Strategic Acquisitions by Corporate Venture Capital Investors*

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Abstract

Unlike traditional venture capitalists, corporate venture capital (CVC) investors are likely to eventually acquire portfolio ventures. I find that the likelihood of such an acquisition decreases with the uncertainty associated with the venture's innovation and increases with the number of CVCs co-invested. Moreover, CVCs with lower level of internal innovation are more likely to acquire portfolio ventures. However, the acquisition signals poor prospects for future innovation, which explains the negative market reaction to the announcements of such deals. I also show that CVCs appear to be learning through active management of their portfolios and acquire ventures backed by other CVCs when their own portfolio performs poorly.

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1 Introduction

Over the past decade, large established companies have undertaken substantial corporate venture capital (CVC) investments in innovative start-ups. In 2011 alone, CVCs invested $2.3 billion into 551 deals, representing 15% of all venture capital deals during that year. These investments are typically minority equity stakes held either directly or through wholly-owned subsidiaries. Such CVCs (e.g., "Intel Capital") bring a unique and specialized perspective to venture investing and are increasingly active in supporting the growth of emerging technologies.[1]

CVC investing is often viewed as an effective way for established companies to benefit from R&D conducted more efficiently by external units (Fulghieri and Sevilir 2009a). And indeed, firms investing in CVC enjoy a significant increase in their innovation rates and higher firm value (Dushnitsky and Lenox 2005b; 2006). CVCs also appear to provide portfolio ventures with valuable inputs improving operating and stock performance, at least when the CVCs play a complementary rather than competing role (Ivanov and Xie 2010). Yet, the extent to which CVC investments benefit the parent company, and the mechanisms through which CVCs add value remain ill-understood. For instance, while "identifying acquisition opportunities" has been a prominent motive for corporate venture investing, CVC acquisitions have been overlooked (Alter and Buchsbaum 2000).

Unlike traditional VCs, who mainly seek financial gains from selling portfolio firms, CVC investors have the additional goal of obtaining strategic benefits that arise from synergies with their existing activities (Hellmann 2002). For this reason, CVCs generally have strong incentives to acquire their portfolio companies, even if this does not maximize the CVC's financial returns from these investments (Masulis and Nahata 2011). Previous research shows that CVC takeovers of own portfolio companies are typically met with a negative stock price reaction, although this is not true for their acquisitions of other entrepreneurial firms (Benson and Ziedonis 2010). This raises the question of why corporate investors are willing to acquire portfolio companies. In this paper, I address this question by studying the determinants of acquisitions of CVC-backed entrepreneurial firms by 54 large U.S. corporate venture capitalists from 1987 to 2010. I also study whether these determinants explain the cross-sectional variation in acquisition performance.

I hypothesize that the timing of a CVC's decision to acquire a portfolio firm results from the trade-off between two opposing forces. On the one hand, the CVC is better off waiting for the venture's uncertainty to resolve before exercising its option to acquire it. Therefore, the likelihood of an acquisition should decrease with the venture's residual uncertainty. On the other hand, by waiting, the CVC runs the risk of being scooped for the venture, in particular by other CVCs co-invested in it. Therefore, the likelihood of an acquisition should increase with the number of

[1] Corporate venture capital, is significantly different from traditional venture capitalists in organizational structure, objectives, investment behavior, and the range of services provided to portfolio companies (Gompers and Lerner 2000a).

competing CVC investors (Grenadier 2002; Morellec and Zhdanov 2005).

I find that CVCs are less likely to acquire portfolio ventures with higher residual uncertainty. I measure the uncertainty associated with the venture's innovation using three alternative measures: number of patents, number of citations, and number of backward citations (references made to prior patents). Because patents and citations may also measure venture performance, I create my third measure of venture uncertainty, backward citations. I find that my results are statistically significant only when I use this last measure. In particular, an increase in the venture uncertainty by one standard deviation reduces the likelihood of a portfolio acquisition by 14%. Moreover, I find that as the number of other CVC investors co-invested in the venture increases, a CVC acquisition is more likely to occur, and to occur earlier.[2] For instance, going from two to four CVC investors increases the likelihood of an acquisition by 29%. In contrast, increasing the number of traditional VCs invested in the venture reduces the probability of a portfolio acquisition.[3] This is consistent with VCs favoring the most profitable exit, which may be an IPO or a trade sale to an outside buyer.

If CVCs manage actively their portfolios, I expect their decision to acquire portfolio venture to depend on the uncertainty associated with all *other ventures* included in the CVC's investment portfolio.[4] I test two alternative hypotheses. On the one hand, if CVCs transfer knowledge between portfolio ventures, and potentially reduce residual venture uncertainty, the probability of an acquisition should decrease with portfolio uncertainty (George et al. 2001). On the other hand, if allocating scarce resources to the most promising portfolio venture implies that start-ups effectively compete with one another for limited CVC capital, the probability of an acquisition should increase with portfolio uncertainty (Inderst, Mueller and Münnich 2007). I find support for the latter. In other words, CVC investors are more likely to acquire an innovative venture when the degree of innovation of its portfolio ventures is more uncertain (Fulghieri and Sevilir 2009b).[5]

I conjecture that the timing of the CVC's decision to acquire also depends on the level of the CVC's own innovation, measured by its patent stock. Some CVCs may be more efficient in producing innovations in-house, while others may choose to outsource R&D and acquire external innovations (Sevilir and Tian 2012). Therefore, controlling for R&D expenditures, the likelihood of an acquisition should decrease with the level of CVC's internal innovation. I find that an increase in the number of CVC patents by one standard deviation reduces the likelihood of a portfolio

[2] I use the number of CVCs invested in a given start-up company to measure the degree of potential competition.

[3] Typically corporate investors co-invest with traditional VCs. I find that portfolio ventures acquired by CVC investors are, on average, backed up by 3.7 traditional VC investors and 1.7 CVC investors. I use the number of traditional VCs co-invested in the venture to measure the degree of uncertainty associated with their presence.

[4] I use three alternative measures of portfolio uncertainty: portfolio patents, portfolio citations, and portfolio backward citations.

[5] Moreover, I also find that CVCs are more likely to acquire portfolio ventures when their holding portfolio is less diversified. I measure portfolio diversification by counting the number of all *other ventures* included in the investment portfolio of a given CVC investor.

acquisition by over 39%.[6] This is consistent with corporate investors with a poor innovation record being more dependent on external innovation and therefore more likely to acquire one of their portfolio ventures.

Next, I study the market reaction to acquisitions by CVC investors. Like Benson and Ziedonis (2010), I find that CVC investors experience an average significant negative abnormal return of -0.60%, when they acquire portfolio companies, but not when they acquire non-portfolio CVC-backed ventures.[7,8] Moreover, CVC acquirers with high levels of internal innovation experience more positive stock price reactions. Increasing the number of CVC patents by one standard deviation leads to an increase in the acquirers' cumulative abnormal returns (CARs) by over 6.8%. Consistent with my previous results that CVCs with less efficient internal innovation are more likely to acquire portfolio ventures, I find that the market reacts more negatively to the announcement of such deals. The decision of a CVC to acquire a portfolio venture reflects the CVC acquirer's high dependence on external innovation.

It is also common for CVC investors to acquire non-portfolio ventures backed by other CVCs. For such acquisitions, the results are slightly different.[9] I find that while the degree of venture uncertainty does not affect the decision of CVC investors to acquire a non-portfolio venture, portfolio uncertainty does. I find that the estimated effects are over twice as large as those for acquisitions of portfolio ventures. For instance, increasing portfolio uncertainty from its 25^{th} percentile to the 50^{th} percentile increases the probability that a CVC investor buys a non-portfolio venture by more than 29.3%, against 14.7% for a portfolio venture. In other words, CVCs appear to be learning through active management of their portfolios and acquire ventures backed by their competitors when their own portfolio performs poorly.

Similar to acquisitions of portfolio ventures, I find that the likelihood of a non-portfolio acquisition increases with the number of CVCs involved. To preempt the potential competition from invested CVCs, outside corporate bidders are more likely to acquire the venture earlier. However, the presence of VCs co-invested in the venture does not appear to affect CVC acquisitions of non-portfolio ventures. I also find that unlike for portfolio ventures, the likelihood of acquisitions of non-portfolio ventures is independent of the level of innovation of the CVC acquirer. Moreover, the level of CVC's innovation does not affect the performance of non-portfolio acquisitions; possibly because acquirers of non-portfolio ventures have not previously invested in the venture, and thus, have not shown intentions of acquiring its innovation. Further, the target insiders, unaware of the CVC's own innovation and its willingness to pay for external innovation, earn lower premi-

[6] My results are even stronger when I scale the number of patents owned by the CVC investor by its R&D expenses.

[7] On a dollar-value basis, these estimates suggest that the average portfolio acquisition is associated with a loss of $45.9 million in CVC's shareholder value.

[8] Although, when I take into account the significant positive market reaction to the initial CVC investments made in portfolio ventures, I show that acquisitions of portfolio ventures are actually not worse than acquisitions of non-portfolio ventures.

[9] Non-invested CVC acquirers, unlike CVCs that have backed the venture, face higher degree of information asymmetry.

ums. Hence, my findings can explain some of the difference in performance between acquisitions of portfolio versus non-portfolio ventures.

A potential issue is that CVCs' investment choices are endogenous. As a further check, I perform Heckman two-stage estimation. The results are robust and remain largely unchanged after taking into account the selectivity correction. I also examine my data in a duration framework to address the issue of timing of the acquisition. I use a Cox proportional hazard model, which in contrast to the logit approach, does not assume the probability of an acquisition to be constant over time. I confirm that my findings do not suffer from survivorship bias.

This paper relates to three strands of literature. First, CVCs have received only limited attention in the finance literature, which unlike the management studies, either ignores them or bundles them together with traditional VCs.[10] To my knowledge, the only paper that studies CVC acquisitions is Benson and Ziedonis (2010). The authors find that, unlike acquisitions of other companies, CVCs experience significant negative abnormal returns when they acquire portfolio ventures.[11] My paper contributes to our understanding of CVC by examining the determinants of such acquisitions. Moreover, I show that some of these determinants can explain part of the difference in performance between acquisitions of portfolio versus non-portfolio ventures. Second, the role of M&A for innovation has recently received attention.[12] Established firms may prefer acquiring smaller innovative firms to conducting R&D in-house. My study sheds light on M&A as a way to access external innovation, by showing that CVCs with poor internal innovation, are more likely to acquire external knowledge. Last, relatively recent and limited research has shown that individual investments are not evaluated in isolation, as predicted by standard models.[13] By documenting the effect of the overall venture portfolio innovativeness and diversification on the CVC investment decisions about individual portfolio and non-portfolio companies, this paper also relates to the limited literature on interactions among investments and CVC firms' investment strategies.

The paper proceeds as follows. Section 2 discusses the literature and derives hypotheses about the decision of the corporate investor to acquire a CVC-backed venture. Section 3 describes the data set and summarizes the characteristics of the sample. Section 4 presents the empirical results. Section 5 concludes.

[10] CVC has been mainly examined by management scholars (See Chesbrough 2002; Dushnitsky and Lenox 2005b).

[11] The authors cannot explain the negative CARs by overconfidence, poor governance, or by competition-driven overbidding by the CVC acquirer.

[12] For instance, see Sevilir and Tian (2012), and Phillips and Zhdanov (2012).

[13] See Kanniainen and Keuschnigg (2004), Inderst, Muller and Münnich (2007), and Sorensen (2008).

2 Literature and Hypothesis Development

This section starts with a discussion of the concept of open innovation and the use of CVC investments as a way to access external innovation. Next, it develops the hypotheses about the determinants of the corporate investor's decision to acquire a portfolio venture. The second half of the section discusses the decision of CVC investors to acquire a non-portfolio venture.

2.1. Open Innovation Paradigm

Firms increasingly use CVC as a "window onto new technologies" that gives them access to highly innovative start-ups, and knowledge that resides outside their boundaries. Fulghieri and Sevilir (2009a) show that with a high level of competition CVC emerges as an optimal investment strategy, especially in innovation-intensive sectors. As the intensity of the race to innovate increases, firms move from internal to external organization of innovation, and increase the success rate of their R&D projects by providing a greater proportion of the financing needs of the R&D project in the form of CVC investments.

The advantage of external innovation comes from the potential to mitigate the moral hazard problem, on the part of the inventor (entrepreneur), arising from the separation of ownership and management. According to the principal-agent conflict, managers are more risk averse than shareholders and avoid innovative projects that will increase the riskiness of the firm. Managers may be reluctant to take variance-increasing R&D projects, which shareholders would like to undertake, and as a result the internal innovation, and long-term investments of the firm can suffer. When innovation is not developed internally, as is the case of CVC investments, the property rights of any future innovation remain in the hands of the innovative start-up companies, and therefore they have stronger incentives to exert effort (Grossman and Hart 1986; Hart and Moore 1990). Moreover, the inability of CVC investors and start-up companies to write ex ante contracts specifying the conditions at which the innovation is delivered and implemented, leads to incomplete contracts. This implies that any preexisting sharing rule is renegotiated away, and the division of the surplus is determined entirely by interim bargaining. Thus, the innovative venture's payoff is independent from any equity stake that the CVC investor may have in the venture's equity. Acquisitions, on the other hand, result in weaker incentives for the innovative ventures, since the CVC acquirer obtains all property rights of any future innovation. Hence, acquisitions may be costly for the CVC firm because they may lead to a lower probability of obtaining innovation. Unless corporate investors are certain about the nature and value of the venture's innovation they will be cautious taking control over the innovative start-up company.

While CVC investments may alleviate the moral hazard problem, they may increase the problem of asymmetric information between the inventor and the CVC investor. An inventor frequently has better information about the likelihood of success and the nature of the contemplated innovation project than the corporate investor. The asymmetric information problem could lead to

Akerlof's (1970) "market for lemons". When the level of intellectual property rights is a highly observable signal, as it is in the U.S., the "lemons" problem could be potentially mitigated, but certainly not eliminated. Moreover, start-up firms are reluctant to reduce the information asymmetry, by revealing their innovative ideas to CVC investors, because of fear of expropriation or imitation of their ideas. In other words, because there could be a substantial cost of revealing information to their competitors, start-up companies have an incentive to reduce the quality of the information they provide about the potential of the venture. CVC investments allow investors to minimize commitment and downside risk, while retaining their ability to gain via subsequent investments from the upside potential of good ideas.[14]

According to Siegel et al. (1988), CVC investors rate "exposure to new technologies and markets" and "potential to acquire companies" among their top five reasons for investing in start-ups. Similarly, Alter and Buchsbaum (2000) report that "identifying acquisition opportunities" is a prominent motive for corporate venture investing. CVC investments that precede acquisitions of full control limit downside risk for corporate investors by providing them with valuable information about their ventures' markets and technologies (Dushnitsky 2006). This information provides investors with an advantaged position relative to non-investors, and allows both investors and ventures to make more informed and better decisions about the acquisition (Roberts and Weitzman 1981). However, since the patent stock of a company is publicly available information, one may argue that in addition to CVC investors any potential bidder has the option to acquire the venture. Therefore, in order to differentiate between CVC acquisitions of portfolio ventures and CVC acquisitions of non-portfolio ventures, in my analysis, I implicitly assume that the asymmetric information between the innovative ventures and CVC investors is lower relative to the incomplete information between the ventures and outside CVC companies that have never invested in them.[15]

Ventures have high dissolution rates and often work with new technologies in unproven markets, creating uncertainty about viability of the technology and the venture.[16] McDonald and Siegel (1986) and Pindyck (1988) use a contingent claims framework to value the option to postpone irreversible investment in the presence of uncertainty. They show that uncertainty lowers irreversible investment in two ways. First, the value of waiting causes firms to defer investing in a given project until uncertainty is resolved. Second, uncertainty lowers investment by reducing the optimal size of risky projects. However, a maintained assumption in the above models is that firms hold exclusive property rights to their options, and that their own-firm investment returns are independent of

[14]First, in the presence of potentially unfavorable outcomes, the investor can minimize its losses by abandoning the investment, by selling or writing off its equity stake (Li and Mahoney 2011). Second, the investor can defer action and allow uncertainty to resolve over time (Dixit and Pindyck 1994). Third, given that CVC investments provide privileged access to valuable real options, investors may decide to exercise their option by taking on subsequent investment opportunities. For example, by taking a full control of the venture.

