diversification***

#### *3.1.1. A market perspective*

Although the evidence from the strategic management literature on the benefits provided by corporate market diversification on firm performance is inconclusive, in general this relation seems to be neutral or, in case of over-diversification, negative (Hoskisson and Hitt, 1988; Markides, 1990). As a consequence, firms tended to refocus on their core businesses when their degree of diversification exceeded the optimal diversification limits in order to improve their profitability and market value (Markides, 1992). Accordingly, Gambardella and Torrison (1998: 446), using data on the largest 32 US and European electronics firms during 1984–1992, found that “*the best performing companies were those that focused on their core business [...]*”. As assets and capabilities needed to succeed in different markets are distinct among

sectors, the boundaries across industries are high and, thus, they limit the possibility of firms entering new markets (Chandler, 1990).

In the CVC context, the issue on the optimal level of diversification that corporation should pursue may be more complex. Corporate diversification is a strategic intent that is carried out through several corporate diversification strategies, such as internal development, joint ventures, alliances, acquisitions and equity investments. CVC activity is, thus, one way in which a firm can achieve corporate diversification. Hence, one would expect the strategic actions - the actual CVC investments in this case - to resemble the strategic intent – the corporate diversification. CVC fund diversification is, thus, a tool to achieve corporate diversification and hence the one does naturally lead to the other.

Taking in mind the previous considerations on the firms' propensity to specialize in a limited number of core market activities (as suggested by the diversification and strategic management literature), this means that if the level of corporate market diversification is quite high, firms will tend to create specialized funds in order to limit the possibility to diversify more. In other words, we suggest that, under a market perspective, corporate diversification negatively impacts the level of diversification of CVC funds.

*Hp 1a: The greater the level of corporate market diversification, the lower the level of CVC fund market diversification.*

### *3.1.2. A technological perspective*

*“[T]he increasing complexity and multi-disciplinarity of resources required for innovation, and of the stock of knowledge itself, tend to make technological innovations the outcome of interactions and cooperation among fundamentally*

*autonomous organizations [...]*” (Arora and Gambardella, 1990: 362). In line with this reasoning, researches on diversification appear to confirm an overall trend among firms towards increasing technological diversification to face the greater complexity characterizing products. Patel and Pavitt (1997), analyzing data on more than 400 of the world’s largest firms, showed that they tend to “*spread their technological resources over a wider spectrum than their products, and particularly into fields where they do not have a distinctive advantage*” (Patel and Pavitt, 1997: 148).

Also, the “technological search” stream that draws on a Carnegie perspective argues for diverse inflows of information enabling “recombinant innovation” (Stuart and Podolny, 1996, Rosenkopf and Nerkar, 2001; Katila and Ahuja, 2002, Laursen and Salter, 2006; Lavie and Rosenkopf, 2006). Indeed, recognition of the firm’s tendency towards “local search” – where a firm’s R&D activity is closely related to its previous R&D activity (March and Simon, 1958; Nelson and Winter, 1982; Stuart and Podolny, 1996) - has given rise to concepts celebrating “exploration”, a boundary-spanning search (March, 1991; Rosenkopf and Nerkar, 2001), and “openness”, involving the use of a wide range of external actors (Chesbrough, 2003; Laursen and Salter, 2006), able to overcome this tendency. Likewise, a broad and varied range of internal technological activities are likely to endow a firm with technical expertise to assimilate and exploit the potential of outside opportunities that provide the firm with new technological resources that cannot be generated internally (Mowery and Rosenberg, 1989). Indeed, firms with a larger level of technological diversification develop greater “absorptive capacities” (Cohen and Levinthal, 1990) that enable them to face important cognitive obstacles, such as existing shared knowledge and routines, communication channels and information filters, that make it difficult to assimilate

technological knowledge developed outside of the firms' boundaries (Nelson and Winter, 1982; Tushman and Anderson, 1986; Laursen et al., 2010).

In sum, high degrees of corporate technological diversification give the corporation a certain level of knowledge flexibility and technical expertise needed for assimilating diversified knowledge that resides outside the firm boundaries. In our setting, this means that technologically diversified corporations may have the ability to create and manage technologically diversified CVC investment portfolios (obtaining high levels of variety among technologies), so that to face the increasing complexity of products and be able to assimilate and integrate the new technological knowledge developed externally. Thus, we suggest that:

*Hp 1b: The greater the level of corporate technological diversification, the greater the level of CVC fund technological diversification.*

### **3.2. The moderating effect of the environmental context**

In addition to explore the effect of corporate diversification and R&D intensity on CVC fund diversification, we also aim to identify contextual variables that may affect these relationships. As our analyses are based on a sample of corporations operating in different sectors, we identify the distinction between high-tech and low-tech sectors as an important factor influencing the above-mentioned relations.

High-tech industries are generally characterized by two aspects: high levels of uncertainty and a wide set of opportunities. Previous research showed that firms are more likely to invest in CVC when there are rich technological opportunities within an industry (Dushnitsky and Lenox, 2006) and when they operate in dynamic industries, with rapid technological change, high competition and weak appropriability (Basu et al., 2011).

Furthermore, CVC, being a sort of diversified activity, allows investor to reduce risk by spreading it across multiple and low-commitment initiatives. Exogenous uncertainty influences the degree to which firms can survive by mainly refining current technologies rather than seeking out new opportunities. In unstable environments (with rapid technological change and obsolescence) firms should commit more resources to exploring a wider set of opportunities compared to more stable environments characterized by less uncertainty (Rowely et al., 2000; Beckman et al., 2004). Thus, firms operating in turbulent environments should maintain a high level of flexibility by investing in a broad set of opportunities to create options for dealing with environmental shocks.

If the presence of higher uncertainty and valuable growth options pushes firms to explore a broad set of opportunities, we would notice an impact on our main hypotheses. More precisely, we expect the negative relationship between corporate market diversification and CVC fund diversification to be mitigated in high-tech industries. Similarly, the positive relation in the case of technological diversification is estimated to be stronger than in low-tech sectors.

*Hp 2a: The influence of corporate market diversification on CVC fund market diversification is more strongly negative in low-tech industries.*

*Hp 2b: The influence of corporate technological diversification on CVC fund technological diversification is more strongly positive in high-tech industries.*

#### **4. Sample and data sources**

We tested our hypotheses on a sample of 234 US public firms active in CVC investment in the period 1996-2006<sup>1</sup>.