[15]In other words, while both acquirers (invested CVC acquirers and non-invested CVC acquirers) hold options, the option of the former has a lower volatility. Therefore the "option to wait" is less valuable for invested CVC acquirers than for non-invested CVC acquirers.

[16]If the start-up fails, its assets cannot be easily redeployed, making the investment largely irreversible (Li and Mahoney 2011).

rivals' investment returns.

Recent takeover models address these concerns by introducing strategic interactions. On the one hand, some argue that competition erodes real option values and reduces investment delays (Grenadier 2002; Lambrecht and Perraudin 2003; Morellec and Zhdanov 2005). On the other hand, other studies show that the prediction that competition drives option premia to zero is not generally true (Novy-Marx 2007). Therefore, while the effect of product market competition on investment is an empirical issue, it is important to study the decision of CVC investors to acquire, while taking into account the strategic acquisition decisions of other corporate investors. Morellec and Zhdanov (2005), show that the timing and the terms of the acquisition are determined jointly in the presence of competition and imperfect information. Because the future value of the innovative venture is uncertain, there is opportunity cost of acquiring it today, "the option to wait". However, when there is competition and fear of preemption, the option to wait becomes less valuable and this speeds up the acquisition process. This may be especially true for CVC investors that are in a weaker competitive position and rely largely on external innovation. Finally, the choice to acquire may also depend on the uncertainty associated with the corporate venture portfolio, which includes all other start-up companies backed by the CVC investor. I develop the testable hypotheses in more detail below.

2.1.1. Venture Uncertainty

New ventures are typically engaged in developing novel technologies that are often characterized by significant uncertainty related to the technological arena the venture is pursuing. They exhibit significant volatility in terms of their survival and future economic returns (Li and Mahoney 2011). Technological uncertainty is an important aspect of uncertainty that innovations are faced with. Furthermore, the level of venture uncertainty could influence the acquisition decision of the CVC investor. As time passes, the technology is being improved, more information becomes available about its commercial viability, and as a result, the uncertainty associated with the venture diminishes. Therefore, I expect that as the technological uncertainty associated with the venture declines, the CVC investor becomes more likely to acquire the start-up.

I estimate the degree of venture uncertainty that CVC investors face, by measuring the uncertainty associated with the start-ups' innovation. An extensive literature on the economics of technological change demonstrates that patenting activity reflects the quality and extent of firm innovation (Hall, Jaffe, and Trajtenberg 2001). I use widely accepted patent-based measures of firm innovative activity that have been shown not only to capture firms' technological contribution but also to be economically meaningful (Hall, Jaffe, and Trajtenberg 2005). The first measure of innovative output that I use is a simple count of the number of patents granted. However, patent counts do not reflect the importance, or novelty of a patent. Therefore, my second metric of innovation involves measuring the value of a patent by counting the number of citations a patent has received following its approval. It should be mentioned that the number of patents and number

of citations variables may suffer from truncation bias. The truncation bias stems from the lag in patent approval (of about two years) and the general lag in citations. Thus, towards the end of the sample, patents and citations under report the actual patenting activity since many patents, although applied for, might not have been granted, or cited.

While I use the stock of patents, and stock of citations as proxies of venture uncertainty, it can be argued that these measures also capture venture performance. Start-up companies may use patents to reduce the asymmetric information between their firms and investors, and improve their chances of securing investment. However, although patents may measure uncertainty, if they are correlated with hard-to-measure start-up firm capabilities and characteristics, they may also signal firm quality. I create an additional measure of venture uncertainty, the number of backward citations (references made to prior patents). In particular, I count the number of citations that a granted patent made to previous patents. I conjecture that granted patents that cite fewer previous patents are more self-reliant, and therefore, associated with more uncertainty, relative to granted patents that cite many previous patents, and are generally considered to be more basic.

2.1.2. Competitive Uncertainty

Shared real options may be less attractive than financial options (which are typically exclusive) because counter investments by the competition can erode or even preempt profits (Kester 1984). When options are shared between investors, each firm may have different reasons to hold the option and will usually assign different values to the underlying assets. Anyone of the holding investors will be encouraged to exercise their option earlier than one otherwise would, to preempt the actions of the competitor and extract higher returns (Trigeorgis 1996; Grenadier 2002). The actions of competitive investors may not only increase the price of exercising the option but also reduce its value (Folta and Miller 2002). As more competing investors are sharing the option, the uncertainty associated with capturing value from it increases.

Typically corporate venture capitalists tend to co-invest with other corporations and with traditional VCs (Dushnitsky 2006). Moreover, traditional VC investors invest in start-up companies following their sole financial objective to maximize return on capital. In contrast, most often CVC investors are motivated to invest based on their strategic objectives to learn about a novel technology and develop a new, related business (Dushnitsky and Lenox 2006; Hellman, Lindsey and Puri 2008). As a consequence, CVC investors who wish to acquire a portfolio venture, a venture in which they have been previously investing, face two forms of competitive uncertainty. First, other investors may prefer venture exit via an IPO, or selling the venture to a different acquirer.[17] Second, a corporate investor may face competition from other CVC investors, who also want to acquire the venture. In both cases a CVC investor delaying the acquisition of the portfolio venture creates the risk of preemptive actions by other investors and potential loss of investment opportunity.

[17]For example, the strategic objectives of CVCs are likely to be in conflict with both those of the traditional VCs and the start-up founders, and this may have an impact on the start-up's development, direction, valuation, and exit strategy (Hellmann 2002).

These two forms of uncertainty have opposing effects on the probability of a portfolio acquisition. The level of potential competition and the fear of preemption coming from other co-invested CVCs, may encourage the CVC acquirer to take over the venture earlier. VC investors might be more inclined to vote against an acquisition by a CVC insider if they can receive higher financial returns when the the venture is sold via IPO, or to an outside company that does not hold a toehold (pre-bid ownership of target shares).[18] Venture capitalists may prefer the portfolio company to go public because this event typically yields the highest returns for investors (Gompers and Lerner 2000a; Gompers and Lerner 2004). Further, Betton and Eckbo (2000) show that greater bidder toeholds reduce the probability of competition and are associated with lower bid premiums.[19]

I use the number of VC and CVC investors in a given start-up company to measure the degree of VC and CVC competitive uncertainty associated with the venture. I expect to find a negative relation between the number of VCs that have invested in the start-up, and the probability that one of the CVC investors acquires the venture. In contrast, as the number of competing CVC investors increases, the threat of preemption also increases. Higher uncertainty that a competing corporate investor may acquire the venture first, is expected to have a positive effect on the speed of acquisition. Moreover, the presence of multiple invested CVC investors may also signal higher interest in the start-up firm. Therefore, I expect the more CVCs have invested in the venture, the more likely that the venture is acquired.

2.1.3. CVC Innovativeness

The effect of potential competition, coming from co-invested CVC investors, on the probability of acquisition may differ depending on the level of competitiveness of the CVC acquirer. Although acquiring innovation may be an important motive for undertaking investments in innovative ventures, and subsequently acquiring them, some CVC investors may rely more on external innovation than others (Sevilir and Tian 2012). For instance, CVCs that are more efficient in producing internal innovation may be less likely to react to the threat of competitors. Because they are less dependent on external innovation, their value of the "option to wait" is higher, despite the risk of being overtaken by the competitors. In other words, the costs of acquiring the venture earlier may be lower for corporate investors that are in need to access new innovation, relative to CVCs that are in a strong competitive position. I measure the degree of CVC competitiveness using the stock of patents owned by a given investor.[20] I conjecture that the likelihood that corporate investors acquire a portfolio venture is higher when their own internal innovation is relatively poor.

[18] This is assuming that CVC investors with a toehold are unable to renege on their offers, and are not intentionally overbidding in hopes of provoking higher counteroffers (Singh 1998).

[19] Other studies explore conflicts of interest in mergers and acquisitions that arise among institutional shareholders, when some institutional investors hold shares in both bidders and targets, and find that they significantly affect managerial merger decisions (Harford, Jenter and Li 2011; Bodnaruk, Massa and Simonov 2009; Matvos and Ostrovsky 2008). Masulis and Nahata (2011) extend this line of research by exploring the conflicts of interest that exist among equity investors in privately held VC- and CVC-backed companies, and show their effects on acquisition profitability and target purchase prices.

[20] My results are robust when I scale the number of patents owned by the CVC investor by its R&D expenses.

2.1.4. CVC Portfolio Uncertainty

Corporate investors typically invest in more than one start-up at any given time, and engage in active portfolio management to maximize the return from their investments. While a smaller portfolio gives stronger incentives for CVCs to provide support to companies, a larger portfolio allows reallocation of human capital across start-ups, which is valuable when the probability of a start-up failing is high, and when start-ups are technologically more related (Kanniainen and Keuschnigg 2004; Fulghieri and Sevilir 2009b). Hence, given the importance of portfolio interactions, it is reasonable to take into account the holding portfolio of CVC investors when examining their decision to acquire.

To measure the size of the CVC's venture portfolio I simply count the number of *all other ventures* that the CVC has invested in for a given year. Therefore, for a given venture i included in the venture portfolio of acquirer k, the portfolio size, $Portfolio\ Size_{itk}$, is the number of all other ventures included in the portfolio of CVC acquirer k in year t, apart from venture i.

$$Portfolio\ Size_{itk} = \sum_{i=1}^{n} Venture_{itk} - Venture_{itk} \tag{1}$$

Because I also study acquisitions by CVC acquirers of non-portfolio ventures, ventures in which they have not been previously investing, the CVC's portfolio size at the time of a non-portfolio acquisition will be the sum of all ventures included in the CVC's portfolio. In other words, for a non-portfolio venture j, acquired by CVC acquirer k but not included in its venture portfolio, the portfolio size, $Portfolio\ Size_{jtk}$, is the number of all ventures that CVC acquirer k is invested in for a given year t.

$$Portfolio\ Size_{jtk} = \sum_{i=1}^{n} Venture_{itk} \tag{2}$$

To measure the degree of innovation on a venture portfolio level, rather than on an individual start-up level, I create three additional variables. The first measure is the sum of all granted patents to the *other ventures* included in the venture portfolio of a given CVC investor. Specifically, let $Patents_{itk}$ be the cumulative number of patents that venture i, from the portfolio of CVC acquirer k holds in year t. The number of patents of the *other ventures* included in the CVC portfolio, $Portfolio\ Patents_{itk}$, is then, $Patents_{-itk}$, the sum of patents of all ventures included in the venture portfolio of CVC acquirer k, excluding the patents of venture i, that is,

$$Portfolio\ Patents_{itk} = \sum_{i=1}^{n} Patents_{itk} - Patents_{itk} \tag{3}$$

For a non-portfolio venture j acquired by CVC acquirer k but not included in its venture portfolio, the number of portfolio patents, $Portfolio\ Patents_{jtk}$, equals the sum of cumulative patents granted to all ventures included in the venture portfolio of CVC acquirer k for a given year t. In other words, the number of portfolio patents, $Portfolio\ Patents_{jtk}$ for a non-portfolio venture j, acquired by CVC investor k, is given by,

$$Portfolio\ Patents_{jtk} = \sum_{i=1}^{n} Patents_{itk} \tag{4}$$

In a similar manner I create my second variable of portfolio uncertainty, $Portfolio\ Cites_{itk}$, a variable that measures the sum of all citations to granted patents to the *other ventures* included in the venture portfolio of a given CVC investor. Hence,

$$Portfolio\ Cites_{itk} = \sum_{i=1}^{n} Cites_{itk} - Cites_{itk} \tag{5}$$

For a venture j that is not included in the venture portfolio of CVC investor k, the equation becomes,

$$Portfolio\ Cites_{jtk} = \sum_{i=1}^{n} Cites_{itk} \tag{6}$$

My third measure of portfolio uncertainty is the backward citations made by granted patents, $Portfolio\ Backward\ Cites_{itk}$, a variable that measures the sum of all backward citations that granted patents to the *other ventures* included in the venture portfolio of a given CVC investor have made.

$$Portfolio\ Backward\ Cites_{itk} = \sum_{i=1}^{n} Backward\ Cites_{itk} - Backward\ Cites_{itk} \tag{7}$$

And for a non-portfolio venture j, respectively,

$$Portfolio\ Backward\ Cites_{jtk} = \sum_{i=1}^{n} Backward\ Cites_{itk} \tag{8}$$

As discussed earlier, although CVC investments give corporations access to highly innovative start-ups, these ventures are typically associated with a significant degree of technological uncertainty. Counting the number of ventures included in the corporate portfolio may not fully capture the gains realized from these investments and it is important to consider them as a bundle of capabilities (George et al. 2001). Higher innovativeness of the *other ventures* (included in the CVC's portfolio) may be associated with a better CVC expertise of selecting, or endorsing the start-up companies. If CVC investors are learning from their investments and transfer knowledge between portfolio ventures, they may potentially reduce the residual uncertainty associated with a given venture. Therefore, the probability of an acquisition should decrease with portfolio uncertainty. On the other hand, allocating scarce resources to the most promising portfolio venture implies that start-ups effectively compete with one another for limited CVC capital (Inderst, Mueller and Münnich 2007). The CVC investor may be more willing to acquire when the degree of innovation of its portfolio ventures is more uncertain. Therefore, the probability of an acquisition should increase with portfolio uncertainty. Which effect dominates (transfer of knowledge vs. allocation of scarce resources) in the decision of CVC investors to acquire is an empirical issue that I test in my analysis.

2.2. Strategic Acquisitions of Non-Portfolio Ventures

In this section I examine the determinants of the decision of CVC investors to acquire CVC-backed start-up companies in which they have not been previously investing. My goal is to understand why a CVC company would decide to acquire a less known, non-portfolio start-up firm, given that it has invested in other start-ups, included in its venture portfolio. By acquiring a non-portfolio start-up, the CVC acquirer is no longer able to take advantage of the reduced information asymmetry associated with ventures that are included in its holding portfolio. Moreover, the CVC acquirer is also risking facing a tougher competition from other CVC investors that have invested in the venture, and are therefore likely to have more preferential positions.

Given their limited resources, corporate investors typically invest in a limited number of heterogeneous ventures. Using a framework that explicitly considers the heterogeneity and availability of projects, Sorensen (2008) finds evidence that strongly rejects the hypothesis that individual VC investments are evaluated in isolation. VCs not only learn from past investments (exploitation) but also consider the option value of future learning (exploration) when making investment decisions. I expand on these findings and study whether the uncertainty of the CVC's venture portfolio could

potentially affect their choice to acquire a non-portfolio venture. The question that I am interested in is whether CVC investors learn from their investments in start-up companies and whether their acquisitions of non-portfolio ventures are a reaction to this learning. If indeed CVC investors engage in active portfolio management, I expect to find a negative relation between the innovation of the CVC's venture portfolio and the propensity of a non-portfolio venture acquisition.

Because CVC acquirers of non-portfolio ventures face higher asymmetric information, their option to acquire a venture in which they have not been previously investing has a higher volatility, and thus, is more valuable. Therefore, similarly to acquisitions of portfolio ventures, I expect to find that the likelihood of a non-portfolio venture acquisition increases with the decline in venture uncertainty. However, the effect should be mitigated by the fact that CVC acquirers of non-portfolio targets face higher information asymmetry. The effect of competitive uncertainty on the CVC decision to acquire a non-portfolio venture is also different since the CVC acquirer is now an outside competitor. Following their financial incentives, VC investors that have invested in the venture, would welcome increased competition for the target by outside bidders. They may act as intermediaries between the ventures and potential outside acquirers, by reducing the information asymmetry between both. Hence, I expect to find a positive relation between the probability that a CVC company acquires a non-portfolio venture, and the number of VCs that have invested in that venture.

When I examine the effect of competitive uncertainty, coming from other CVC investors that have invested in the venture, on the decision of an outside CVC acquirer to purchase a non-portfolio venture, I expect to find a stronger effect, relative to my findings on acquisitions of portfolio ventures. The fact that CVC investors who have been previously investing in the venture have superior information and in some cases possibly preferential contracts, suggests that an outside bidder will face a stronger competition when buying a non-portfolio CVC-backed venture. The outside CVC acquirer may try to preempt the actions of inside CVC investors, who may also want to acquire the venture, and purchase the venture earlier. Therefore, I expect to find a positive relation between the number of CVC investors that have invested in the venture and the speed to acquisition by an outside CVC acquirer.

2.3. Performance of Acquisitions by CVC Investors

Next, I seek to explain the cross-sectional variation in the CVC acquirers' acquisition performance by focusing on factors that explain their decision to acquire. Following Benson and Ziedonis (2010), I include venture uncertainty and competition as explanatory variables in my model. Under uncertainty, the option to wait is usually more valuable. However, in the presence of competition and fear of preemption, CVC investors may be encouraged to acquire the venture earlier. Given the high opportunity cost of an early acquisition, high venture uncertainty may signal premature acquisition. Therefore, I expect the market reaction to the acquisition announcement to be negatively related to the level of venture uncertainty. CVC firms may offer higher premiums to potential targets in order to deter competing bids and acquire the target. Because CVC acquirers may end

up overpaying, I also expect to find a negative relation between acquirers' abnormal returns and competition coming from other CVC investors (Moeller et al. 2004).

If indeed CVC investors are investing in innovative start-ups mainly to access external innovation, the decision of a CVC investor to acquire a portfolio venture may reveal information to the market not only about the innovativeness of the target, but also about the CVC's own current and future innovation. The competitive race for innovation may especially affect CVC investors who rely extensively on external innovation, investors who are in a weaker competitive position and have lower level of internal innovation. I test this hypothesis by measuring the internal innovation of the acquirer with the patent stock of the CVC investor, and conjecture a positive relation between the level of the acquirer's internal innovation and acquisition performance.[21] In other words, I expect that the market reacts more negatively to the announcement of acquisitions by CVC acquirers with poor internal innovation, relative to the announcement of acquisitions by CVC acquirers that are less dependent on external innovation.

Lastly, I examine the cross-sectional variation in the acquisition returns of acquirers of non-portfolio ventures. Similarly to acquisitions of portfolio ventures, I expect venture uncertainty and competition to have negative effect on the announcement returns of CVC acquirers. However, the expected effect of CVC's internal innovation on the acquirer's returns is unclear. The CVC acquirer has not previously invested in the non-portfolio venture, and therefore, has not signaled to the market its interest of acquiring external innovation. Moreover, the target insiders are also unaware about CVC's willingness to pay for external knowledge, and may not be able to extract higher premiums. For these reasons, when I examine acquisitions of non-portfolio ventures, I do not expect to find a significant relation between the level of the acquirer's internal innovation and acquisition performance.

3 Data

The data set is constructed from several data sources combining information on CVC and VC investments, patent data, financial information and other firm characteristics. In this section I describe the steps in constructing the sample, and provide summary statistics.

3.1. CVC and M&A Data

To construct my sample of CVC acquirers, I first use the population of firms engaging in corporate venture activity from Thomson Financial's VentureXpert database. I examine all publicly traded U.S. companies that have provided venture capital directly to start-ups, from 1987 through 2010. Using Thomson Financial's SDC Mergers and Acquisitions database I identify all CVC investors that have subsequently acquired at least one entrepreneurial firm from their venture portfolios. The

[21] The results are robust when I scale the number of CVC's patents by its R&D expenses.

resulting sample includes 54 CVC acquirers of 117 targets of portfolio ventures acquired by them.[22] Approximately 89% of these targets are private companies. I next obtain all start-up companies that were part of the venture portfolios of those 54 CVC investors but were never acquired by them. This results in 2,662 ventures that were not acquired, from a total of 2,779 start-ups, in which corporate investors have invested over the years. I also select all acquisitions, made by the 54 CVC investors, of start-up companies that were not included in their venture portfolios but were CVC-backed by other investors. My sample includes 186 acquisitions of targets of non-portfolio ventures, 80.7% of which are private companies. These findings suggest that CVC investors are also likely to acquire competitors' CVC-backed start-ups, without previously having investing in them.

Table 1 presents all 54 CVC acquirers in my sample, the number of ventures included in their investment portfolios, as well as the number and fractions of acquisitions of portfolio and acquisitions of non-portfolio start-ups that they have made. The distributions suggest that on average CVC investors acquire only 4.2% of all portfolio companies in which they have been previously investing. At the same time they also acquire non-portfolio CVC-backed start-ups. These acquisitions represent 6.7% of all companies in which the corporate investors have invested.[23] Further, the results presented in Table 1 also show that there is a significant variation across different CVC acquirers, in both the size of their venture portfolios and the fraction of portfolio and non-portfolio ventures that they eventually acquire.

Table 2 summarizes the distributions of my sub-samples by year. The table presents the number of ventures included in the CVC portfolio each year. It also lists the share of portfolio ventures that were acquired by their CVC investors every year, as well as the share of non-portfolio ventures purchased by CVC acquirers. Two things should be highlighted from the summary statistics. First, the level of corporate venture activity has risen over the period, reflecting the more general growth of the corporate venture capital industry over these years. Second, the share of acquisitions of portfolio and non-portfolio ventures, purchased by CVC acquirers, also appears to be increasing over time. Moreover, the summary statistics show that some periods, such as the late-1990s, and late mid-2000s, are associated with a significant increase in the number of both portfolio and non-portfolio acquisitions. In good times, money flows easily into start-ups. When times turn bad, corporate investors disappear. Therefore, to control for the time clustering of acquisition events across firms, I include year-fixed effects in my regression analyses.

Table 3 contains the industry composition of CVCs' venture portfolios, and the composition of their portfolio and non-portfolio target firms. The dominant importance of firms in the "business services", "electronic, electrical equipment and components, except computer equipment", and "surgical and medical instruments and apparatus" industries is apparent. The concentration

[22] I have 3 financial acquirers (SIC codes between 6000 and 6999) in my sample, however their inclusion in my analyses does not change the results.

[23] The difference between the number of portfolio acquisitions and the number of non-portfolio acquisitions is not statistically significant.

of acquired targets by CVC companies in these industries closely mirrors the overall corporate investment pattern of the examined CVC investors. What is more interesting is that the pattern of acquired portfolio targets almost perfectly matches the pattern of acquired non-portfolio targets. This suggests that CVCs may be learning from their investments in portfolio ventures and acquire non-portfolio companies.

3.2. Patent Data

The patent data are obtained from the National Bureau of Economic Research (NBER) patent database, which includes detailed information on more than three million patent documents submitted to the U.S. Patent and Trademark Office (USPTO) from 1976 to 2006. Since the NBER database ends in 2006, I consult the USPTO database search engine and update my dataset to 2010. Most start-ups included in my sample are private companies that lack an identification number. Therefore, I use their firm name to obtain the patent data. The goal is to collect information on the firms' innovative activity covering the period from their founding year until 2010, or the year of the company's acquisition or liquidation. Further, I obtain information on the ventures' exits, to account for the fact that over the long time span of my sample, some of the start-ups may have been acquired (by acquirers other than the 54 acquirers of my sample), or filed for bankruptcy. I use the SDC Mergers and Acquisitions database and CapitalIQ to search for acquisitions and bankruptcies. I perform extensive checks to verify the nature of private firms' exits using the Public Access to Court Electronic Records (PACER) database, Factiva, and web searches. Finally, I also collect the patent data of all the CVC acquirers included in my sample.

In Panel A of Table 4, I compare the patenting activity of portfolio ventures that were acquired by their CVC investors, with portfolio ventures that were not acquired, conditionally on the CVCs previously investing in the ventures. I do not find any significant differences across the two groups in terms of the number of patents and the number of citations variables.[24] As discussed previously, patents and citations may not only measure venture uncertainty but also venture performance. Therefore, as a third measure of venture uncertainty I use the number of backward citations made by granted patents. Based on this measure, my results show that on average, acquired portfolio ventures are associated with lower degree of uncertainty relative to ventures that were not acquired. In Panel B of Table 4, I compare acquisitions of portfolio ventures with acquisitions of non-portfolio ventures. In the former, the CVC acquires the start-up company after previously investing in it, while in the latter, the CVC investor purchases the start-up without having made a prior investment. My results show that there are no significant differences across any of the patenting measures.[25]

[24] It is possible that some of the ventures that are not acquired are being taken public by venture capitalists. If ventures that are taken public hold more patents and citations, and are associated with less uncertainty, my comparison between the uncertainty of ventures that are acquired by CVC investors and ventures that are not acquired may be biased. In other words, the fact that my sample of not acquired ventures has more public companies than the sample of acquired ventures, can potentially explain why I do not find a significant difference in venture uncertainty between the two groups. Therefore, in unreported results I exclude all publicly traded ventures. I confirm that my results do not suffer from a bias and remain qualitatively unchanged. Finally, my results also do not change if I use the number of applied patents instead of the number of granted patents.

[25] As inside investors, CVC acquirers that have previously invested in the venture could be taking advantage of the

The analysis of private start-up companies is usually restricted due to data limitations. While patents are useful in capturing the level of uncertainty and innovative activity associated with new ventures, no financial information is available on such companies in the standard financial databases. The only additional variables I am able to obtain on private ventures is their founding year and the four-digit standard industrial classification (SIC) code, both collected from the VentureXpert database. These control variables are particularly important, because I expect the number of patents and citations to increase with firm age. In Panel A of Table 4, I report the age of the start-up ventures and find that portfolio targets tend to be significantly younger relative to ventures that were not acquired. Further, I find that portfolio targets were backed by fewer corporate venture capitalists as well as traditional VC investors.[26] The smaller number of investors in portfolio targets, may be caused by the fact that these ventures are being acquired early in their stage. I find similar results in Panel B of Table 4, when I compare acquisitions of portfolio ventures to acquisitions of non-portfolio ventures. Portfolio targets are younger and have the support of fewer VC investors. However, although portfolio targets have fewer VC investors, they are endorsed by significantly more CVC companies. The results reported in this table show that the timing of the acquisition matters and that controlling for venture age is required.

Finally, I analyze the degree of innovation at the venture portfolio level, rather than the individual start-up level. In Panel A of Table 5, I compare the portfolio patenting activity of CVC acquirers versus CVCs that did not acquire portfolio ventures in a given year. I find that CVC acquirers tend to have smaller holding portfolios relative to corporate investors that do not acquire. The differences in means and medians between all variables that measure the level of CVC's portfolio uncertainty are statistically significant at the 1 percent level. These findings suggest that corporate investors take into account their portfolio interactions, when they make acquisition decisions. The more innovative are the *other ventures* included in the venture portfolio, the less likely the CVC investor is to acquire a portfolio target. In Panel B of Table 5, I compare how innovative the portfolio of CVC acquirers of portfolio ventures is, relative to the portfolio of CVC acquirers of non-portfolio ventures. I find that the former tend to hold larger portfolios of start-up companies, and their portfolios also appear to be more innovative. However, these results are based only on univariate statistics, and further analysis is required before I can draw any conclusions about the effect of portfolio uncertainty on the decision of CVC investors to acquire.

3.3. Financial Characteristics and Innovation of the Acquirer

All financial information on the acquirers in my sample comes from the COMPUSTAT database.

lower information asymmetry they face and acquire innovative ventures just prior to a patent grant. I investigate whether this is the case by examining the number of post-acquisition patents granted to the acquirer. In particular, I only count the number of acquirer's patents that involve at least one of the target's inventors and are granted in the first three years following the acquisition. My unreported results show that although CVC acquirers of portfolio ventures obtain more patents (protecting inventions created by target inventors) following the acquisition, relative to CVC acquirers of non-portfolio ventures, the difference in patents between the two types of acquirers is not statistically significant.

[26] I use VentureXpert database to collect information on the number of VC and CVC investors that have invested in the start-up company.

The CRSP database is used to obtain the stock returns of the publicly traded CVC acquirers. In Panel A of Table 6, I examine whether CVC acquirers differ from corporate investors who do not acquire their portfolio ventures by comparing their financial characteristics and innovation. I find substantial differences between the two groups of corporate investors. CVC acquirers tend to be significantly smaller in size, and to have lower net income to assets, and cash to assets. Moreover, they also appear to have higher R&D expenditures, and higher Tobin's Q. Surprisingly, although they invest heavily in R&D, their output of R&D expenditures, measured by the number of patents owned by the CVC acquirer, is significantly lower. This hints that CVC investors may be acquiring portfolio ventures because they are less efficient in producing internal innovation, and rely more on external innovation. All differences in means are statistically significant at least at the 5 percent threshold. Interestingly, when in Panel B of Table 6, I compare the financial characteristics of CVC acquirers of portfolio ventures with those of CVC acquirers of non-portfolio ventures, I find no significant differences between the two types of acquirers. They do not appear to differ across any of the financial characteristics that I study.[27]

3.4. Empirical Design

To identify the factors that affect the decision of CVC investors to acquire a portfolio, or a non-portfolio venture I start by estimating a baseline logit specification. In the case of acquisitions of portfolio ventures, equation (9), the dependent variable measures the probability of acquisition conditional on a CVC investment. When I examine acquisitions of non-portfolio ventures, equation (10), the dependent variable measures the unconditional probability of acquisition.

$$Pr(Acquisition|CVC\ investment) = F(Venture\ uncertainty,\ Competitive\ uncertainty,\ CVC\ innovativeness,\ CVC's\ portfolio\ uncertainty,\ Controls) \quad (9)$$

$$Pr(Acquisition|No\ CVC\ investment) = F(Venture\ uncertainty,\ Competitive\ uncertainty,\ CVC\ innovativeness,\ CVC's\ portfolio\ uncertainty,\ Controls) \quad (10)$$

The logit model estimates the overall likelihood of an acquisition by a CVC acquirer, but it does not use information on the timing of the acquisition. Duration analysis uses valuable information about the timing of events that logit analysis is not able to capture. Duration analysis is appropriate when: (1) events occur at different times, (2) the probability of events may be changing over time, and (3) observations are censored. In my empirical analysis, I employ a

[27] In unreported analysis I also compare CVC acquirers of non-portfolio ventures with corporate investors who do not acquire their portfolio ventures. I find that CVC acquirers of non-portfolio ventures tend to be smaller, to have higher R&D expenditures, higher Tobin's Q, and lower patent stock.

duration model to investigate the length of time from the first CVC investment in the venture to the complete acquisition of the venture by a CVC acquirer (i.e., the timing of the acquisition), as well as the factors that influence the acquisition decision. A standard procedure for dealing with duration data is to employ a hazard model (Kalbfleisch and Prentice 1980; Kiefer 1988). I choose a Cox proportional hazard model, which is a parsimonious semiparametric model, and a common choice for modeling duration. The duration model explicitly takes into account the fact that different ventures may be acquired at different points of time, and that some start-ups may be removed from the sample of potential targets, either because they are acquired by other companies, or because they were liquidated. In other words, the hazard model allows for approximation of the probability of acquisition conditional on survival of the venture. The hazard function of the Cox proportional hazard model has the form

$$h(t) = h_0(t) exp\{\beta' X(t)\} \tag{11}$$

The Cox proportional hazard model does not impose any structure on the baseline hazard $h_0(t)$ and provides a way of estimating β without requiring estimates of $h_0(t)$. Suppose the complete durations are ordered $t_1 < t_2 < ... < t_n$. The risk set with respect to any moment of time is the set of firms that have not yet exited just prior to that time. Based on the hazard function, the conditional probability that observation i exits at time t_i, given that any of the observations in the risk set R_i could have been concluded at duration t_i, is given by

$$\frac{exp\{\beta' X_i(t)\}}{\sum_{j \in R_i} exp\{\beta' X_j(t)\}} \tag{12}$$

This conditional probability is independent of the baseline hazard function.[28]

Given that most of the independent variables included in my analysis are time-varying, the original Cox proportional hazard model needs to be modified to allow for time-varying covariates. The model that I estimate takes the form of

[28]The corresponding log partial likelihood is

$$lnL = \sum_{i=1}^{n} \left[exp\{\beta' X_i\} - \sum_{j \in R_i} exp\{\beta' X_j\} \right]$$

Technically, this is for the simplest case where exactly one firm exits at each distinct time and there are no censored observations. The partial log likelihood can handle censoring easily. Censored observations enter the risk set at each observation (in the denominator) but do not enter in the numerator of the partial likelihood.

$$h(t,\ X(t)) = h_0(t,0)exp\{\beta' X(t)\} \tag{13}$$

where *h(t, X(t))* is the hazard rate at time t for a firm with covariates *X(t)*, and the Cox regression estimates the coefficient vector β. For ease of interpretation, in my results I also report the hazard ratios. The hazard ratio shows how much the hazard (i.e., the instantaneous risk) of the event increases for a unit change in the independent variables. In the case of a dummy variable, this is equal to the ratio of the (instantaneous) probabilities of the two possible states. A coefficient greater than one implies a higher hazard rate and thus a lower expected duration.