To ensure consistency across data, we decided to refer to the United States as context of analysis, since it has the largest and most developed venture capital industry in the world (NVCA, 2008), “*representing 74% of global investments in the five quarters up to April 2008. Europe forms a second tier, and Israel and China are minor players*” (Ernst & Young, 2008). Furthermore, VC under management by corporations in the United States increased from \$3,100 million in the 1996 to \$18,107 million in 2006, equal to 6.5% and 7.8% respectively of the total capital in the venture capital sector.

As the level of CVC investing has been extremely variable over time and has mirrored the cyclical nature of the venture capital industry in a significant manner (Gompers and Lerner 1998, 2001), we decided to focus on the period 1996-2006 as it represents the most recent and biggest wave of the CVC cycle<sup>2</sup>.

To construct our sample, we referred to the *VentureXpert* database<sup>3</sup> to identify all the corporations<sup>4</sup> in the US that invested VC funds at least once in external

---

<sup>1</sup>Some of the corporations included in our sample have more CVC funds under management. Although it could be possible considering the single fund as unit of analysis of our study, we decided to refer to the single corporate investor for two main reasons. The first one is a theoretical reason: the focus of the study is assessing how a set of corporate-level characteristic (i.e., corporate diversification and R&D intensity) impacts on the overall degree of diversification among all the ventures in which the corporation invests. Since we have firm-level variables, if the fund is considered as unit of analysis, some corporations would be more heavily weighted in the sample than others. The second one is a methodological reason: since firm-level variables are used in the analysis (i.e., size, R&D intensity), some firms (i.e., those with more than one fund) are more heavily weighted in the sample than others. Thus, we treat the different funds as one single fund. As in the model we have three fund-level variables (CVC fund market and technological diversification and CVC fund size), for firms with more than one funds, we assessed these variables by aggregating all the data.

<sup>2</sup> Investments in CVC have shown periods of rapid growth and decline through three main waves. The first wave covers the period from the late 1960s to the early 1970s, with the decrease beginning around 1973. The second wave occurred from the late 1970s to the early 1980s (Gompers and Lerner 1998, 2001). Finally, the biggest wave occurred in the late 1990s, with a peak in 2000, where corporations participated in approximately 20% of venture investments in the United States, to take advantage of the technological shock caused by Internet (source: *VentureXpert* database).

<sup>3</sup> Previous academic studies on the VC industry have widely used this data source (Gompers, 1995; Kortum and Lerner, 2000; Maula, 2007; Dushnitsky, 2004; Dushnitsky and Lenox, 2005a, 2005b).

ventures during the period of analysis. Then, we refined this initial sample, by excluding corporations with CVC funds investing only in one company<sup>5</sup> and dropping private corporations, as we focus only on public firms. Our final sample consists of 234 US public firms in the period 1996-2006.

For each corporation, we collected information in *VentureXpert* on the number of funds managed and their size, the geographical location, the vintage year of their funds and the ventures belonging to their investments portfolio. For each CVC-backed company, we extracted data about the main industry in which it operates and its stage of development.

Then, a hand-checking procedure was used to link the *VentureXpert* sample of corporate investors with the *Worldscope* dataset in order to gather data on total corporate assets and corporate R&D expenses, and identify the industries where the corporations operate.

Finally, in order to construct our technological measures of diversification, we referred to two data sources – the *NBER database* and *Delphion* - in order to identify the set of patents assigned by the US Patents and Trademarks Office (USPTO) to both the investor firms and the investee companies included in our sample. In particular, we referred to the second version of the *NBER database* (see Hall et al. (2002) for a detailed description of the database) providing data up to 2002, and to *Delphion*, for patents in the remaining period 2003-2006<sup>6</sup>. We collected a total number of 135,525

---

<sup>4</sup> Among the several types of investors included in *VentureXpert*, we selected only corporate firms defined as “Corporate Venturing Group” and “Corporations”.

<sup>5</sup> Portfolio companies are in general small and young entities characterized by only one industry code. In these cases, the measure of market diversification assumes a value equal to zero corresponding to perfect specialization. However, this type of interpretation could be misleading, as it is evident that a portfolio with only one company is specialized in the industry associated with that company.

<sup>6</sup> A strength of both these databases is the possibility of appropriately identifying the patents that were granted to subsidiaries of our sample of corporate investors and of aggregating the patents assigned to these subsidiaries in that year to the parent firm: *NBER database* aggregates the patents assigned to these subsidiaries in a given year to the parent firm level, while *Delphion* offers the “corporate tree” tool which makes it possible to construct the corporate family trees and create the same patent

granted patents for the corporations and 29,413 granted patents assigned to the portfolio companies (by considering the date of their original application as suggested by previous studies (Ahuja and Katila, 2001; Dushnitsky and Lenox, 2005a).

## 5. Variables

### 5.1. Dependent variables

We examine the level of CVC fund diversification as a function of corporate diversification. Hence our dependent variable captures the level of diversity within the portfolio companies. This relation is assessed under both a market and a technological perspective and, thus, we define two different variables: *CVC Fund Market Diversification* and *CVC Fund Technological Diversification*.

Measures developed for the analysis of firm's diversification abound in the literature (i.e., Rumelt, 1974, Jacquemin and Berry, 1979). We refer to the *Herfindahl Index*, a method widely diffused as a measure of economic concentration in industrial organization literature (Palepu, 1985; Robins and Wiersema, 1995, 2003; Ahuja and Katila, 2001; Munari et al., 2011). In our setting, we use the complement of the *Herfindahl Index* assessed at the year 2006, to distinguish diversification indexes from concentration indexes (Robins and Wiersema, 2003) and we define the following index of CVC fund diversification (taking value 0 for a specialized CVC fund and increasing for a higher level of diversification, its upper limit being 1):

$$Herfindahl_i = \left[ 1 - \sum_{j=1}^J (P_{ij})^2 \right] = \left[ 1 - \sum_{j=1}^J \left( \frac{N_{ij}}{N_{iT}} \right)^2 \right]$$

---

aggregation offered by the previous database. *Delphion* has also been used to collect data about the patents requested by the investee companies of our sample.