In order to explain the cross-sectional variation in acquisition performance, I estimate an ordinary least squares (OLS) regression model presented by equation (14). The dependent variable is the three-day event window cumulative abnormal returns measured around the acquisition announcement date. To estimate abnormal returns, I use standard event study methodology (see Brown and Warner 1985) and compute market model abnormal returns using the CRSP value-weighted index returns.

$$\begin{aligned} \textit{Acquisition Performance} = F(&\textit{Venture uncertainty, Competitive uncertainty,} \\ &\textit{CVC innovativeness, CVC's portfolio uncertainty, Controls)} \end{aligned} \tag{14}$$

4 Multivariate Results

I present my results in five subsections. I start in Section 4.1. by analyzing the factors that determine the decision of a CVC investor to acquire a portfolio venture. In Section 4.2., I examine whether the factors that explain CVC investor's decision to acquire a portfolio venture, also explain its decision to acquire a non-portfolio venture. In Section 4.3., I use an alternative method, proportional hazard model, to address the main questions of the paper. In Section 4.4., as a robustness check of my results, I perform Heckman two-stage selection bias model of the decision of a CVC investor to acquire a portfolio, or a non-portfolio venture. In Section 4.5., I report the CVC acquirers' stock returns at the acquisition announcement and at the announcement of the initial CVC investments, and compare the returns of acquisitions of portfolio ventures with the returns of acquisitions of non-portfolio ventures. In Section 4.6., I examine the extent to which the stock returns at the acquisition announcement are related to factors that explain the decision of CVC investors to acquire.

4.1. Decision to Acquire a Portfolio Venture

I start my analysis by exploring the determinants of the decision of corporate investors to acquire one of their own portfolio ventures. My sample includes CVC investments and subsequent acquisitions made during the sample period 1987 to 2010. Table 7 reports the results of a cross-sectional logit regression, where the sample includes only the ventures in which the CVC investor has previously invested. The dependent variable is a dummy variable that equals one if the CVC investor acquires a portfolio venture, and zero otherwise. The regressors in this analysis are: (1) the total number of patents the venture was granted; (2) the total number of citations to granted patents to the venture; (3) the total number of backward citations that granted patents to the venture have made; (4) the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; (5) the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio; (6) the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made; (7) the number of *all other ventures* that the CVC is invested in for a given year; (8) the total number of patents granted to the CVC investor; (9) the total number of VC investors that have invested in the venture; (10) the total number of CVC investors that have invested in the venture; (11) the log of venture age; (12) a dummy variable that equals one if the venture is a public company; (13) a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; (14) the log of acquirer's total assets; (15) the ratio of acquirer's R&D expenditures to assets; (16) the ratio of acquirer's cash to assets; (17) the acquirer's Tobin's Q.

Because patents, citations and backward citations are highly correlated variables, given that they all measure the level of venture uncertainty, I include only one at a time when I estimate various specifications. For consistency, I also do that with my three variables ((4), (5) and (6)) that measure uncertainty at the venture portfolio level. I include a dummy variable (12) to control for the fact that information asymmetry between the venture and the CVC acquirer will be lower when the start-up company is publicly traded. Similarly, CVC acquirers may be more likely to acquire ventures that are closely related to them.[29] To control for that, I also include dummy variable (13). Finally, I control for year and industry variation by including year- and acquirer's industry-fixed effects.[30] The reported standard errors are robust, having been adjusted for clustering by CVC acquirer firm.

The coefficient estimate of backward citations is statistically significant and indicates that CVC investors are more likely to acquire a portfolio venture when part of the uncertainty associated with the venture is resolved. In particular, an increase in the number of backward citations by

[29]The relatedness between the corporate investor and the start-up company should allow the two firms to exchange knowledge more easily. Relatedness between the start-up firm and its investor has been previously found to affect the choice of acquisitions over alliances, and alliances over joint ventures (Villalonga and McGahan 2005). Further, being in the same industry as the target improves the returns to acquirers (Higgins and Rodriguez 2006).

[30]My results remain qualitatively unchanged if I remove the year- and acquirer's industry-fixed effects.

one standard deviation increases the likelihood of a portfolio acquisition by 14%. On the other hand, the coefficient estimates of patents and citations are not statistically significant. It appears that these variables do not have predictive power in the decision of the CVC investor to acquire a portfolio venture. It is possible that *backward citations* is a better measure of venture uncertainty, while *patents* and *citations* are more likely to measure venture quality. Therefore, in unreported analysis I include both *backward citations* and *patents* (*backward citations* and *citations*) in the same regression model. I find that my results do not change. While *backward citations* remains statistically significant, *patents* and *citations* are not statistically significant.[31]

I also find that the total number of patents, citations and backward citations of the *other ventures* included in the CVC's investment portfolio all have negative and significant effect on the probability of an acquisition. Hence, the CVC's decision to acquire is a complex process that takes more than simply evaluating the potential target in isolation. The more innovative are the other ventures included in the corporate portfolio, the less likely the CVC investor is to acquire. The effect is significant, an increase from the 25^{th} percentile of portfolio patents (portfolio backward citations) to the 50^{th} percentile, an increase of 315 portfolio patents (2,834 portfolio backward citations), leads to a decline of 15.9% (14.7%) in the probability of an acquisition. The effect is even stronger in columns (3) and (4), where I measures the degree of uncertainty associated with the CVC's venture portfolio, with the number of citations received by all granted patents to the *other ventures*. The negative and statistically significant coefficient estimate on portfolio size further confirms my findings that the scarce resources of CVC investors affect their choice to acquire. The fewer the outside options, and the less valuable the outside options of the investor, the more likely is the CVC investor to acquire. In particular, an increase of one standard deviation in the portfolio size is associated with more than 32% decline in the likelihood of a portfolio venture acquisition.

Competitive uncertainty, measured by the number of VC and CVC investors in the start-up company, also matters. Both coefficients are statistically significant at the 1 percent level, and consistent with the predictions of my hypotheses. I find that the higher the number of VCs invested in the venture, the less likely is the CVC investor to purchase the venture. On the other hand, the more CVCs have invested in the venture, the more likely is the CVC investor to acquire. These findings are consistent with the conflicting interests of VC and CVC investors who have co-invested in the venture. Unlike CVCs who have additional goals of obtaining strategic benefits arising from synergies with their existing activities, traditional venture capitalists' mainly seek financial gains from selling the portfolio firms. Therefore, VCs may prevent the CVC from acquiring the venture if they could obtain higher profit by selling it to outside investors via an IPO, or to a competing bidder in an acquisition. For instance, doubling the number of VCs invested in the venture from

[31] I also estimate two alternative specifications. In the first, I transform the *patent* (*citation*) variable into a dummy variable that equals one if the venture holds any patents (citations), and zero otherwise. In the second, I transform the *patent* (*citation*) variable into ordered dummy variables of five categories. Based on the first transformation, I find that CVCs are more likely to acquire ventures with patents (citations). Based on the second transformation, I find positive and significant, non-monotonic relation between patents (citations) and the probability of a portfolio acquisition by a CVC acquirer.

two to four, while keeping all other variables at their means, leads to at least 18% (depending on the specification) decrease in the probability of an acquisition. On the other hand, increasing the number of CVC investors from two to four, increases the likelihood of an acquisition by 29% on average. A start-up company endorsed by higher number of CVC investors signals higher interest in the venture, and thus, increases the likelihood of an acquisition.[32]

My results are consistent with the predictions of Morellec and Zhdanov (2005) that the decision of CVC investors to acquire a portfolio venture represents a trade-off between venture uncertainty and competitive uncertainty. In my analysis I find that the effect of potential competition is very important. This result is further confirmed by the negative and statistically significant coefficient estimate of the CVC's innovation variable. I show that CVC investors are more likely to acquire one of their portfolio ventures when their own internal innovation, measured by the number of patents owned by the CVC investor, is relatively poor. For instance, an increase in the number of CVC's patents by one standard deviation from their mean, while keeping all other variables at their averages, reduces the likelihood of an acquisition by more than 39%.[33] CVC companies that are less innovative may be in a weaker competitive position. Hence, their dependence on external innovation, and the fear of missing out on an opportunity may encourage an earlier acquisition. The results are consistent across specifications independently of whether I measure venture uncertainty using patents, citations, or backward citations.

Table 7 also indicates that CVC acquirers are more likely to acquire start-up portfolio companies that operate in the same industry. This is consistent with these deals being associated with lower information asymmetry, higher synergies, or CVCs trying to acquire their close competitors. The coefficient estimate of *Same Industry* is highly significant in all specifications. Finally, my results suggest a positive relation between the Tobin's Q of the CVC investor and its decision to acquire a portfolio venture. Highly valued CVC investors are more likely to take full control of a portfolio venture.

4.2. Decision to Acquire a Non-Portfolio Venture

In this section I explore the decision of corporate investors to acquire the competitor's venture (venture in which they have not been previously investing compared to other CVC investors), although they hold a portfolio of ventures in which they have been investing. For this purpose my sample in this section includes not only all ventures in which the CVC company has previously invested, but also all CVC-backed ventures that were not included in the CVC's venture portfolio but were eventually acquired by the corporate investor. Table 8 reports the results of a cross-sectional logit regression, where the dependent variable is a dummy variable that equals one if the

[32] In Section 4.3. of the paper I use an alternative method, a duration model, and show that higher potential competition for the venture may encourage CVC investors to preempt the actions of other CVC investors and acquire the venture earlier.

[33] In an alternative specification I scale the number of patents owned by the CVC investor by its R&D expenses. Consistent with the previous findings, my unreported results show that CVCs that are less efficient in producing internal innovation are more likely to take full control of a venture in which they have been previously investing.

CVC investor acquires a non-portfolio venture, and zero otherwise. In this analysis I use the same regressors as in Table 7.

I find that across all specifications, the coefficient estimates of the number of patents, citations, and backward citations are statistically insignificant. CVC acquirers of non-portfolio ventures are likely to face higher degree of information asymmetry relative to CVC investors who have invested in the venture, especially since most of these ventures are young, private companies. Therefore, in contrast to my findings on acquisitions of portfolio ventures, the decision of CVC investors to acquire a non-portfolio venture does not depend on the venture's uncertainty. On the other hand, I find that the decision of CVC investors to acquire a non-portfolio venture is significantly determined by the innovativeness and the size of their holding portfolio. I find that increasing the number of portfolio patents (portfolio backward citations) from their 25^{th} percentile to the 50^{th} percentile, an increase of 305 patents (2,658 backward citations) decreases the probability that CVC investor buys a non-portfolio venture by 40% (29.3%). The estimated effect of the uncertainty of the venture portfolio is quite large, and it is more than double the effect that portfolio uncertainty has on acquisitions of portfolio ventures. My results suggest that CVCs are not passive investors, they appear to be learning from their investments and acquire the competitor's venture when their own portfolio is not performing well. Finally, I do not find a significant relation between the level of innovativeness of the corporate acquirer and the CVC's decision to acquire a venture backed by the competitor. The results from Table 8 suggest that CVCs' decision to acquire a non-portfolio start-up company is not driven by their need to access more efficient external innovation.

I next analyze the competitive uncertainty that CVC acquirers face when they purchase a CVC-backed start-up company, without previously having invested in it. My results are different from the results on acquisitions of portfolio ventures. The coefficient estimate of the number of VC investors is now positive but statistically insignificant. To some extent this result is consistent with my previous hypothesis that VCs' financial interests may encourage them to increase competition for the target by inviting outside corporate investors to participate in the bidding process. However, bidding for a start-up company that has been backed-up by the investments of other corporate investors may be a difficult task to complete. If the venture is valuable, previously invested CVC investors may not be willing to share their competitive advantage.[34] I find that outside CVC investors are more likely to acquire non-portfolio ventures that are backed by more CVC investors. In particular, I find large and highly statistically significant, positive coefficient estimate of the number of CVC investors. For example, across all specifications, increasing the number of CVCs invested in the venture from two to four increases the probability of an outside bidder acquiring the venture by more than 42%. In the following section of the paper I use an alternative model, and test whether outside CVC investors are likely to preempt the competition from invested CVCs and reduce the time to acquisition by acquiring the non-portfolio venture earlier.

[34] In fact, the presence of more CVC companies that have invested in the venture may be a signal of a high potential start-up company.

In Table 8, I also report that, similarly to acquisitions of portfolio ventures, CVC acquirers tend to have higher Tobin's Q and are more likely to acquire start-up companies that operate in the same industry. In other words, they are highly valued companies who are likely to acquire their close competitors' portfolio ventures. Interestingly, in contrast to acquisitions of portfolio ventures, I find that acquisitions of non-portfolio ventures involve targets that are more likely to be publicly traded. The chance of a non-portfolio acquisition is higher if the target venture is a public company. A plausible explanation for this result is that public firms are associated with lower degree of information asymmetry, and therefore, are easier to evaluate by outside bidders. In the next section, I proceed by estimating a proportional hazard model to study the timing of the acquisition, and the fact that my dataset is censored.

4.3. Proportional Hazard Model

To allay concerns, that the acquisition of a portfolio or a non-portfolio venture involves the timing of these events, this section presents an alternative method that addresses the main questions of the paper by examining my data in a duration framework. I use a Cox proportional hazard model, a parsimonious semi-parametric model, and a common choice for modeling duration. The dependent variable in my duration regressions is time-to-acquisition, while the independent variables are the same as in my previous analyses. Table 9 reports the results of acquisitions of portfolio ventures, where the dependent variable measures the time between the first CVC investment in the company and the time the company is acquired by a CVC acquirer that has previously invested in the venture. The main difference that appears in the duration model is that the coefficient estimates on the portfolio backward citations variable and on the acquirer's Tobin's Q are no longer statistically significant. Most of the other results are very similar to my results reported in Table 7. Lower innovativeness of the CVC's venture portfolio leads to a quicker acquisition. For both statistically significant measures of portfolio uncertainty, the hazard ratio equals one, indicating that increasing portfolio innovation by a unit increases the likelihood of a portfolio venture acquisition proportionally. The innovativeness of the CVC's venture, measured by the number of backward citations has negative and significant effect on the time to acquisition. Lower uncertainty associated with the venture speeds up the acquisition. However, similarly to my logit regression results, the number of patents and number of citations variables are not statistically significant. My results also show that the internal innovation of the CVC acquirer matters. CVC investors are more likely to acquire a portfolio venture sooner, when their internal R&D output is lower. Consistent with my previous results, I also find strong negative (positive) relation between the number of VCs (CVCs) invested in the venture and the probability of an acquisition conditional on survival of the venture.

The dependent variable in Table 10 measures the time-to-acquisition of the start-up company by a CVC acquirer that has not invested in the venture. Neither the magnitude nor the statistical significance of the key results presented in Table 8 changes significantly. I find that the time to a non-portfolio acquisition does not depend on the innovativeness of the venture, but it is significantly affected by the innovativeness of the CVC's venture portfolio. CVC investors are more likely to

speed up the acquisition of a non-portfolio venture, when their own holding portfolio is associated with more uncertainty. CVC companies are also more likely to acquire earlier when faced with higher competition coming from inside CVC investors. The coefficient estimate on number of CVCs remains statistically significant at the 1 percent threshold. The results in both Table 9 and Table 10, also show that CVC acquirers operating in the same industry as the start-up firm are more likely to purchase the venture sooner. The duration analysis in this section confirms that the main findings of the paper continue to hold after allowing for the probability of acquisition to vary over time.

4.4. Heckman Two-Stage Estimator

A potential challenge of this research is that CVCs' investment choices are endogenous. I address the issue by estimating Heckman two-stage model (Heckman, 1979). The proposed estimation technique corrects for the self selection problem by proceeding in two steps. The first step involves estimating a probit regression determining the decision of CVC investment. The second step is estimating a logit regression on the subsequent decision of corporate venture capitalists to acquire, including the inverse Mills ratio estimated from the first step as an additional regressor.

The procedure requires the availability of valid instruments, variables which contribute to determining the propensity to make CVC investments but are not related to the decision to make an acquisition. To satisfy the required exclusion restriction I use the number of spin-offs in a given year, a variable that enters in the first stage selection regression but not in the second stage regression. Existing firms are an important source of new entrepreneurs, and spin-offs from existing firms are seen as a major deal flow for "entrepreneurial spawning". (Bhidé 1994; Gompers, Lerner, and Scharfstein 2005; Klepper and Sleeper 2005). I explore whether the choice of corporate venture capitalists to invest is explained by a supply shock to their investment opportunity set, where I assume that the number of new spin-offs will directly affect their choice to invest but will not affect their future choice to acquire. I define spin-off as a "clean" transaction in which the existing parent company goes from 100 percent ownership to 0 percent ownership.[35] Moreover, given that CVC investment rounds do not take place every year and firms can only invest in a start-up company when an investment round takes place, I estimate my first stage probit regression only for the investment round years included in my sample.

The dependent variable in the first stage probit model is one if the start-up firm has received CVC financing, and zero otherwise. The independent variables included in the first stage regression are the same as the variables used in my main regressions in Table 7 and Table 8. To meet the exclusion restrictions, I include the number of new spin-offs in each year an investment round takes place in the probit model. Next, I use the estimates of the coefficients in the probit equation to form the expected value of the residuals, conditional on CVC investment. This is the inverse Mills ratio. In the second stage regression, reported in Table 12, I re-estimate the regressions from Table

[35] I obtain the number of spin-offs from Thomson Financial's SDC Mergers and Acquisitions database.

7 and Table 8, but now additionally include the inverse Mills ratio obtained from the first step regression. The probit results reported in Table 11 confirm that the number of spin-offs is a good predictor of the probability of CVC investment. The coefficient estimate of number of spin-offs is positive and statistically significant in all first stage specifications.[36] The coefficient estimate of the inverse Mills ratio, included in my second stage regression, on the other hand, is statistically insignificant in all specifications, which provides evidence that my sample does not suffer from a selection bias. Moreover, even after taking the selectivity correction into account, the results remain qualitatively similar to my main findings reported in Table 7 and Table 8. This suggests that selection on observables is not driving my results.

4.5. Stock Returns to CVC Acquirers

In this section I examine the acquisition performance of all successfully completed acquisitions of CVC-backed ventures made by the 54 CVC acquirers in my sample. I compare the performance of acquisitions of portfolio versus acquisitions of non-portfolio start-ups. In particular, I measure the market reaction to CVC acquisitions by calculating the cumulative abnormal returns over a three-day event window around the acquisition announcement date.

The univariate results are reported in Panel A of Table 13. Upon the acquisition announcement, CVC acquirers of portfolio ventures experience an average significant negative announcement return of -0.60%, over a three-day event window.[37] On the other hand, when I examine the acquisitions of non-portfolio ventures, I find that the market reaction to these deals is positive and insignificantly different from zero. In the last column of Table 13 I report the differences in means and medians between acquisitions of portfolio ventures and acquisitions of non-portfolio ventures. While the differences in means are not statistically significant, the differences in medians appear to be significant at the one percent level. Although weak, these results are generally consistent with the findings of Benson and Ziedonis (2010) that the average CAR of CVC acquirers of portfolio ventures is -0.97%, compared to an average CAR of 0.67% when the same acquirers purchase ventures in which they have not been previously investing.[38,39]

In Panel B of Table 13, I examine the stock performance of CVC investors when they make the

[36]To test the relevance of my exclusion variable, the number of new spin-offs, I also perform a placebo test. I investigate whether the decision of CVC investors to invest today can be explained by future supply shocks to their investment opportunity set (using one year lead spin-offs variable). As expected, I find no evidence that the future number of spin-offs predicts the probability of CVC investment today. I do find, however, that the number of last year's spin-offs (measured by one year lag spin-offs variable) predicts the probability of CVC investment today, which is reasonable given the high persistence of the number of spin-offs variable.

[37]On a dollar-value basis, these estimates suggest that the average portfolio acquisition is associated with a loss of $45.9 million in CVC's shareholder value. The effect is substantial given that, on average, the size of the target is less than 4% of the acquirer's market capitalization.

[38]While, as in Benson and Ziedonis (2010), I study acquisitions by CVC investors, there are two main reasons why my results are slightly different from theirs: sample and construction method. I start constructing my sample by requiring that every CVC acquirer in my sample has made at least one acquisition of a portfolio venture between 1987 and 2010. In contrast, Benson and Ziedonis select the top 100 CVC investors, and choose the subset that acquired at least one entrepreneurial firm between 1987 and 2003, irrespective of whether the startup was a portfolio company.

[39]In contrast, Higgins and Rodriguez (2006) find that the use of "pre-acquisition information-gathering mechanism" such as alliances, for example, improves the returns to acquirers in the event of a subsequent acquisition.

initial minority investments in innovative ventures included in their portfolio. I find that initially corporate investors gain 1.20% average significant cumulative abnormal return over a three-day event window. This result suggests that, in contrast to acquisitions of full control, the market reacts positively to the preceding CVC investments made by CVC acquirers. While minority CVC investments are perceived as valuable growth opportunities, acquisitions of full control result in weaker incentives for the innovative ventures, and lower probability of future innovation for the acquirer. Furthermore, in Panel C of Table 13 where I represent acquisitions of portfolio ventures as two-stage deals (initial minority investment and subsequent acquisition of full control), and examine the combined CARs to CVC investors (CARs at the time of the initial investments plus CARs at the time of the subsequent acquisition), I find that on average the total market reaction to acquisitions of portfolio ventures is not significantly different from zero. Moreover, when I take into account the significant positive market reaction to the initial CVC investments made in portfolio ventures, I find that acquisitions of portfolio ventures are actually not worse than acquisitions of non-portfolio ventures.

4.6. Cross-Sectional Determinants of Stock Returns

In this section, I seek to explain the cross-sectional variation in performance of CVC acquirers by focusing on factors related to the decision of CVC investors to acquire. Table 14 presents my results. The dependent variable is the three-day event window CAR of the CVC acquirer, measured around the announcement of the acquisition of full control. The independent variables are the same as in Table 7. Models (1), (2), and (3) report the results of a cross-sectional regression on the performance of CVC acquirers of portfolio companies; models (4), (5), and (6) show the results of the performance of CVC acquirers when they purchase non-portfolio companies. In my regressions I control for acquirer's size, relative size, medium of exchange, and public status of the target, since these variables have been found to have an effect on acquisition announcement returns (see Moeller et al. 2004; Moeller et al. 2007; Travlos 1987; Officer 2007).[40] I also control for year- and industry-fixed effects to make sure that the results are not driven by time or acquirer's industry specific characteristics.[41] Standard errors are clustered by CVC acquirer firm.

Interestingly, while venture uncertainty and competition do not appear to have a predictive power in the performance of portfolio venture acquisitions, the variable that measures CVC's own innovation has a substantial positive effect on acquisition performance.[42] The coefficient estimate of the *CVC Number of Patents* is statistically significant in all specifications at the 1 percent threshold.[43] Increasing the number of CVC patents by one standard deviation leads to an increase

[40]Relative size is the value of the target as a fraction of the market capitalization of the acquirer. On average, the relative size of portfolio targets is 3.8%, while the relative size of non-portfolio targets is 4%.

[41]My results remain qualitatively unchanged if I remove the year-fixed effects.

[42]The insignificant coefficient estimates of venture uncertainty and competition are consistent with the findings of Benson and Ziedonis (2010). In contrast, Sevilir and Tian (2012) find that venture innovation has a positive effect on CARs of acquirers. However, they do not control for acquirer's level of innovation in their analysis, and measure the level of venture uncertainty by creating a dummy variable rather than using a continuous variable.

[43]The statistical significance of my results is even stronger if I scale the number of patents owned by the CVC

in the acquirers' CARs by over 6.8%. My results suggest that the announcement of a portfolio venture acquisition reveals negative information about the acquirer's own innovation. In other words, lower internal innovation of the CVC acquirers and large dependence on external knowledge, can potentially explain the average negative abnormal return of the acquirers at the acquisition announcement. Moreover, the acquisition of full control and the resulting transfer of property rights in the hands of the CVC acquirer can signal lower probability of obtaining future innovation. In contrast, when I examine the effect of the CVC's innovativeness on performance in the case of non-portfolio acquisitions, I do not find a significant relation. It appears that the market perceives these acquisitions differently; possibly because CVC acquirers have not invested in the ventures previously, and thus have not revealed that they may be interested in the start-ups' innovation. Moreover, the target insiders are unable to extract higher premiums because they know less about the CVC's own innovation and willingness to pay for external knowledge.

My findings in Table 14 also show that the coefficient estimates on venture age, acquirer's size and relative size are all negative and statistically significant. Some of these results are consistent with the available empirical evidence, such as the negative correlation between acquirer announcement returns and both acquirer size (Moeller, Schlingemann, and Stulz 2004) and the relative size of the merger transaction (Travlos 1987). However, the fact that these variables only matter in the case of acquisitions of portfolio ventures is puzzling. When I study the cross-sectional performance of acquisitions of portfolio companies, I also find that CVC acquirers with higher Tobin's Q tend to have better acquisition performance. The higher abnormal returns of these deals potentially reflects higher quality ventures that are being endorsed by highly valued CVC investors. Finally, my results on acquisitions of non-portfolio ventures show negative and statistically significant coefficient estimates of portfolio patents and portfolio citations. In other words, the market reacts more negatively to deals, where the CVC acquires a non-portfolio venture, although the degree of innovation of its own portfolio of ventures is less uncertain.

5 Conclusion

While corporate venture capital is attracting growing attention from academic researchers, it remains unclear to what extent corporate venture investments benefit their parent companies, either financially or strategically. In this paper, I examine acquisitions by corporate venture capital investors as a way to access external innovation. In particular, I investigate what determines the decision of large CVC investors to acquire a venture in which they have been previously investing. I also study the propensity of CVC investors to acquire a non-portfolio venture, a company that was not included in the CVC's venture portfolio, but has received investments from other corporate venture capitalists.

investor by its R&D expenses.

Consistent with Benson and Ziedonis (2010), I find that CVC investors experience significant negative returns when they acquire portfolio ventures, but not when they acquire non-portfolio ventures backed by competing CVCs. However, when I take into account the significant positive market reaction to the initial CVC investments in portfolio ventures, I show that acquisitions of portfolio ventures are actually not worse than acquisitions of non-portfolio ventures. Yet, the determinants of the decision of CVC investors to acquire one versus the other appear to be different. I find that CVC investors are more likely to acquire portfolio ventures when the start-up's innovation is associated with low degree of uncertainty. However, when faced with higher competition coming from co-invested corporate investors, CVC acquirers are likely to preempt the actions of their competitors and acquire the venture earlier. Moreover, corporate investors that are largely dependent on external innovation, are more likely to acquire innovative portfolio ventures. I also show that higher number of co-invested VCs leads to a lower chance of a portfolio acquisition. This is consistent with the conflicts of interest between traditional VCs and CVC investors.

Similar to acquisitions of portfolio ventures, I find that the probability of a non-portfolio acquisition is also higher when more competing CVCs have invested in the venture. However, the presence of traditional VCs co-invested in the venture does not affect the probability of a non-portfolio acquisition. My results also suggest that CVCs are actively managing their portfolios and tend to acquire non-portfolio ventures when their own portfolio performs poorly. Lastly, unlike for portfolio ventures, the probability of acquisitions of non-portfolio ventures is independent of the level of the CVC's innovation. This finding potentially explains some of the difference in acquisition performance between the two types of deals. Indeed, while CVC's innovation does not affect the performance of non-portfolio acquisitions, I find that acquisitions of portfolio ventures made by CVC acquirers with fewer patents have worse acquisition performance.

One implication of my analysis is that corporate venture capitalists appear to invest in innovative ventures as a way to access external innovation. However, the announcement of the acquisition of a portfolio venture sends a negative signal to market participants about the level of the CVC's internal innovation and the likelihood of obtaining future innovation.

This study suggests several avenues for future research. First, I hope to supplement my analysis with information on the innovation of CVC acquirers post acquisition. How does the acquisition of a start-up company affect the innovativeness of the CVC acquirers of portfolio ventures versus CVC acquirers of non-portfolio ventures? Second, what happens with the innovation of portfolio ventures that are not being acquired by the CVC investor?

Appendix

This appendix provides a summary of all explanatory variables used in my analysis.

Variable Name	Variable Description
Venture Uncertainty Measures:	
Patents	Number of granted patents.
Citations	Number of citations a patent receives from its grant year.
Backward Citations	Number of citations a granted patent have made to previous patents.
Portfolio Size	The number of all *other ventures* included in the venture portfolio of a given CVC investor, apart from the analyzed portfolio venture.
Portfolio Patents	The sum of all granted patents to the *other ventures* included in the venture portfolio of a given CVC investor. In the case of acquisitions of portfolio ventures, this variable will equal the sum of all granted patents to all portfolio ventures, excluding the number of granted patents to the analyzed portfolio venture. In the case of acquisitions of non-portfolio ventures, this variable will equal the sum of all granted patents to *all ventures* included in the venture portfolio, since the acquired venture is not part of the CVC investor's portfolio.
Portfolio Citations	The sum of all citations to granted patents received by the *other ventures* included in the venture portfolio of a given CVC investor. In the case of acquisitions of portfolio ventures, this variable will equal the sum of all citations received by all portfolio ventures, excluding the number of citations received by the analyzed portfolio venture. In the case of acquisitions of non-portfolio ventures, this variable will equal the sum of all citations received by *all ventures* included in the venture portfolio, since the acquired venture is not part of the CVC investor's portfolio.
Portfolio Backward Citations	The sum of all citations to previous patents made by all granted patents to the *other ventures* included in the venture portfolio of a given CVC investor. In the case of acquisitions of portfolio ventures, this variable will equal the sum of all backward citations made by all portfolio ventures, excluding the number of backward citations made by the analyzed portfolio venture. In the case of acquisitions of non-portfolio ventures, this variable will equal the sum of all backward citations made by *all ventures* included in the venture portfolio, since the acquired venture is not part of the CVC investor's portfolio.
Competitive Uncertainty Measures:	
Number of VCs	Number of all VC companies that have invested in the venture.
Number of CVCs	Number of all CVC companies that have invested in the venture.