If we refer to the *Market Diversification*,  $N_{ij}$  denotes the stock of companies up to 2006 of the CVC fund  $i$  operating in industry  $j$  and  $N_{iT}$  refers to the total number of portfolio companies up to 2006 of the CVC fund  $i$ . If we refer to a measure of *Technological Diversification*,  $N_{ij}$  denotes the stock of patents granted up to 2006 by the companies belonging to the CVC fund  $i$  in the technological domain  $j$  and  $N_{iT}$  refers to the total number of patents up to 2006 of all the companies belonging to the CVC fund  $i$ . We use the 4-digit Standard Industrial Classification (SIC) and the 4-digit International Patent Classification (IPC) systems as market and technological domains to construct these two measures<sup>7</sup>.

## **5.2. Independent variables**

The level of *Corporate Market* and *Technological Diversification* serve as our independent variables. *Corporate Technological Diversification* is constructed by following the same procedure presented for *CVC Fund Technological Diversification*, where the term  $P_{ij}$  refers to the number of patents granted up to 2006 by the corporation  $i$  in a specific technology domain  $j$  over its total number of granted patents up to 2006. In the case of *Corporate Market Diversification*, the term  $P_{ij}$  refers to the proportion of a firm's sales in a specific industry class  $j$  over her total sales computed at the year 2006<sup>8,9</sup>.

---

<sup>7</sup> The assumption is that if two businesses (technologies) share the same SIC (IPC) code, they must have common input requirements and similar production (and technology) functions.

<sup>8</sup> Generating the measures of *Corporate* and *CVC Fund Market Diversification* involved a number of steps and problems that need some clarifications. For the portfolio companies belonging to each CVC fund, *VentureXpert* provides an industry classification based on a proprietary scheme, called Venture Economics Industry Classification (VEIC), but offers also the match between the VEIC and the SIC codes (at the 4-digit level). However, to be sure of perfect comparability in terms of classification systems, we manually control each VEIC-SIC pair assigned to each venture using a manual process. For corporate investors, instead, *VentureXpert* provides only the VEIC codes that, in addition, are available at a more aggregate level (1-digit number). In order to assess the level of corporate market diversification at the same degree of accuracy of the CVC fund ventures, we complemented the data gathered from *VentureXpert* with *Worldscope*, which provides a list of maximum eight SIC codes at the 4-digit level for each of our corporations on the base of the distribution of sales (the first SIC is the

In order to test hypotheses 2a and 2b, we include the dummy *High-Tech* (with value 1 for high-tech sectors) in order to take into account the distinction between high-tech and low-tech industries in the core business (identified by the primary 4-digit SIC code) of the corporations. However, the definition of ‘high technology’ is not unique as it depends on the level of narrowness adopted. We apply the widely used Butchart (1987) classification, which identifies 19 high-tech sectors on the base of an industry value of R&D expenditures (as a proportion of sales) and its level of scientific, engineering and technical employment<sup>10</sup>.

### **5.3. Control variables**

Following previous research on VC fund structure (i.e., Cumming, 2006), we include several control variables. We control for corporate size, using the logarithm of corporate assets in 2006 (*Corporate Size*), as larger firms with greater resources for investing in research are more likely to create diversified CVC funds (Dushnitsky and Lenox, 2005b). In order to take into account the variance in inputs for innovation activity which impact on a firm’s propensity to innovate (Wadhwa and Kotha, 2006) and, thus, to invest in diversified CVC programs, we also controlled for R&D expenses computed in the year 2006 (*R&D Expenses*). We gather these data from *Worldscope*.

---

industry with the greatest level of firm’s sales and the last SIC is the smallest). The measurement of *Corporate* and *CVC Fund Technological Diversification* posed minor problems as patent classification (IPC) is unique and the detail level is the same for both corporations and ventures.

<sup>9</sup> Our data provides, for each corporation, a list of eight (or less) different SIC codes. As the majority of the corporations in our sample is characterized by high diversification levels with eight SIC codes, the assessment of *Corporate Market Diversification* according with the *Herfindhal Index* would have been equal to 0.125 ( $1/64*8$ ) for the majority of the firms. Thus, by referring to the percentage of sales in the different industries, we create more variance for this variable.

<sup>10</sup> Although this categorization is applied to the United Kingdom, it is appropriate also for the United States context (Thompson, 1988), as studies providing a definition of high technology in the US refer to similar indicators of research intensity and technical employment (Riche et al., 1983).

We also include fund-level characteristics. CVC fund size is measured as the logarithm of the total amount of money (\$ Mil) invested in the CVC fund (*CVC Fund Size*) computed at the year 2006. The dummy variable *Early Stage* takes value 1 for funds investing in seed stage/startup, development or early stage companies and 0 for later-stage and expansion companies (Gupta and Sapienza, 1992; Norton and Tenenbaum, 1993). In order to capture differences among corporations operating in the US, we use the dummy *California* (taking value 1 when the fund's geographical location is California, and 0 otherwise). Finally, as the year 2000 registered the highest peak in terms of number of corporations engaged in CVC activities and the largest amount committed to CVC investments, we created a dummy variable which splits the sample of corporate investors into two group depending on the year of creation of their CVC funds: pre-2000 and post-2000 (*Year2000*).

Finally, Lerner's empirical work (2002: 25) suggests that higher expected returns push investors to supply more VC funding than during a period with lower expected returns. To control for these market conditions, we use the yearly *Datastream Index* of real returns of the corporate main industry (*Market Conditions*) to test if CVC funds formed over a period in which the market is "bullish" have higher/lower fund diversification than a period characterized by a "bearish" market.

## **6. Analyses and Results**

### ***6.1. Descriptive statistics***

We first present some descriptive statistics. As far as the 234 US corporate investors of our sample, we can see that the level of diversification is about 0.55 and 0.67 for the market and technological sides. They are generally big firms with an average size of \$37 billion, an average amount of R&D expenditure of \$14 billion and equally

distributed between high-tech and low-tech in terms of their main industry. For what concern CVC fund features, we observe that the average level of diversification of the CVC funds is 0.52 and 0.63 for the market and technological domains respectively. Furthermore, the average CVC fund size is \$807 million, about 32% are located in California (the remaining 68% include funds in other parts of the United States, especially in the East coast), the majority of them are focused on early-stage ventures (57%), and the 62% of them has been created during the Internet bubble.

[Insert Table 1 around here]

## **6.2. Regressions**

In order to test our hypotheses, we adopt the “Fractional Logit Regression Model” using Quasi-Maximum Likelihood Estimation (Papke and Wooldridge, 1996), as our dependent variables are bounded between zero and one.

Table 2 reports the results of our analyses. Models 1 and 4 (for the market and technological perspective respectively) omit the corporate diversification variables. The positively significant predictors in Model 1 are the distinction between high- and low-tech industries, *Corporate Size* and *Fund Size* as might be expected from theory. Larger firms and firms operating in high-tech sectors tend to create more market diversified CVC funds than smaller firms or firms active in low-tech sectors. Furthermore, greater funds tend to be more diversified. Finally, funds created during the Internet bubble tend to be less diversified. Surprisingly, the same variables are not significant when their effect on the CVC fund technological diversification is analyzed (except for the year of foundation of the fund), thus suggesting that firm-level and fund-level factors do not affect portfolio decisions focused on the search of new technologies.

[Insert Table 2 around here]

In Models 2 and 5 our main independent variables on corporate diversification are introduced. Model 2 tests the Hypothesis 1a which predicts a negative relationship between corporate and CVC fund diversification for market domains. The negative (-0.433) and significant (at the 5% level) coefficient for our main independent variable supports this hypothesis. Conversely, Hypothesis 1b suggests a positive relationship between corporate and CVC fund diversification for technological domains. The coefficient of *Corporate Technological Diversification* in Model 5 is equal to 0.575 and significant at the 10% level, thus also sustaining this second hypothesis. The data of these models also confirm the significant impact of technology intensity, *Corporate Size*, *Fund Size*, *R&D* and the period of creation of the funds on *CVC Fund Market Diversification* and the absence of significant effect on *CVC Fund Technological Diversification*, as in the previous models.

Finally, Models 3 and 6 show the tests for interaction effects. The moderating effect suggested by our second set of hypotheses is significant only for the market side. More precisely, by introducing the interactive term between our main independent variable *Corporate Market Diversification* and the dummy *High-Tech* to the previous regressions, we find that the negative effect of corporate diversification on CVC fund diversification for the market side decreases (Hp. 2a is confirmed at the 1% level). In other words, the negative relation obtained in Model 2 is due to corporations operating in low-tech sectors. However, for the technological perspective, the positive effect between *Corporate* and *CVC Fund Market Diversification* does not depend on the level of technology intensity of the main industry of the parent firm. Thus, Hp. 2b is not supported.

Our analysis, therefore, provides evidence of significant differences in the strategic use of CVC investments in terms of its composition, as the simultaneous distinction of market and technological domains is worthwhile. This is in line with the diversification literature suggesting that the technological competencies of large firms are spread over a large number of fields, while market capabilities tend to be more focused.

## **7. Robustness check**

Our sample includes all US corporate investors active in the period 1996-2006 disregarding any distinction in terms of type of organizational structure of the CVC entity. However, as suggested by researchers on the topic, CVC can take different forms (McNally, 1997; MacMillan et al., 2008). On one hand, externally managed (indirect) investment occurs when investments are made via externally managed VC funds, which in turn reinvest in small firms. On the other hand, internally managed (direct) investment takes form when investments in individual independent ventures are selected and managed by the corporation itself.

In order to control for this heterogeneity, we run additional estimates including only corporate firms having an internally managed CVC structure, corresponding to a total of 120 observations. We focus on this sub-sample as direct internally managed investments, allowing much closer interaction between large and small partners, may have the potential to provide greater strategic benefit than indirect investment. Table 3 reports the results of the analyses for this restricted sample. Overall, results are robust to the previous findings given that the sign and significant of the main variables remain confirmed.

[Insert Table 3 around here]

## **8. Discussion and conclusions**

The contributions of this paper are multiple. The first contribution is related to the literature on portfolio choices. While several studies on VC have investigated how managers create their portfolios in terms of preferences for particular stages of development, industries or technologies, diversification and size of the fund (Norton and Tenenbaum, 1993; Cressy et al., 2007), in the CVC field, little attention has been paid to how corporate investors cope with the composition of their portfolios. CVC, if compared to traditional VC investments, is characterized by the presence of the corporate firm that creates the fund in addition to the fund's managers and the investee companies. Studies on portfolio choices made by corporate investors need to introduce this aspect. In this study, we addressed this issue by analyzing how the level of corporate diversification impacts on the choices of portfolio's design. Second, following the literature that decomposes diversification into market and technological domains, we increase our knowledge of the importance of conducting analyses based on the distinction between these dimensions. Finally, we suggest that contextual variables (the level of technology intensity in the main industry of the corporate investor) play a moderating role in the relationship between corporate and CVC fund diversification.

It is important to consider the study's limitations, since they suggest further topics, which can be directly addressed by future research. The first consideration is on the generalizability of the findings. The US is an ideal setting for doing research on VC, since it is the most developed equity market. However, there are differences between the various geographic markets, which can affect the application of these findings to other countries. For instance, in relatively underdeveloped markets, levels

of market and technological diversification can be completely different. Thus, future research could extend these analyses to different countries. Second, in order to assess the relationship between a corporation and her CVC fund, we used the level of diversification of the CVC fund, measuring the degree of variation among the CVC fund investments. However, this measure does not allow analyzing the level of overlap between corporate and fund diversification (Schildt et al., 2005). A highly diversified firm may invest in a diverse set of CVC companies that have a close match with the internal activities. On the other hand, a diversified firm can invest in a very specialized set of portfolio companies that are on a large distance from its in-house activities. Third, we tested our hypotheses through cross-sectional analyses due to the peculiar features of the archival data available to construct the measure of market diversification. Indeed, the SIC codes for corporations are available only for the year of data collection and not on an annual basis. Future research could improve our empirical investigation by adopting panel data techniques, which support causal inferences since they control for unobserved heterogeneity or temporal precedence. Finally, we investigated the effect of inter-industry differences through the macro-distinction between high versus low-tech sectors, assessed in terms of technology intensity of the main industry of the corporation. This aspect can be improved along two main directions. First of all, future studies could introduce additional variables such as geographic conditions, possibility to access specific resources, effect of government regulations and action of competitors to determine how these factors impact on the level of CVC fund diversification. Secondly, we are aware that a dummy variable that roughly describes the intensity of technological search within an industry has limits. Within these broad categories there is high heterogeneity that is not explained. Specific characteristics of the technology such as complex (i.e.

telecommunications) versus discrete (i.e. pharmaceuticals), as suggested by Kash and Kingston (2001), or the appropriability regime within which the corporation operates (Teece, 1986; Dushnitsky and Lenox, 2005b) could address this issue as they might have a moderating effect on the usage of CVC. Normally, firms in complex technologies tend to file several patents covering each component of a product whereas firms in discrete technology markets can protect single products by fewer patents. Future studies could include these variables by using the Yale Survey (Levin et al., 1987) or the survey used in the work by Cohen et al. (2000) that gathered data to construct measures of appropriability at the industry level widely used by several applications (Levin et al., 1985; Cohen et al., 1987; Cassiman and Veugelers, 2002).