(Continue)

Appendix– *Continued*

Variable Name	Variable Description
Control Variables:	
Venture Age	Firm age is calculated from the founding date. I collect the founding date of the venture from VentureXpert database.
Public Venture	A dummy variable that equals one if the venture is a public company.
Same Industry	A dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry.
Cash Deal	A dummy variable that equals one if the acquisition is paid 100 percent by cash.
Relative Size	The value of the target as a fraction of the market capitalization of the acquirer.
Number of Spin-offs	Spin-off is defined as a "clean" transaction in which the existing parent company goes from 100 percent ownership to 0 percent ownership.
Financial Characteristics and Innovation of the CVC Acquirer:	
Log Total Assets	The natural logarithm of the total book value of assets.
R&D / Assets	The ratio of R&D expenditure to book value of assets.
Net Income / Assets	The ratio of net income to book value of assets.
Cash / Assets	The ratio of cash holdings to book value of assets.
Tobin's Q	The ratio of book value of assets minus book value of equity minus deferred taxes plus market value of equity, to book value of assets.
CVC Number of Patents	Number of patents granted to the CVC company.

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Table 1: The 54 CVC Acquirers, their Portfolio Ventures and Acquisitions

Acquirer	Number of portfolio ventures	Acquisitions of portfolio targets		Acquisitions of non-portfolio targets	
		Number of targets	Fraction of targets (%)	Number of targets	Fraction of targets (%)
3Com Corp	24	1	4.2	2	8.3
Abbott Laboratories	16	2	12.5	3	18.8
ADC Telecommunications Inc	13	2	15.4	2	15.4
Advanced Fibre Communications Inc	2	1	50.0	0	0.0
Affymetrix Inc	6	1	16.7	0	0.0
Amazon.com Inc	19	3	15.8	3	15.8
Amgen Inc	24	1	4.2	3	12.5
Autodesk Inc	10	1	10.0	2	20.0
Becton, Dickinson and Co	12	1	8.3	4	33.3
Boston Scientific Corp	31	3	9.7	4	12.9
Broad.com Corp	6	2	33.3	12	200.0
Cisco Systems Inc	205	22	10.7	19	9.3
Comcast Corp	78	1	1.3	2	2.6
Compaq Computer Corp	2	1	50.0	2	100.0
Cypress Semiconductor Corp	7	1	14.3	1	14.3
Dun & Bradstreet Corp	6	2	33.3	0	0.0
eBay Inc	6	1	16.7	4	66.7
Eli Lilly and Co	20	1	5.0	2	10.0
Equifax Inc	4	1	25.0	2	50.0
General Electric Co	367	1	0.3	0	0.0
Harris Corp	12	2	16.7	1	8.3
I2 Technologies Inc	5	1	20.0	1	20.0
International Business Machines Corp	35	5	14.3	20	57.1
Inktomi Corp	10	1	10.0	1	10.0
Intel Corp	864	7	0.8	6	0.7
Intelligent System Corp	22	1	4.5	0	0.0
Johnson & Johnson	154	6	3.9	4	2.6
Juniper Networks Inc	16	2	12.5	2	12.5

(*Continue*)

Table 1– *Continued*

Acquirer	Number of portfolio ventures	Acquisitions of portfolio targets		Acquisitions of non-portfolio targets	
		Number of targets	Fraction of targets (%)	Number of targets	Fraction of targets (%)
Liberty Media Corp Starz Group	16	1	6.3	0	0.0
Lucent Technologies Inc	29	2	6.9	5	17.2
MedImmune Inc	25	1	4.0	1	4.0
Medtronic Inc	41	3	7.3	2	4.9
Merck & Co Inc	17	1	5.9	1	5.9
Microsoft Corp	84	6	7.1	20	23.8
Monsanto Co	7	1	14.3	0	0.0
Motorola Solutions Inc	160	6	3.8	8	5.0
NCR Corp	2	1	50.0	1	50.0
Novell Inc	52	1	1.9	8	15.4
Peoplesoft Inc	6	1	16.7	1	16.7
Platinum Technology International Inc	3	1	33.3	0	0.0
QUALCOMM Inc	58	1	1.7	2	3.4
Quantum Corp	2	1	50.0	1	50.0
Repligen Corp	1	1	100.0	0	0.0
Safeguard Scientifics Inc	80	1	1.3	0	0.0
Sepracor Inc	2	1	50.0	0	0.0
Sun Microsystems Inc	64	2	3.1	6	9.4
Symantec Corp	11	1	9.1	8	72.7
Tandem Computers Inc	8	1	12.5	1	12.5
Texas Instruments Inc	50	1	2.0	5	10.0
Washington Post Co	12	1	8.3	0	0.0
Verisign Inc	21	1	4.8	5	23.8
Visa Inc	27	1	3.7	0	0.0
Walt Disney Co	8	2	25.0	1	12.5
Yahoo Inc	17	3	17.6	8	47.1
Total	**2779**	**117**	**4.2**	**186**	**6.7**

Table 2: Distribution by Year

		Acquisitions of portfolio targets		Acquisitions of non-portfolio targets	
Year	**Number of portfolio ventures**	**Number of targets**	**Fraction of targets (%)**	**Number of targets**	**Fraction of targets (%)**
1987	343	1	0.29	1	0.29
1988	363	0	0.00	1	0.28
1989	411	1	0.24	2	0.49
1990	439	0	0.00	0	0.00
1991	483	1	0.21	1	0.21
1992	536	0	0.00	1	0.19
1993	606	1	0.17	2	0.33
1994	687	0	0.00	1	0.15
1995	868	0	0.00	4	0.46
1996	1,109	4	0.36	4	0.36
1997	1,329	5	0.38	2	0.15
1998	1,605	4	0.25	6	0.37
1999	1,934	12	0.62	16	0.83
2000	2,119	13	0.61	15	0.71
2001	2,135	6	0.28	9	0.42
2002	2,086	8	0.38	10	0.48
2003	2,060	3	0.15	8	0.39
2004	2,029	7	0.34	12	0.59
2005	1,993	9	0.45	15	0.75
2006	1,936	9	0.46	24	1.24
2007	1,834	9	0.49	13	0.71
2008	1,719	10	0.58	16	0.93
2009	1,603	6	0.37	7	0.44
2010	1,504	8	0.53	16	1.06

Table 3: Distribution by Industry

Target Industry	Portfolio Ventures	Portfolio Targets	Non-Portfolio Targets
Agricultural Production Crops (SIC 01)	1	1	0
Crude Petroleum & Natural Gas (SIC 13)	1	0	0
Building Construction General Contractors & Operative Builders (SIC 15)	2	0	0
Food & Kindred Products (SIC 20)	1	0	0
Textile Mill Products (SIC 22)	1	0	0
Paper & Allied Products (SIC 26)	1	0	0
Printing, Publishing & Allied Industries (SIC 27)	6	1	0
Chemicals & Allied Products (SIC 28)	177	8	7
Rubber & Miscellaneous Plastics Products (SIC 30)	1	0	0
Leather & Leather Products (SIC 31)	1	0	0
Stone, Clay, Glass & Concrete Products (SIC 32)	3	0	0
Primary Metal Industries (SIC 33)	11	0	0
Fabricated Metal Products, Except Machinery & Transportation Equipment (SIC 34)	1	0	0
Industrial & Commercial Machinery & Computer Equipment (SIC 35)	70	4	6
Electronic, Electrical Equipment & Components, Except Computer Equipment (SIC 36)	345	20	32
Transportation Equipment (SIC 37)	3	0	0
Surgical & Medical Instruments & Apparatus (SIC 38)	167	14	14
Miscellaneous Manufacturing Industries (SIC 39)	2	0	0
Local & Suburban Transit & Interurban Highway Passenger Transportation (SIC 41)	1	0	0
Motor Freight Transportation & Warehousing (SIC 42)	1	0	0
Transportation Services (SIC 47)	2	0	0
Communications (SIC 48)	153	1	2
Electric, Gas & Sanitary Services (SIC 49)	2	0	0
Wholesale Trade - Durable Goods (SIC 50)	19	1	1
Wholesale Trade-non-durable Goods (SIC 51)	1	0	0
Building Materials, Hardware, Garden Supply & Mobile Home Dealers (SIC 52)	1	0	0
Food Stores (SIC 54)	2	0	0
Apparel & Accessory Stores (SIC 56)	2	0	0
Home Furniture, Furnishings & Equipment Stores (SIC 57)	2	0	0
Eating And Drinking Places (SIC 58)	3	0	0
Miscellaneous Retail (SIC 59)	32	2	4
Depository Institutions (SIC 60)	3	0	0

(Continue)

Table 3 – *Continued*

Target Industry	**Portfolio Ventures**	**Portfolio Targets**	**Non-Portfolio Targets**
Non-depository Credit Institutions (SIC 61)	4	0	0
Security & Commodity Brokers, Dealers, Exchanges & Services (SIC 62)	13	0	0
Insurance Carriers (SIC 63)	6	0	0
Insurance Agents, Brokers & Service (SIC 64)	1	0	0
Real Estate (SIC 65)	1	0	0
Holding & Other Investment Offices (SIC 67)	15	0	0
Business Services (SIC 73)	1300	63	115
Motion Pictures (SIC 78)	10	1	0
Amusement & Recreation Services (SIC 79)	9	0	0
Health Services (SIC 80)	19	0	1
Educational Services (SIC 82)	12	0	0
Social Services (SIC 83)	3	0	0
Engineering, Accounting, Research, Management & Related Services (SIC 87)	70	1	4
Miscellaneous Services (SIC 89)	2	0	0
Administration Of Environmental Quality & Housing Programs (SIC 95)	1	0	0

Table 4: Characteristics of Start-up Companies

The sample of 54 CVC acquirers is derived from VentureXpert, and includes public companies that have provided venture capital directly to start-ups, from 1987 through 2010, and that have subsequently acquired at least one entrepreneurial firm from their venture portfolio. Portfolio targets are identified as start-up companies, which were included in the CVC's venture portfolio and were later acquired by the CVC investor. Non-portfolio targets are CVC-backed ventures, which were not part of the CVC's investment portfolio but were acquired by it. Panel A of the table compares the characteristics of portfolio targets (columns (1), (2), and (3)) to the characteristics of not acquired portfolio ventures (columns (4), (5), and (6)), in the year of the acquisition. Panel B compares the characteristics of portfolio targets (columns (1), (2), and (3)) to the characteristics of non-portfolio targets (columns (4), (5), and (6)), in the year of the acquisition. The t-tests of differences in means, and nonparametric Wilcoxon signed rank tests for differences in medians are reported in the last two columns. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Portfolio Targets			**Not Acquired Portfolio Ventures**			**Difference**	
	Mean	**Median**	**Observations**	**Mean**	**Median**	**Observations**		
Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(1) - (4)	(2) - (5)
Number of patents	3.39	0	116	4.86	0	13,489	-1.47	0.00
Number of citations	150.14	0	116	162.76	0	13,489	-12.63	0.00
Number of backward citations	63.72	0	116	43.08	0	13,489	20.64*	0.00
Venture age	6.58	5	103	8.10	7	12,491	-1.52**	-2.00***
Number of VC investors	3.69	4	116	5.44	5	13,489	-1.75***	-1.00***
Number of CVC investors	1.66	1	116	2.26	2	13,489	-0.60***	-1.00***

(Continue)

Table 4 – *Continued*

	Portfolio Targets			Non-Portfolio Targets			Difference	
	Mean	**Median**	**Observations**	**Mean**	**Median**	**Observations**		
Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(1) - (4)	(2) - (5)
Number of patents	3.39	0	116	5.54	1	186	-2.15	-1.00
Number of citations	150.14	0	116	190.11	1	186	-39.97	-1.00
Number of backward citations	63.72	0	116	49.94	3.5	186	13.78	-3.50
Venture age	6.58	5	103	7.57	7	180	-0.99	-2.00***
Number of VC investors	3.69	4	116	5.31	5	186	-1.62***	-1.00***
Number of CVC investors	1.66	1	116	1.45	1	186	0.21*	0.00*

Table 5: Characteristics of Holding Portfolios of CVC Companies

The sample of 54 CVC acquirers is derived from VentureXpert, and includes public companies that have provided venture capital directly to start-ups, from 1987 through 2010, and that have subsequently acquired at least one entrepreneurial firm from their venture portfolio. Portfolio targets are identified as start-up companies, which were included in the CVC's venture portfolio and were later acquired by the CVC investor. Non-portfolio targets are CVC-backed ventures, which were not part of the CVC's investment portfolio but were acquired by it. Panel A of the table compares characteristics of the corporate venture portfolio of CVC acquirers (columns (1), (2), and (3)), to the characteristics of the corporate venture portfolio of non-acquirers (columns (4), (5), and (6)), in the year of the acquisition. Panel B compares characteristics of the corporate venture portfolio of CVC acquirers of portfolio targets (columns (1), (2), and (3)), to the characteristics of the corporate venture portfolio of CVC acquirers of non-portfolio targets (columns (4), (5), and (6)), in the year of the acquisition. The t-tests of differences in means, and nonparametric Wilcoxon signed rank tests for differences in medians are reported in the last two columns. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Acquirers of Portfolio Ventures			**Non-Acquirers of Portfolio Ventures**			**Difference**	
	Mean	**Median**	**Observations**	**Mean**	**Median**	**Observations**		
Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(1) - (4)	(2) - (5)
Portfolio size	109.54	27.5	116	288.43	148	13,489	-178.89***	-120.50***
Portfolio patents	243.65	98	116	882.98	413	13,489	-639.33***	-315***
Portfolio citations	8,408.07	3,624	116	27,517.2	17,779	13,489	-19,109.13***	-14,155***
Portfolio backward citations	2,404.22	565.5	116	6,962.79	3,781	13,489	-4,558.57***	-3,215.5***

(Continue)

Table 5 – *Continued*

	Acquirers of Portfolio Targets			Acquirers of Non-Portfolio Targets			Difference	
	Mean	**Median**	**Observations**	**Mean**	**Median**	**Observations**		
Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(1) - (4)	(2) - (5)
Portfolio size	109.54	27.5	116	70.75	25	186	38.80**	2.50
Portfolio patents	243.65	98	116	162.49	58.5	186	81.16**	39.5
Portfolio citations	8,408.06	3,624	116	5,831	1,152	186	2577.06*	2,472
Portfolio backward citations	2,404.22	565.5	116	1,695.94	485.5	186	708.28*	80