To conclude, our paper has also important managerial implications. CVC investment plays an important role in emerging technologies and markets and, accordingly, firms manage this type of activity with the aim to pursue strategic benefits. Our study draws implications for a more comprehensive and successful use of this type of inter-firm relations. As firm are, for definition, resources constrained, it is important providing managers with some insights regarding an effective use of CVC investments. In particular, incumbent firms should coordinate efforts in external venturing, taking into account the aim underlying the exploitation of CVC activities (entering new markets versus enhancing innovation), in-house characteristics (the level of corporate diversification) and contextual features (technological intensity of the industry). Furthermore, these considerations can be extremely helpful for corporations to decide what type of organizational structure for their CVC arms is more suitable. Indeed, corporate investment can take several forms. They can be externally managed (when investment are made via externally managed VC funds which in turn reinvest in small ventures) or internally managed (when investment in

external ventures are directly selected by and managed by the corporation) and, in each case, they may be coordinated by a separate subsidiary (full or partially owned) or by an in-house division. Firms can decide to externalize (or directly manage) some of their investments depending on the type of advantage these investments are able to provide with. In turbulent and technology-driven sectors, for instance, firms could be prone to increase the level of direct involvement in investment selection and venture nurturing given the high strategic benefits deriving from the investments. Conversely, in case of marginal benefits such as the extension of a current line of products or the access to a secondary market, corporations could prefer a less integrated organizational structure.

## References

- Ahuja, G. 2000. The duality of collaboration: inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal* 21(Special Issue): 317–343.
- Ahuja, G., and R. Katila. 2001. Technological acquisitions and the innovation performance of acquiring firms: A longitudinal study. *Strategic Management Journal*, 22: 197-220.
- Allen, S. C., Hevert, K. T. 2007. Venture capital investing by information technology companies: Did it pay? *Journal of Business Venturing*, 22: 262-282.
- Arora, A., and A. Gambardella. 1990. Complementarity and external linkages: The strategies of the large firms in biotechnology. *The Journal of Industrial Economics*, 38(4): 361-379.
- Basu, S., Phelps, C., Kotha, S. 2009. Towards understanding who makes corporate venture capital investments and why. *Journal of Business Venturing*, 26: 153-171.
- Beckman, C. M., P. R. Haunschild, and D. J. Phillips. 2004. Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection. *Organization Science*, 15(3): 259-275.
- Birkinshaw, J., van Basten Batenburg, R., Murray, G. 2002. *Corporate Venturing: The State of the Art and the Prospects for the Future*. London Business School: Centre for the Network Economy, London, U.K.
- Block Z, MacMillan I. 1993. *Corporate Venturing: Creating New Business Within the Firm*. Harvard Business School Press: Boston, MA.
- Brody, P., and D. Ehrlich. 1998. Can big companies become successful venture capitalists? *McKinsey Quarterly*, 2: 50-63.
- Butchart, R. 1987. A new UK definition of high-technology industries. *Economic Trends*, 400: 82-88.
- Cassiman, B., and R. Veugelers. 2002. R&D cooperation and spillovers: Some empirical evidence from Belgium. *The American Economic Review*, 92: 1169-1184.
- Chesbrough, H. W., and C. L. Tucci. 2004. Corporate venture capital in the context of corporate innovation. Working paper, Hass School of Business, UC-Berkeley.
- Chesbrough, H. W. 2002. Making sense of corporate venture capital. *Harvard Business Review*, March 2002.
- Chesbrough, H. W. 2003. *Open Innovation*. Harvard University Press: Cambridge, MA.
- Cohen, W. M., and D. A. Levinthal. 1990. Absorptive capacity: A new perspective of learning and innovation. *Administrative Science Quarterly*, 35: 128-152.
- Cohen, W. M., R. C. Levin, and D. C. Mowery. 1987. Firm size and R&D intensity: A re-examination. *Journal of Industrial Economics*, 55(4): 543-565.
- Cohen, W., R. R. Nelson, and J. Walsh. 2000. Protecting their intellectual assets: Appropriability conditions and why US manufacturing firms patent or not. Discussion Paper 7552, NBER.
- Cressy, R., F. Munari, and A. Malipiero. 2007. Playing to their strengths? Evidence that specialization in the private equity industry confers competitive advantage. *Journal of Corporate Finance*, 13: 647-669.
- Cumming, D. J. 2006. The determinants of venture capital portfolio size: Empirical evidence. *Journal of Business*, 79(3): 1083-1126.