Table 6: Characteristics of CVC Companies

The sample of 54 CVC acquirers is derived from VentureXpert, and includes public companies that have provided venture capital directly to start-ups, from 1987 through 2010, and that have subsequently acquired at least one entrepreneurial firm from their venture portfolio. Portfolio targets are identified as start-up companies, which were included in the CVC's venture portfolio and were later acquired by the CVC investor. Non-portfolio targets are CVC-backed ventures, which were not part of the CVC's investment portfolio but were acquired by it. Panel A of the table compares characteristics of the CVC acquirers of portfolio ventures in the year of the acquisition (columns (1), (2), and (3)), to their average characteristics in years when they do not acquire portfolio ventures (columns (4), (5), and (6)). Panel B compares characteristics of CVC acquirers of portfolio targets (columns (1), (2), and (3)) to the characteristics of CVC acquirers of non-portfolio targets (columns (4), (5), and (6)) in the year of the acquisition. All dollar figures are in millions of dollars. Financial data on the acquirers comes from COMPUSTAT database. The t-tests of differences in means, and nonparametric Wilcoxon signed rank tests for differences in medians are reported in the last two columns. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Acquirers of Portfolio Targets			**Non-Acquirers of Portfolio Ventures**			**Difference**	
	Mean	**Median**	**Observations**	**Mean**	**Median**	**Observations**		
Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(1) - (4)	(2) - (5)
Total assets ($MMs)	33,016	19,231	116	114,541	47,143	13,443	-81,525***	-27,912***
R&D to assets (%)	0.09	0.09	116	0.08	0.09	13,443	0.01***	0.00*
Net income to assets (%)	0.03	0.08	116	0.07	0.09	13,443	-0.04**	-0.01
Cash to assets (%)	0.09	0.12	116	0.12	0.15	13,443	-0.03**	-0.03*
Tobin's Q	4.25	3.04	115	2.98	2.45	13,405	1.26***	0.59***
CVC Number of Patents	4,664.62	1,259	116	16,038	8,044	13,489	-11,373.38***	-6,785***

(Continue)

Table 6 – *Continued*

	Acquirers of Portfolio Targets			Acquirers of Non-Portfolio Targets			Difference	
	Mean	**Median**	**Observations**	**Mean**	**Median**	**Observations**		
Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(1) - (4)	(2) - (5)
Total assets ($MMs)	33,016.35	19,230.90	116	32,031.58	15,592.44	186	984.77	3,638.46
R&D to assets (%)	0.09	0.09	116	0.10	0.09	186	-0.01	0.00
Net income to assets (%)	0.03	0.08	116	0.08	0.10	186	-0.05	-0.02
Cash to assets (%)	0.09	0.12	116	0.12	0.14	186	-0.03	-0.02
Tobin's Q	4.25	3.04	115	3.98	3.05	186	0.27	-0.01
CVC Patents	4,664.62	1,259	116	5,628.98	2,409	186	-964.36	-1,150*

Table 7: Decision to Acquire a Portfolio Venture

This table reports results of a cross-sectional logit regression, where the sample includes only ventures in which the CVC investor has invested. The dependent variable is a dummy variable that equals one if the CVC investor acquires a portfolio venture, and zero otherwise. Independent variables include the total number of patents the venture was granted; the total number of citations to granted patents to the venture; the total number of backward citations that granted patents to the venture have made; the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio multiplied by 100; the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made multiplied by 100; CVC's investor portfolio size; the total number of patents granted to the CVC investor multiplied by 100; the total number of VC investors that have invested in the venture; the total number of CVC investors that have invested in the venture; the log of venture age; a dummy variable that equals one if the venture is a public company; a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; the log of acquirer's total assets; the ratio of acquirer's R&D expenditures to assets; the ratio of acquirer's cash to assets; and the acquirer's Tobin's Q, winsorized at the 99th percentile. All regressions include year- and industry-fixed effects. The reported standard errors are clustered by CVC acquirer firm. T-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Acquisition of Portfolio Venture					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Patents	-0.002	-0.002				
	(-0.30)	(-0.33)				
Number of Citations			0.008	0.008		
			(1.10)	(1.06)		
Number of Backward Citations					0.001***	0.001***
					(3.36)	(3.10)
Portfolio Patents	-0.001***	-0.001***				
	(-5.55)	(-2.89)				
Portfolio Citations			-0.003***	-0.002***		
			(-6.50)	(-2.40)		
Portfolio Backward Citations					-0.010***	-0.006***
					(-3.87)	(-2.64)
Portfolio Size		-0.002***		-0.001**		-0.002***
		(-3.17)		(-2.10)		(-3.44)
CVC Number of Patents	-0.002**	-0.002**	-0.002**	-0.002**	-0.003***	-0.003***
	(-2.25)	(-2.29)	(-2.10)	(-2.20)	-(2.81)	(-2.84)
Number of VCs	-0.097***	-0.102***	-0.102***	-0.106***	-0.103***	-0.109***
	(-2.75)	(-2.95)	(-2.93)	(-3.04)	(-2.96)	(-3.17)
Number of CVCs	0.135***	0.132***	0.132***	0.132***	0.134***	0.130***
	(3.04)	(3.00)	(3.02)	(3.01)	(3.10)	(3.02)
Log of Venture Age	-0.126	-0.126	-0.139	-0.142	-0.163	-0.162
	(-1.11)	(-1.11)	(-1.28)	(-1.30)	(-1.45)	(-1.42)
Public Venture	0.319	0.305	0.280	0.274	0.278	0.262
	(0.82)	(0.78)	(0.73)	(0.72)	(0.74)	(0.70)
Same Industry	0.726***	0.645***	0.723***	0.665***	0.765***	0.663***
	(3.42)	(3.11)	(3.53)	(3.24)	(3.67)	(3.24)
Log of Total Assets	0.010	0.034	0.017	0.030	0.014	0.038
	(0.11)	(0.39)	(0.19)	(0.35)	(0.15)	(0.43)
R&D to Total Assets	0.155	0.328	0.213	0.263	0.057	0.287
	(0.09)	(0.20)	(0.13)	(0.16)	(0.03)	(0.17)

(Continue)

Table 7 – *Continued*

	Dependent Variable: Acquisition of Portfolio Venture					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Cash to Total Assets	-0.794*	-0.660	-0.696	-0.639	-0.808*	-0.662
	(-1.77)	(-1.29)	(-1.48)	(-1.25)	(-1.81)	(-1.29)
Tobin's Q	0.160**	0.144**	0.151**	0.142**	0.154**	0.141**
	(2.26)	(2.13)	(2.24)	(2.13)	(2.19)	(2.09)
Constant	-5.020***	-4.767***	-5.045***	-4.760***	-4.993***	-4.721***
	(-3.61)	(-3.50)	(-3.67)	(-3.47)	(-3.58)	(-3.46)
N	22,939	22,939	22,939	22,939	22,939	22,939
Adj R^2	0.096	0.101	0.098	0.100	0.098	0.103
Industry-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Decision to Acquire a Non-Portfolio Venture

This table reports results of a cross-sectional logit regression, where the sample includes all ventures in which the CVC investor has previously invested, plus all ventures that were not included in the CVC's venture portfolio but were eventually acquired by the corporate investor. The dependent variable is a dummy variable that equals one if the CVC investor acquires a non-portfolio venture, and zero otherwise. Independent variables include the total number of patents the venture was granted; the total number of citations to granted patents to the venture; the total number of backward citations that granted patents to the venture have made; the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio multiplied by 100; the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made multiplied by 100; CVC's investor portfolio size; the total number of patents granted to the CVC investor multiplied by 100; the total number of VC investors that have invested in the venture; the total number of CVC investors that have invested in the venture; the log of venture age; a dummy variable that equals one if the venture is a public company; a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; the log of acquirer's total assets; the ratio of acquirer's R&D expenditures to assets; the ratio of acquirer's cash to assets; and the acquirer's Tobin's Q, winsorized at the 99th percentile. All regressions include year- and industry-fixed effects. The reported standard errors are clustered by CVC acquirer firm. T-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Acquisition of Non-Portfolio Venture					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Patents	-0.004	-0.004				
	(-0.78)	(-0.79)				
Number of Citations			0.003	0.002		
			(0.28)	(0.20)		
Number of Backward Citations					0.000	0.000
					(0.37)	(0.03)
Portfolio Patents	-0.002***	-0.002**				
	(-2.92)	(-2.18)				
Portfolio Citations			-0.006***	-0.005**		
			(-3.45)	(-2.16)		
Portfolio Backward Citations					-0.019***	-0.014**
					(-3.08)	(-2.19)
Portfolio Size		-0.002**		-0.002		-0.002**
		(-2.17)		(-1.49)		(-2.17)
CVC Number of Patents	0.000	-0.001	-0.000	-0.000	-0.001	-0.001
	(0.09)	(-0.00)	(-0.18)	(-0.27)	(-0.57)	(-0.59)
Number of VCs	0.008	0.004	0.002	-0.002	0.003	-0.001
	(0.37)	(0.17)	(0.03)	(-0.11)	(0.16)	(-0.03)
Number of CVCs	0.189***	0.189***	0.198***	0.200***	0.199***	0.197***
	(5.16)	(5.18)	(5.56)	(5.57)	(5.65)	(5.63)
Log of Venture Age	0.205*	0.200	0.186	0.183	0.187	0.184
	(1.69)	(1.64)	(1.57)	(1.53)	(1.54)	(1.50)
Public Venture	0.457*	0.432*	0.415*	0.401*	0.419*	0.392
	(1.93)	(1.87)	(1.77)	(1.74)	(1.73)	(1.65)
Same Industry	1.045***	0.949***	1.073***	1.003***	1.139***	1.005***
	(5.51)	(4.90)	(5.76)	(5.17)	(6.16)	(5.24)
Log of Total Assets	0.025	0.048	0.022	0.036	0.027	0.054
	(0.33)	(0.63)	(0.29)	(0.48)	(0.36)	(0.71)
R&D to Total Assets	1.576	1.732	1.571	1.632	1.537	1.742
	(0.83)	(0.89)	(0.82)	(0.83)	(0.81)	(0.90)

(Continue)

Table 8 – *Continued*

	Dependent Variable: Acquisition of Portfolio Venture					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Cash to Total Assets	0.446	0.824	0.625	0.825	0.351	0.797
	(0.67)	(1.05)	(0.90)	(1.08)	(0.57)	(1.06)
Tobin's Q	0.165***	0.144***	0.152***	0.140***	0.160***	0.138***
	(3.59)	(3.33)	(3.50)	(3.35)	(3.44)	(3.27)
Constant	-6.409***	-6.140***	-6.341***	-6.059***	-6.422***	-6.100***
	(-5.13)	(-4.92)	(-5.34)	(-5.11)	(-5.20)	(-4.95)
N	25,065	25,065	25,065	25,065	25,065	25,065
Adj R^2	0.161	0.166	0.159	0.161	0.156	0.163
Industry-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Cox Proportional Hazard Model

This table reports results of a Cox proportional hazard regression, where the sample includes only ventures in which the CVC investor has invested. The dependent variable is time-to-acquisition of a portfolio venture, which measures the time from the birth of a company to the date the company is acquired by a CVC acquirer that has previously invested in the venture. Independent variables include the total number of patents the venture was granted; the total number of citations to granted patents to the venture; the total number of backward citations that granted patents to the venture have made; the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio multiplied by 100; the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made multiplied by 100; CVC's investor portfolio size; the total number of patents granted to the CVC investor multiplied by 100; the total number of VC investors that have invested in the venture; the total number of CVC investors that have invested in the venture; the log of venture age; a dummy variable that equals one if the venture is a public company; a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; the log of acquirer's total assets; the ratio of acquirer's R&D expenditures to assets; the ratio of acquirer's cash to assets; and the acquirer's Tobin's Q, winsorized at the 99th percentile. All regressions include year- and industry-fixed effects. The reported standard errors are clustered by CVC acquirer firm. T-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Time-to-Acquisition of Portfolio Venture					
	Coefficient	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Patents	-0.003	0.997				
	(-0.44)					
Number of Citations			0.006	1.000		
			(0.75)			
Number of Backward Citations					0.001***	1.001***
					(3.24)	
Portfolio Patents	-0.001**	1.000**				
	(-2.24)					
Portfolio Citations			-0.002*	1.000*		
			(-1.81)			
Portfolio Backward Citations					-0.004	1.000
					(-1.57)	
Portfolio Size	-0.002***	0.998***	-0.001**	0.999**	-0.002***	0.998***
	(-2.79)		(-2.07)		(-2.99)	
CVC Number of Patents	-0.002*	1.000*	-0.002*	1.000*	-0.002**	1.000**
	(-1.89)		(-1.85)		(-2.38)	
Number of VCs	-0.102***	0.903***	-0.105***	0.900***	-0.109***	0.897***
	(-2.96)		(-3.06)		(-3.18)	
Number of CVCs	0.138***	1.148***	0.138***	1.148***	0.136***	1.145***
	(3.29)		(3.31)		(3.30)	
Log of Venture Age	-0.118	0.889	-0.133	0.876	-0.157	0.855
	(-1.12)		(-1.32)		(-1.50)	
Public Venture	0.289	1.335	0.259	1.296	0.245	1.277
	(0.76)		(0.70)		(0.67)	
Same Industry	0.724***	2.063***	0.744***	2.104***	0.745***	2.106***
	(3.81)		(3.89)		(3.95)	

(Continue)

Table 9 – *Continued*

	Dependent Variable: Time-to-Acquisition of Portfolio Venture					
	Coefficient	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Log of Total Assets	0.037	1.038	0.033	1.033	0.034	1.035
	(0.44)		(0.39)		(0.40)	
R&D to Total Assets	0.964	2.622	0.914	2.493	0.828	2.289
	(0.58)		(0.55)		(0.50)	
Cash to Total Assets	-0.463	0.629	-0.484	0.616	-0.505	0.603
	(-0.83)		(-0.89)		(-0.92)	
Tobin's Q	0.084	1.088	0.083	1.086	0.084	1.087
	(1.36)		(1.36)		(1.35)	
N	24,346		24,346		24,346	
Model p-value	0.000		0.000		0.000	
Industry-Fixed Effects	Yes		Yes		Yes	
Year-Fixed Effects	Yes		Yes		Yes	

Table 10: Cox Proportional Hazard Model

This table reports results of a Cox proportional hazard regression, where the sample includes all ventures in which the CVC investor has previously invested, plus all ventures that were not included in the CVC's venture portfolio but were eventually acquired by the corporate investor. The dependent variable is time-to-acquisition of a non-portfolio venture, which measures the time from the birth of a company to the date the company is acquired by a CVC acquirer that has has not been previously investing in the venture. Independent variables include the total number of patents the venture was granted; the total number of citations to granted patents to the venture; the total number of backward citations that granted patents to the venture have made; the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio multiplied by 100; the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made multiplied by 100; CVC's investor portfolio size; the total number of patents granted to the CVC investor multiplied by 100; the total number of VC investors that have invested in the venture; the total number of CVC investors that have invested in the venture; the log of venture age; a dummy variable that equals one if the venture is a public company; a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; the log of acquirer's total assets; the ratio of acquirer's R&D expenditures to assets; the ratio of acquirer's cash to assets; and the acquirer's Tobin's Q, winsorized at the 99th percentile. All regressions include year- and industry-fixed effects. The reported standard errors are clustered by CVC acquirer firm. T-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Time-to-Acquisition of Non-Portfolio Venture					
	Coefficient	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Patents	-0.004	0.996				
	(-0.99)					
Number of Citations			-0.001	1.000		
			(-0.11)			
Number of Backward Citations					0.000	1.000
					(0.10)	
Portfolio Patents	-0.002***	0.998***				
	(-2.35)					
Portfolio Citations			-0.004**	1.000**		
			(-2.16)			
Portfolio Backward Citations					-0.013**	1.000**
					(-2.13)	
Portfolio Size	-0.002***	0.998***	-0.002	0.998	-0.002***	0.998***
	(-2.52)		(-1.67)		(-2.47)	
CVC Number of Patents	-0.000	1.000	-0.001	1.000	-0.001	1.000
	(-0.17)		(-0.39)		(-0.77)	
Number of VCs	0.006	1.006	-0.001	0.999	0.001	1.001
	(0.27)		(-0.05)		(0.05)	
Number of CVCs	0.178***	1.195***	0.191***	1.211***	0.189***	1.207***
	(5.11)		(5.64)		(5.72)	
Log of Venture Age	0.238*	1.269*	0.223*	1.250*	0.218*	1.243*
	(1.90)		(1.79)		(1.70)	
Public Venture	0.421*	1.524*	0.395*	1.484*	0.372	1.450
	(1.84)		(1.72)		(1.58)	
Same Industry	0.930***	2.533***	0.985***	2.678***	0.992***	2.696***
	(5.47)		(5.76)		(5.89)	