- Dermine, J., and C. Neto de Carvalho. 2006. Bank loan losses-given-default: A case study. *Journal of Banking & Finance*, 30: 1219-1243.
- Dushnitsky, G. 2004. Limitations to inter-organizational knowledge acquisition\_ The paradox of corporate venture capital. Job market paper.
- Dushnitsky, G. 2006. Corporate venture capital: Past evidence and future directions. In *Oxford Handbook of Entrepreneurship (Oxford Handbook in Business & Management)*, Casson M., Yeung, B., Basu A., Wadeson N. (eds.) Oxford University Press: Oxford, UK.
- Dushnitsky, G., M. J. Lenox. 2005a. When do incumbents learn from entrepreneurial ventures? Corporate venture capital and investing firm innovation rates, *Research Policy*, 34: 615-639.
- Dushnitsky, G., M. J. Lenox. 2005b. When do firms undertake R&D by investing in new ventures? *Strategic Management Journal*, 26: 947-965.
- Dushnitsky, G., Lavie, D. 2010. How alliance formation shapes corporate venture capital investment in the software industry: A resource-based view perspective. *Strategic Entrepreneurship Journal*, 4(1): 22-48.
- Dushnitsky, G., and M. J. Lenox. 2006. When does corporate venture capital investment create firm value? *Journal of Business Venturing*, 21: 753-772.
- Ernst and Young. 2008. *Global corporate venture capital survey 2008-2009. Benchmarking programs and practices*. Available at [http://www.ey.com/GL/en/Services/Strategic-Growth-Markets/SGM\\_VC\\_Global\\_corporate\\_venture\\_capital\\_survey](http://www.ey.com/GL/en/Services/Strategic-Growth-Markets/SGM_VC_Global_corporate_venture_capital_survey).
- Ernst, H., P. Witt, and G. Brachtendorf. 2005. Corporate venture capital as a strategy for external innovation: An exploratory empirical study. *R&D Management*, 35(3): 233-242.
- Fulghieri, P., and Sevilir, M. 2005. Size and focus of a venture capitalist's portfolio. Working paper.
- Gambardella, A., and S. Torrisi. 1998. Does technological convergence imply convergence in markets? Evidence from the electronics industry. *Research Policy*, 27: 445-463.
- Gompers, P. 1995. Optimal investment, monitoring and the staging of venture capital, *Journal of Finance*, 50(5):1461-1489.
- Gompers, P., and J. Lerner. 1998. The determinants of corporate venture capital success: Organizational structure, incentives and complementarities. NBER Working paper N. 6725, Cambridge, MA.
- Gompers, P., and J. Lerner. 2001. *The money of invention: How venture capital creates new wealth*. Boston: Harvard Business School Press.
- Granstrand, O., and S. Sjolander. 1990. Managing innovation in multi-technology corporations. *Research Policy*, 19: 35-60.
- Granstrand, O., and S. Sjolander. 1992. Internationalization and diversification of multi-technology corporations. In: Granstrand, O., Hakanson, L., Sjolander, S. (eds.), *Technology management and international business - internationalization of R&D and technology*. John Wiley & Sons, Chichester.
- Granstrand, O., E. Bohlin, C. Oskarsson, and N. Sjoberg. 1992. External technology acquisition in large multi-technology corporations. *R&D Management*, 22(2): 111-133.

- Gupta, A. K., and H. J. Sapienza. 1992. Determinants of venture capital firms' preferences regarding the industry diversity and geographic scope of their investment, *Journal of Business Venturing*, 7(5): 347-362.
- Hall, B. H., A. B. Jaffe, and M. Trajtenberg. 2002. The NBER patent citations data file: Lessons, insights and methodological tools. NBER Working Paper Series.
- Hill S, Maula M, Birkinshaw J, Murray G. 2009. Transfer- ability of the venture capital model to the corporate context: implications for the performance of corporate venture units. *Strategic Entrepreneurship Journal* 3(1): 3–27.
- Hoskisson, R., Hitt, M. 1988. Strategic control systems and relative R&D investment in large multi-products firm. *Strategic Management Journal*, 9: 605-621.
- Jacquemin, A. P., and C. H. Berry. 1979. Entropy measure of diversification and corporate growth. *The Journal of Industrial Economics*, 27(4): 359-369.
- Kanniainen, V., and C. Keuschnigg. 2003. The optimal portfolio of start-up firms in venture capital finance. *Journal of Corporate Finance*, 9: 521-534.
- Katila, R. Ahuja, A. 2002. Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45(6): 1183-1195.
- Katila, R., Rosenberger, J. D., Eisenhardt, K. M. 2008. Swimming with sharks: Technology ventures and corporate relationships. *Administrative Science Quarterly*, 53(2): 295-332.
- Keil, T. 2002. *External corporate venturing: Strategic renewal in rapidly changing industries*. Quorum Books: Wetsport, CT.
- Keil, T. 2004. Building external corporate venturing capability. *Journal of Management Studies*, 41(5): 799-825.
- Keil, T., Maula, M., Schildt, H., Zahra, S. A. 2008. The effect of governance modes and relatedness of external business development activities on innovative performance. *Strategic Management Journal*, 29: 895-907.
- Keswani, A., and D. Stolin. 2006. Mutual fund performance persistence and competition: A cross-sector analysis. *The Journal of Financial Research*, 29(3): 349-366.
- Kodama, F. 1992. Technology fusion and the new R&D. *Harvard Business Review*, July-August: 70-78.
- Kodama, F. 1995. Emerging patterns of innovation - sources of Japan's technological edge. *Harvard Business School Press*, Boston, MA.
- Kortum, S., and J. Lerner. 2000. Assessing the contribution of venture capital to innovation. *The RAND Journal of Economics*, 31(4): 674-692.
- Laursen, K., M. Leone, and S. Torrisi. 2010. Technological exploration through licensing: New insights from the licensee's point of view. *Industrial and Corporate Change*, 19(3): 871-897.
- Laursen, K. Salter, A. 2006. Open for innovation: The role of openness in explaining innovation performance UK manufacturing firms. *Strategic Management Journal*, 27(2): 131-150.
- Lavie, D., and L. Rosenkopf. 2006. Balancing exploration and exploitation in alliance formation. *Academy of Management Journal*, 49(6), 797-818.

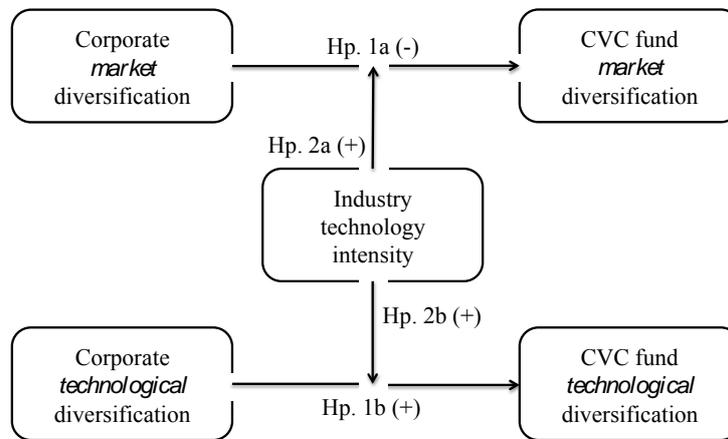
- Lerner, J. 2002. Boom and bust in the venture capital industry and the impact on innovation. *Federal Reserve Bank of Atlanta Economic Review*, Fourth Quarter 2002: 25-39.
- Levin, R. C., W. M. Cohen, and D. C. Mowery. 1985. R&D appropriability, opportunity, and market structure: New evidence on Schumpeterian hypotheses. *American Economic Review*, 75(2): 20-24.
- Levin, R. C., A. K. Klevorick, R. R. Nelson, and S. G. Winter. 1987. Appropriating the returns from industrial R&D. *Brookings Papers on Economic Activity*, 3: 783-820.
- MacMillan, I., Roberts, E., Livada, V., Wang, A. 2008. *Corporate Venture Capital (CVC) seeking innovation and strategic growth. Recent patterns in CVC mission, structure, and investment*. National Institute of Standards and Technology.
- March, J. G. 1991. Exploration and exploitation in organizational learning. *Organization Science*, 2(1): 71-87.
- March, J. G., Simon, H. 1958. *Organizations*. Wiley: New York.
- Markides, C. 1990. Corporate refocusing and economic performance. Unpublished doctoral dissertation, Harvard Business School.
- Markides, C. 1992. Consequence of corporate refocusing: Ex ante evidence. *Academy of Management*, 35(2): 398-412.
- Maula, M. V. J. 2007. Corporate venture capital as a strategic tool for corporations. In Landström, H. (eds.) *Handbook of research on venture capital*. Cheltenham, UK: Edward Elgar Publishing Ltd.
- Maula, M. V. J., Autio, E., Murray, G. 2009. Corporate venture capital and the balance of risks and rewards for portfolio companies, *Journal of Business Venturing*, 24: 274-286.
- Maula, M. V. J., Murray, G. 2002. Corporate venture capital and the creation of US public companies: The impact of sources of venture capital on the performance of portfolio companies. In: Hitt, M. A., Amit, R., Lucier, C., Nixon, R. D. (eds) *Creating value: Winners in the new business environment*. Blackwell Publishers, Oxford, UK.
- Maula, M. V. J., Autio, E., Murray, G. 2003. Prerequisites for the creation of social capital and subsequent knowledge acquisition in corporate venture capital, *Venture Capital*, 5(2): 117-134.
- Maula, M. V. J., Autio, E., Murray, G. 2005. Corporate venture capitalists and independent venture capitalists: what do they know, who do they know, and should entrepreneurs care? *Venture Capital*, 7(1): 3-19.
- McNally, K. 1997. *Corporate Venture Capital: Bridging the Equity Gap in the Small Business Sector*. Routledge: London, U.K.
- Mowery, D. C., and N. Rosenberg. 1989. *Technology and the pursuit of economic growth*. Cambridge University Press, New York.
- Nelson, R., and S. Winter. 1982. An evolutionary theory of economic change. *Harvard University Press*, Cambridge, MA.
- Norton, E., and B. H. Tenenbaum. 1993. Specialization versus diversification as a venture capital investment strategy, *Journal of Business Venturing*, 8(5): 431-442.

- NVCA. 2008. *NVCA Yearbook 2008*. [www.nvca.org](http://www.nvca.org)
- Palepu, K. 1985. Diversification strategy, profit performance and the entropy measure. *Strategic Management Journal*, 6: 239-255.
- Papke, L., and J. Wooldridge. 1996. Econometric methods for fractional response variables with an application to 401(K) plan participation rates. *Journal of Applied Econometrics*, 11(6): 619-632.
- Patel, P., and K. Pavitt. 1994. The continuing, widespread (and neglected) importance of improvements in mechanical technologies. *Research Policy*, 23(5), 533-545.
- Patel, P., and K. Pavitt. 1997. The technological competencies in the world's largest firms: Complex and path-dependent, but not much variety. *Research Policy*, 26(2), 141-156.
- Roberts, E. B., and C. A. Berry. 1985. Entering new business: Selecting strategies for success. *Sloan Management Review*, 26(3): 3-17.
- Robins, J., and M. F. Wiersema. 1995. A resource-based approach to the multibusiness firm: Empirical analysis of portfolio interrelationships and corporate financial performance. *Strategic Management Journal*, 16: 277-299.
- Robins, J., and M. F. Wiersema. 2003. The measurement of corporate portfolio strategy: Analysis of the content validity of related diversification indexes. *Strategic Management Journal*, 24: 39-59.
- Rosenkopf, L., Nerkar, A. 2001. Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal*, 22: 287-306.
- Rumelt, R. P. 1974. *Strategy, structure, and economic performance*. Harvard University Press: Cambridge, MA.
- Sahaym, A., Steensma, H. K., Barden, J. Q. 2010. The influence of R&D investment on the use of corporate venture capital: An industry-level analysis. *Journal of Business Venturing*, 25: 376-388.
- Sampat, B. 2005. Determinants of patent quality: An empirical analysis. Working paper.
- Schildt, H. A., M. V. J. Maula, and T. Keil. 2005. Explorative and exploitative learning from external corporate ventures. *Entrepreneurship Theory and Practice*, 29(4): 493-515.
- Siegel R, Siegel E, MacMillan I. 1988. Corporate venture capitalists: autonomy, obstacles, and performance. *Journal of Business Venturing* 3: 233-247.
- Stuart, T. E., Podolny, J. M. 1996. Local search and the evolution of technological capabilities. *Strategic Management Journal*, 17: 21-38.
- Sykes, H. 1990. Corporate venture capital: strategies for success. *Journal of Business Venturing* 5: 37.
- Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing, and public policy. *Research Policy*, 15: 285-305.
- Thompson, C. 1988. Some problems with R&D/SE&T-based definitions of high technology industries, *Area*, 20(3): 265-277.
- Tushman, M. L., and P. Anderson. 1986. Technological discontinuities and organizational environments. *Administrative Science Quarterly*, 31(3): 439-465.

- Wadhwa, A., and S. Kotha. 2006. Knowledge creation through external venturing: Evidence from the telecommunications equipment manufacturing industry. *Academy of Management Journal*, 49(4): 1-17.
- Zahra, S. A. 1996. Governance, ownership, and corporate entrepreneurship: The moderating impact of industry technological opportunities. *Academy of Management Journal*, 39(6): 1713-1735.
- Zahra, S. A., Covin, J. 1995. Contextual influences on the corporate entrepreneurship-performance relationship: A longitudinal analysis. *Journal of Business Venturing*, 10(1): 43-59.

## Figures

Figure 1. Theoretical model



## Tables

Table 1. Descriptive statistics and correlations (n = 234)

Variable	Mean	Std. Dev.	Min	Max	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. CVC Fund Market Diversification	0.519	0.225	0	0.88	1											
2. CVC Fund Technological Diversification	0.626	0.216	0	0.95	0.26*	1										
3. Corporate Market Diversification	0.555	0.232	0	0.875	-0.12	0.02	1									
4. Corporate Technological Diversification	0.675	0.216	0	0.983	0.06	0.18*	0.25*	1								
5. High-Tech	0.504	0.501	0	1	0.15	-0.01	-0.22*	-0.04	1							
6. Corporate Size (Log)	3.631	0.913	0.62	5.92	0.14	0.10	0.17*	0.19*	-0.03	1						
7. R&D Expenses	14680.79	55599.97	0.05	564781	-0.23*	0.05	0.11	0.04	0.09	0.16	1					
8. CVC Fund Size (Log)	1.453	0.592	0	4.903	0.16	0.03	-0.01	-0.05	0.08	0.07	0.06	1				
9. Early Stage	0.573	0.496	0	1	0.08	-0.03	-0.04	0.07	0.09	0.03	-0.06	0.09	1			
10. California	0.325	0.469	0	1	0.03	-0.10	-0.11	-0.12	0.27*	-0.09	-0.01	0.14	0.08	1		
11. Year2000	0.624	0.485	0	1	-0.10	-0.11	-0.10	-0.29*	0.01	-0.21*	0.04	0.38*	-0.12	0.14	1	
12. Market Conditions	1.130	0.450	-0.08	2.04	-0.01	-0.12	-0.14	-0.16	0.12	-0.19*	-0.2*	0.03	0.08	0.23*	0.03	1

Significance level (2-tailed): \* p<0.01

Table 2. Fractional Logit Regression with QMLE (n= 234)

Dependent Variable	<i>CVC Fund Market Diversification</i>			<i>CVC Fund Technological Diversification</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Corporate Market Diversification</i>		-0.433** (0.198)	-0.973*** (0.294)			
<i>Corporate Technological Diversification</i>					0.575* (0.321)	0.794* (0.472)
<i>High-Tech</i>	0.285** (0.118)	0.243** (0.118)	-0.344 (0.225)	0.0125 (0.127)	0.0189 (0.129)	0.301 (0.429)
<i>Corporate Market Diversification * High-Tech</i>			1.062*** (0.381)			
<i>Corporate Technological Diversification * High-Tech</i>						-0.422 (0.580)
<i>Corporate Size</i>	0.138* (0.0784)	0.151* (0.0785)	0.168** (0.0797)	0.0466 (0.0601)	0.0341 (0.0610)	0.0327 (0.0610)
<i>R&amp;D Expenses</i>	-7.36e-06*** (2.76e-06)	-7.11e-06*** (2.74e-06)	-7.48e-06*** (2.68e-06)	3.01e-07 (3.22e-07)	2.87e-07 (3.41e-07)	2.91e-07 (3.27e-07)
<i>CVC Fund Size</i>	0.347*** (0.0873)	0.353*** (0.0873)	0.364*** (0.0859)	0.148 (0.126)	0.139 (0.124)	0.146 (0.123)
<i>Early Stage</i>	0.0328 (0.114)	0.0273 (0.113)	0.0382 (0.112)	-0.0702 (0.119)	-0.0818 (0.119)	-0.0816 (0.119)
<i>California</i>	0.0124 (0.132)	0.010 (0.130)	0.00766 (0.130)	-0.131 (0.155)	-0.120 (0.156)	-0.125 (0.157)
<i>Year2000</i>	-0.280** (0.132)	-0.299** (0.133)	-0.295** (0.133)	-0.242* (0.129)	-0.171 (0.135)	-0.164 (0.135)
<i>Market Conditions</i>	-0.102 (0.138)	-0.124 (0.137)	-0.129 (0.138)	-0.183* (0.0998)	-0.149 (0.101)	-0.146 (0.100)
Constant	-0.708** (0.332)	-0.462 (0.344)	-0.215 (0.357)	0.566* (0.321)	0.155 (0.385)	-0.005 (0.467)

Robust standard errors are in parentheses. Significance level (2-tailed): \*\*\* p<0.01, \*\* p<0.05, \* p<0.1).

Table 3. Fractional Logit Regression with QMLE for the sub-sample of internally (direct) managed CVC (n= 120)

Dependent Variable	<i>CVC Fund Market Diversification</i>			<i>CVC Fund Technological Diversification</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Corporate Market Diversification</i>		-0.331 (0.269)	-1.064*** (0.381)			
<i>Corporate Technological Diversification</i>					1.329*** (0.512)	1.729** (0.816)
<i>High-Tech</i>	0.516*** (0.159)	0.479*** (0.156)	-0.290 (0.331)	0.0121 (0.190)	0.148 (0.186)	0.693 (0.752)
<i>Corporate Market Diversification * High-Tech</i>			1.357** (0.548)			
<i>Corporate Technological Diversification * High-Tech</i>						-0.781 (0.967)
<i>Corporate Size</i>	0.212** (0.0784)	0.225** (0.0978)	0.259*** (0.0995)	0.0622 (0.0806)	-0.009 (0.0908)	-0.0135 (0.0901)
<i>R&amp;D Expenses</i>	-1.32e-05* (7.63e-06)	-1.28e-05* (7.53e-06)	-1.27e-05* (6.85e-06)	-1.36e-08 (4.03e-07)	-1.53e-07 (4.44e-07)	-1.47e-07 (4.20e-07)
<i>CVC Fund Size</i>	0.264*** (0.0941)	0.275*** (0.0966)	0.294*** (0.0957)	0.115 (0.166)	0.148 (0.164)	0.161 (0.165)
<i>Early Stage</i>	0.134 (0.174)	0.125 (0.171)	0.116 (0.170)	-0.0605 (0.175)	-0.140 (0.170)	-0.139 (0.171)
<i>California</i>	-0.311* (0.175)	-0.311* (0.175)	-0.326* (0.174)	-0.366 (0.227)	-0.447** (0.221)	-0.450** (0.219)
<i>Year2000</i>	-0.0391 (0.156)	-0.0550 (0.158)	-0.0015 (0.161)	-0.169 (0.211)	-0.053 (0.208)	-0.049 (0.209)
<i>Market Conditions</i>	0.0507 (0.189)	0.0455 (0.187)	0.0713 (0.187)	-0.227* (0.136)	-0.141 (0.133)	-0.156 (0.137)
Constant	-1.124** (0.521)	-0.967* (0.523)	-0.718 (0.525)	0.605 (0.486)	-0.207 (0.588)	-0.474 (0.763)

Robust standard errors are in parentheses. Significance level (2-tailed): \*\*\* p<0.01, \*\* p<0.05, \* p<0.1).