(Continue)

Table 10 – *Continued*

	Dependent Variable: Time-to-Acquisition of Non-Portfolio Venture					
	Coefficient	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**	**Coefficient**	**Hazard Ratio**
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Log of Total Assets	0.117*	1.124*	0.100	1.106	0.118*	1.126*
	(1.88)		(1.54)		(1.82)	
R&D to Total Assets	2.616	13.677	2.485	12.006	2.594	13.386
	(1.61)		(1.54)		(1.56)	
Cash to Total Assets	1.975*	7.209*	1.928*	6.873*	1.871*	6.492*
	(1.87)		(1.83)		(1.80)	
Tobin's Q	0.068	1.071	0.062	1.064	0.065	1.067
	(1.65)		(1.46)		(1.60)	
N	25,506		25,506		25,506	
Model p-value	0.000		0.000		0.000	
Industry-Fixed Effects	Yes		Yes		Yes	
Year-Fixed Effects	Yes		Yes		Yes	

Table 11: Heckman Selection Model – First Stage

This table presents the first stage estimates (using Heckman's (1979) two step procedure) of the determinants of CVC acquisition. The dependent variable is a dummy variable that equals one if the start-up company receives CVC financing, and zero otherwise. Independent variables include the total number of spin-offs in an given year; the total number of patents the venture was granted; the total number of citations to granted patents to the venture; the total number of backward citations that granted patents to the venture have made; the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio multiplied by 100; the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made multiplied by 100; CVC's investor portfolio size; the total number of patents granted to the CVC investor multiplied by 100; the total number of VC investors that have invested in the venture; the total number of CVC investors that have invested in the venture; the log of venture age; a dummy variable that equals one if the venture is a public company; a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; the log of acquirer's total assets; the ratio of acquirer's R&D expenditures to assets; the ratio of acquirer's cash to assets; and the acquirer's Tobin's Q, winsorized at the 99th percentile. All regressions include year- and industry-fixed effects. The reported standard errors are clustered by CVC acquirer firm. T-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variables:		
Independent variables	(1)	(2)	(3)
Number of Spin-offs	0.099***	0.112***	0.100***
	(2.47)	(2.82)	(2.55)
Number of Patents	-0.001		
	(-0.23)		
Number of Citations		0.003	
		(0.41)	
Number of Backward Citations			-0.000
			(-0.95)
Portfolio Patents	0.001***		
	(2.63)		
Portfolio Citations		0.002***	
		(2.80)	
Portfolio Backward Citations			0.010***
			(2.83)
Portfolio Size	0.001***	0.001**	0.001***
	(2.37)	(2.03)	(2.77)
CVC Number of Patents	0.001	0.001	0.001
	(0.52)	(0.85)	(1.20)
Number of VCs	0.025	0.026	0.026
	(1.49)	(1.57)	(1.55)
Number of CVCs	-0.063**	-0.065**	-0.063**
	(-1.98)	(-2.07)	(-2.02)
Log of Venture Age	0.016	0.011	0.017
	(0.30)	(0.21)	(0.31)
Public Venture	-0.472***	-0.479***	-0.468***
	(-2.84)	(-2.94)	(-2.79)
Same Industry	-0.434***	-0.435***	-0.440***
	(-4.14)	(-4.17)	(-4.20)

(Continue)

Table 11 – *Continued*

	Dependent Variables:		
Independent variables	(1)	(2)	(3)
Log of Total Assets	-0.038	-0.034	-0.043
	(-0.90)	(-0.81)	(-1.01)
R&D to Total Assets	-1.711	-1.928	-1.857
	(-1.31)	(-1.48)	(-1.43)
Cash to Total Assets	-0.294	-0.308	-0.294
	(-1.10)	(-1.16)	(-1.10)
Tobin's Q	0.013	0.015	0.016
	(0.59)	(0.67)	(0.71)
Constant	0.451	0.251	0.472
	(0.50)	(0.29)	(0.54)
N	8,370	8,370	8,370
Adj R^2	0.221	0.219	0.219
Industry-Fixed Effects	Yes	Yes	Yes
Year-Fixed Effects	Yes	Yes	Yes

Table 12: Heckman Selection Model – Second Stage

This table presents the second stage estimates (using Heckman's (1979) two step procedure) of the determinants of CVC acquisition. The dependent variable in the first three specifications, (1), (2), and (3) is a dummy variable that equals one if the CVC investor acquires a portfolio venture, and zero otherwise. The sample in these specifications includes only ventures in which the CVC investor has invested. The dependent variable in specifications, (4), (5), and (6) is a dummy variable that equals one if the CVC investor acquires a non-portfolio venture, and zero otherwise. The sample in the last three specifications includes all ventures in which the CVC investor has previously invested, plus all venture that were not included in the CVC's venture portfolio but were eventually acquired by the corporate investor. Independent variables include the total number of patents the venture was granted; the total number of citations to granted patents to the venture; the total number of backward citations that granted patents to the venture have made; the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio multiplied by 100; the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made multiplied by 100; CVC's investor portfolio size; the total number of patents granted to the CVC investor multiplied by 100; the total number of VC investors that have invested in the venture; the total number of CVC investors that have invested in the venture; the log of venture age; a dummy variable that equals one if the venture is a public company; a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; the log of acquirer's total assets; the ratio of acquirer's R&D expenditures to assets; the ratio of acquirer's cash to assets; and the acquirer's Tobin's Q, winsorized at the 99th percentile; and the inverse Mills ratio obtained from the first step regression. All regressions include year- and industry-fixed effects. The reported standard errors are clustered by CVC acquirer firm. T-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variables:					
	Acquisition of Portfolio Venture			**Acquisition of Non-Portfolio Venture**		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Patents	-0.002			-0.003		
	(-0.23)			(-0.66)		
Number of Citations		0.009			0.004	
		(1.13)			(0.49)	
Number of Backward Citations			0.001***			-0.000
			(2.89)			(-0.04)
Portfolio Patents	-0.001***			-0.001*		
	(-3.28)			(-1.88)		
Portfolio Citations		-0.002***			-0.004*	
		(-2.56)			(-1.86)	
Portfolio Backward Citations			-0.005**			-0.012**
			(-2.14)			(-1.98)
Portfolio Size	-0.001***	-0.001**	-0.001***	-0.002**	-0.001	-0.002**
	(-3.15)	(-1.97)	(-3.49)	(-2.14)	(-1.37)	(-2.17)
CVC Number of Patents	-0.001*	-0.002*	-0.002***	0.001	-0.000	-0.001
	(-1.89)	(-1.82)	(-2.43)	(0.04)	(-0.25)	(-0.50)
Number of VCs	-0.093***	-0.097***	-0.099***	0.012	0.009	0.008
	(-2.64)	(-2.75)	(-2.85)	(0.49)	(0.36)	(0.36)
Number of CVCs	0.106***	0.109***	0.109***	0.152***	0.157***	0.161***
	(2.36)	(2.33)	(2.54)	(3.88)	(3.99)	(4.29)
Log of Venture Age	-0.135	-0.150	-0.170	0.203	0.185	0.192
	(-1.18)	(-1.36)	(-1.48)	(1.66)	(1.53)	(1.57)
Public Venture	0.122	0.117	0.104	0.238	0.190	0.224
	(0.28)	(0.27)	(0.26)	(0.78)	(0.66)	(0.77)

(Continue)

Table 12 – *Continued*

	Dependent Variables:					
	Acquisition of Portfolio Venture			**Acquisition of Non-Portfolio Venture**		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Same Industry	0.501***	0.539***	0.534***	0.665***	0.692***	0.725***
	(2.43)	(2.41)	(2.55)	(3.29)	(3.31)	(3.54)
Log of Total Assets	-0.057	-0.061	-0.048	-0.030	-0.033	-0.013
	(-0.50)	(-0.54)	(-0.42)	(-0.41)	(-0.46)	(-0.17)
R&D to Total Assets	0.490	0.428	0.424	1.206	1.055	1.235
	(0.29)	(0.25)	(0.25)	(0.55)	(0.48)	(0.57)
Cash to Total Assets	-0.599	-0.572	-0.601	0.752	0.745	0.733
	(-1.18)	(-1.13)	(-1.19)	(0.98)	(1.00)	(1.00)
Tobin's Q	0.111	0.109	0.108	0.127***	0.123***	0.123***
	(1.53)	(1.52)	(1.50)	(2.69)	(2.69)	(2.69)
Inverse Mills Ratio	0.602	0.492	0.526	1.088	1.218	1.012
	(0.66)	(0.49)	(0.58)	(1.19)	(1.40)	(1.19)
Constant	-4.087***	-4.052***	-4.032***	-5.718***	-5.727***	-5.745***
	(-2.69)	(-2.67)	(-2.64)	(-4.79)	(-5.12)	(-4.70)
N	21,744	21,744	21,744	23,952	23,952	23,952
Adj R^2	0.104	0.103	0.106	0.167	0.163	0.165
Industry-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 13: Acquirer Abnormal Returns by Acquisition Type

This table reports CARs to 54 CVC investors from acquiring CVC-backed start-ups. CARs are measured over a three-day event window around the acquisition announcement date. Acquisitions of portfolio ventures (non-portfolio ventures) are defined as acquisitions in which the acquirer had (had not) provided venture funds to the target at an earlier stage of development. Panel A reports CARs measured around the announcement of acquisitions of full control. Panel B restricts the sample to acquisitions of portfolio ventures only, and reports CARs measured around the announcement of initial CVC investments. Panel C restricts the sample to acquisitions of portfolio ventures only, and reports the combined CARs measured around the announcement of initial CVC investments and at the announcement of subsequent acquisitions of full control. Column 3 tests for significant differences in the mean and median (reported in brackets) abnormal returns to portfolio ventures (column 1) and non-portfolio ventures (column 2) using t-tests for differences in means, and nonparametric Wilcoxon signed rank tests for differences in medians. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Acquisitions of portfolio ventures	**Acquisitions of non-portfolio ventures**	**Difference**
Announcement Returns	(1)	(2)	(1) - (2)
Panel A: At the acquisition of full control			
CAR (-1,1)	-0.006*	0.000	-0.007
	[-0.004]*	[-0.001]	[-0.003]*
Number of Observations	114	186	
Panel B: At the acquisition of initial CVC stake			
CAR (-1,1)	0.012**		
	[0.003]*		
Number of Observations	114		
Panel C: Combined returns at initial CVC stake and subsequent acquisition			
CAR (-1,1)	0.006	0.000	0.006
	[-0.001]	[-0.001]	[0.000]
Number of Observations	114	186	

Table 14: Cross-Sectional Regression of CVC Acquisition Performance

This table presents results of a cross-sectional ordinary least squares regression of the performance of CVC acquisitions. The dependent variable is the market-adjusted CARs earned by CVC acquirers over a three-day event window around the acquisition announcement date. The sample in specifications (1), (2), and (3) includes only ventures in which the CVC investor has invested. The sample in specifications, (4), (5), and (6) includes all ventures in which the CVC investor has previously invested, plus all venture that were not included in the CVC's venture portfolio but were eventually acquired by the corporate investor. Independent variables include the total number of patents the venture was granted; the total number of citations to granted patents to the venture; the total number of backward citations that granted patents to the venture have made; the total number of patents granted to the *other ventures* included in the CVC's investment portfolio; the total number of citations to granted patents to the *other ventures* included in the CVC's investment portfolio multiplied by 100; the total number of backward citations that granted patents to the *other ventures* included in the CVC's investment portfolio have made multiplied by 100; the CVC's investor portfolio size; the total number of patents granted to the CVC investor multiplied by 100; the total number of VC investors that have invested in the venture; the total number of CVC investors that have invested in the venture; the log of venture age; a dummy variable that equals one if the venture is a public company; a dummy variable that equals one if the venture and the CVC acquirer are from the same 2-digit SIC code industry; the log of acquirer's total assets; the ratio of acquirer's R&D expenditures to assets; the ratio of acquirer's cash to assets; and the acquirer's Tobin's Q, winsorized at the 99th percentile; a dummy variable that equals one if the acquisition is paid 100 percent by cash; and the value of the target as a fraction of the market capitalization of the acquirer. All regressions include year- and industry-fixed effects. The reported standard errors are clustered by CVC acquirer firm. T-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Three-Day CAR					
	Acquisition of Portfolio Venture			**Acquisition of Non-Portfolio Venture**		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Patents	-0.000			0.000		
	(-0.72)			(0.35)		
Number of Citations		0.002			0.001	
		(1.54)			(0.76)	
Number of Backward Citations			0.000			-0.000
			(0.71)			(-0.14)
Portfolio Patents	-0.000			-0.001***		
	(-0.29)			(-2.39)		
Portfolio Citations		-0.000			-0.001*	
		(-0.15)			(-1.92)	
Portfolio Backward Citations			0.000			-0.001
			(0.87)			(-0.72)
Portfolio Size	0.000	0.000	0.000	-0.000	-0.000	-0.001**
	(0.47)	(0.50)	(0.47)	(-1.36)	(-0.87)	(-2.12)
CVC Number of Patents	0.001***	0.001***	0.001***	0.001	0.001	0.001
	(2.38)	(2.82)	(2.49)	(0.45)	(0.39)	(0.24)
Number of VCs	0.002	0.002	0.001	-0.000	-0.000	-0.000
	(0.47)	(0.62)	(0.34)	(-0.19)	(-0.28)	(-0.39)
Number of CVCs	-0.006	-0.008	-0.003	-0.002	-0.001	-0.002
	(-0.82)	(-1.47)	(-0.42)	(-0.29)	(-0.19)	(-0.20)
Log of Venture Age	-0.022***	-0.025***	-0.019***	-0.002	-0.003	-0.001
	(-2.46)	(-3.09)	(-2.48)	(-0.29)	(-0.35)	(-0.17)
Public Venture	0.029	0.029	0.019	-0.013	-0.015	-0.013
	(1.30)	(1.52)	(0.83)	(-1.16)	(-1.29)	(-1.22)

(Continue)

Table 14 – *Continued*

	Dependent Variable: Three-Day CAR					
	Acquisition of Portfolio Venture			**Acquisition of Non-Portfolio Venture**		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Same Industry	0.012	0.009	0.009	-0.002	0.000	-0.001
	(0.78)	(0.59)	(0.57)	(-0.12)	(0.03)	(-0.09)
Log of Total Assets	-0.032***	-0.032***	-0.032***	-0.002	-0.002	-0.002
	(-2.38)	(-2.43)	(-2.51)	(-0.23)	(-0.35)	(-0.27)
R&D to Total Assets	-0.015	0.020	0.048	-0.071	-0.058	-0.051
	(-0.08)	(0.13)	(0.27)	(-0.82)	(-0.68)	(-0.58)
Cash to Total Assets	0.016	0.017	0.016	0.096	0.109	0.103
	(1.03)	(1.20)	(1.14)	(1.16)	(1.33)	(1.24)
Tobin's Q	0.007***	0.007***	0.008***	0.002	0.002	0.002
	(2.45)	(3.12)	(2.81)	(0.59)	(0.48)	(0.44)
Cash Deals	0.003	0.000	0.002	0.025**	0.025**	0.025**
	(0.17)	(0.01)	(0.11)	(2.27)	(2.26)	(2.04)
Relative Size	-0.113*	-0.101*	-0.114**	0.006	0.012	0.014
	(-1.79)	(-1.69)	(-2.17)	(0.10)	(0.16)	(0.22)
Constant	0.289**	0.268***	0.294***	-0.055	0.041	-0.045
	(2.26)	(2.43)	(2.41)	(-0.70)	(0.49)	(-0.55)
N	65	65	65	115	115	115
Adj R^2	0.611	0.632	0.622	0.399	0.382	0.369
Industry-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes