A Dark Side of Corporate Venture Capital

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Abstract

We examine a dark side of corporate venture capital (CVC) programs via the lens of institutional investors, although the existing literature generally finds CVC programs benefit both the parent firms and startups. Relying on plausibly exogenous variation in institutional ownership generated by annual reconstitutions of Russell 1000 and 2000 indexes, we show that an increase in institutional ownership is associated with a cut in firms' CVC investment. This effect is more pronounced for firms that are subject to more serious managerial agency problems. Further tests show that institutional investors induce firms to cut CVC investment in startups that are unrelated to the firms' core business and are of low quality as well as when firms have poor track record on CVC investment. By doing so, both short-term and long-term firm value increases. Our paper uncovers a previously under-explored dark side of CVC programs – their giving rise to managerial agency problems.

Key words: Corporate venture capital, institutional investors, agency problem, firm value

JEL number: G24; G23; G30

1. Introduction

Corporate venture capital (CVC) is a subsidiary of non-financial firms that makes minority equity investment in early-stage startups. Unlike traditional independent venture capital (IVC) funds, the objective of CVC investment is not primarily to maximize financial returns. Instead, CVC investment is arguably motivated for strategic concerns of their parent firms, such as "exposure to a pioneering technology and early establishment of alliances in the product market" (Chemmanur and Loutskina, 2015). As early as the 1960s, U.S. corporations started to establish CVC funds, and CVC has become a common form of corporate investment adopted by hundreds of publicly traded firms, such as Intel, Google, Microsoft, and GE. According to the National Venture Capital Association, CVC investment accounts for 20% of VC investment in 2016, a rapid increase from about 7% in early 2000s.

Existing literature on CVC programs overall shows their bright side for both the CVCs' parent firms and startups receiving CVC investment (hereafter CVC-backed startups). First, CVC programs increase their parent firms' own innovation output. Dushnitsky and Lenox (2005, 2006) find that firms with CVC programs enjoy a significant increase in their own innovation output and higher firm value. Potential reasons, as modeled by Hellmann (2002), could be that CVC programs create synergies between their parent firms and startups. CVC investment, however, could exploit startups as well, which contributes to their enhanced innovation output and valuation. Second, CVC investment is beneficial to startups. Chemmanur et al. (2014) show that CVC-backed startups are more innovative than IVC-backed startups, because CVCs are more failure tolerant than IVCs (Tian and Wang, 2014). Lerner and Gompers (2000) and Gompers (2002) find that CVC-backed startups tend to have higher successful rates than IVC-backed startups in terms of going public. Chemmanur and Loutskina (2015) find that, compared to IVC-backed startups, CVC-backed startups access the equity market at an earlier stage in their life cycles and obtain higher IPO market valuations. Given the above documented benefits CVCs can bring to their parent firms and portfolio startups, a natural question, however, is why do not all publically listed firms establish CVC funds and make CVC investment? Specifically, why do the majority of publicly traded firms not have CVC programs? Our paper provides a plausible reason that explains this seemingly puzzling phenomenon: CVC programs could lead parent firms to overinvest in early-stage startups and create managerial agency problems, which destroy shareholder value.

Like any investment decisions, a firm should engage in CVC investment only if it offers an expectation of positive net present value. CVC programs, unfortunately, may cause managerial agency problems, i.e., conflicts of interest between managers and shareholders, that distort a firm's investment decision from the optimal level and lead to over-investment in startups. As pointed out by Scharfstein and Stein (2000), specialized investment could effectively entrench firm managers, which makes them hard to be replaced, so that they can enjoy the private, non-pecuniary benefits of control. CVC program is a good candidate for such specialized investment. CVCs typically invest in early-stage startups that are very risky with highly uncertain prospects. CVCs need to exert intensive due diligence before making an investment in startups and intensively monitor and supervise the startups throughout the incubation period. Given that CVC investment process is long, risky, and idiosyncratic, it has many unique features and is substantially different from a firm's routine investment, which could effectively entrench firm managers. In addition, managers with career concerns who want to "grandstand" from their peers could overinvest in CVCs, hoping to achieve breakthrough innovation and obtain extraordinary high returns, which may not necessarily best serve shareholders' interests.[1] Both arguments suggest that CVC programs could distort managerial incentives and destroy shareholder value. We term this view the "managerial agency hypothesis."

Testing the managerial agency hypothesis is not an easy task because of two reasons. First, econometricians do not directly observe the investment opportunities of a firm's CVC program and hence the "optimal" level of the firm's CVC investment. To get around this difficulty, we explore how firms adjust their CVC investment after enhanced monitoring from institutional investors. A large strand of existing literature shows that institutional investors play important monitoring roles and are able to influence the governance and policies of firms (see, e.g., Gillan and Starks (2006) and Edmans and Holderness (2017) for surveys), and this is the case not only for active investors such as hedge fund activism (Brav et al., 2008), but passive institutional investors who do not actively buy or sell shares (e.g., Appel et al., 2016). Hence, exploring how firms react to increased monitoring from institutional investors in terms of their CVC investment should allow us to evaluate the quality of the CVC investment and test the managerial agency hypothesis.

[1] Gompers (1996) shows the grandstanding incentive of VC fund managers and the negative consequences it brings.

Second, there is simultaneity between CVC investment and institutional ownership, which makes causal inferences difficult. This is because institutional ownership may be correlated with factors, such as firms' investment opportunities or managerial styles, that are not observable but directly affect managerial decisions, i.e., the typical omitted variable problem. Meanwhile, a firm's CVC investment decisions could affect institutional holdings, which lead to the reverse causality concern. To overcome these challenges and establish causality, following the existing literature (e.g., Boone and White, 2015; Appel et al., 2016; Chen, Dong, and Lin, 2016, 2018; Crane et al., 2016; Schmidt and Fahlenbrach, 2017), we make use of plausibly exogenous variation in institutional ownership generated by annual reconstitutions of the Russell 1000 and 2000 indexes. Suggested by the prior studies, this identification strategy relies on two important features of firms around the Russell 1000/2000 cutoff. First, because firms cannot precisely manipulate their ranking in the Russell index, firms on either side of the cutoff have similar characteristics that affect their CVC investment decisions. This assumption seems to be reasonable in our setting because it is unclear why index inclusion would be directly related to a firm's CVC program, especially after we restrict the sample to firms near the Russell 1000/2000 cutoff and control for the factor that determines index inclusion. Second, because of the value-weighted construction of each index, firms near the top of the Russell 2000 have significantly larger index portfolio weights compared with firms near the bottom of the Russell 1000. Consistent with the literature, we identify a 0.9% jump in passive institutional ownership from the bottom of the Russell 1000 to the top of the Russell 2000.[2]

One potential criticism of the identification strategy is that Russell index reconstitutions mainly alter ownership by passive institutional investors who may not directly have influences on firm policies. This concern, however, may not be the case. There are compelling reasons to believe that managers would respond to passive institutional investors. For example, passive institutional investors hold a significant portion of total equity funds (Del Guercio and Hawkins, 1999) and they have strong incentives to obtain high returns by increasing the value of their assets under management (Cremers and Petajisto, 2009). As a matter of fact, existing studies find that passive institutional investors are active voters (Lu, 2013; Crane et al., 2014) and influence a variety of

[2] The mean value of passive institutional ownership of firms in our sample is 4.1%. Consistent with previous studies, we find no significant effect of Russell index reassignment on active institutional ownership.

firm governance and policies (e.g., Bushee 1998; Appel et al., 2016; Chen , Dong, and Lin, 2016, 2018; and Crane et al., 2016)

Using an instrumental variable approach with Russell index reconstitutions as the instrument, our baseline results show that an increase in institutional ownership leads to a reduction in the firms' CVC investment propensity and CVC portfolio size. Specifically, a one-standard-deviation increase in institutional ownership leads to a 5.7% reduction in a firm's CVC investment likelihood and a 9.5% decrease in the firm's CVC portfolio size (in terms of the number of portfolio startups). We further show that the reduction in the firm's CVC portfolio is due to a decrease in the number of existing startups in the portfolio. In other words, firms actively write off existing startups in their portfolios. Institutional investors, however, have no effect on the number of new startups the firms' CVC funds are investing.

We undertake a variety of additional tests to ensure that our baseline findings are robust. The test results suggest that our main findings are robust to including firm fixed effects in the regressions, controlling for firms' financial variables, and restricting the sample to firms with CVC programs. Our placebo tests suggest that the discontinuity in CVC investment is absent at artificially chosen market capitalization ranking cutoffs other than the real Russell 1000/2000 index reconstitution cutoff, which suggests that our main findings are unlikely driven by chance.

Next, we make use of heterogeneity in firms' exposures to managerial agency problems, captured by the G-index, "busy" boards, and dispersive technology, and undertake a number of cross-sectional tests. We find that firms with high *ex ante* managerial agency problems are more likely to shrink CVC portfolio after an increase in institutional ownership due to Russell index assignments. These findings provide additional evidence and lend further credence to our main argument that, to entrench themselves, managers tend to invest in CVC projects that beyond the optimal investment level and institutional investors help to correct this misbehavior.

Our results so far are consistent with two plausible interpretations. The first interpretation is our managerial agency hypothesis: firms' CVC programs over-invest startups to entrench themselves and to best serve their interest at the expense of shareholders, which reduces firm value. Institutional investors who have strong incentives to achieve high returns on their holdings play important monitoring roles and mitigate the managerial agency problems. They induce firms to cut CVC investment. If this interpretation is supported, we should observe that firms cut CVC investment in poor quality startups, which enhances firm value.

An alternative interpretation of our main results could be consistent with a managerial myopia argument. Institutional investors could impose short-term pressures on managers to meet near-term earnings goals (e.g., Bushee, 1998, 2001). Graham et al. (2005) show that, in a survey of 401 U.S. Chief Financial Officers (CFOs), a majority of CFOs admit that they are willing to sacrifice long-term firm value to meet the desired short-term earnings targets due to their own career, wealth, and external reputation concerns. If managers miss the consensus earnings forecasts, there could be a significant decline in the firms' stock prices (Bartov et al., 2002); CEO bonuses decrease (Matsunaga and Park, 2001), and management turnover probability increases (Mergenthaler et al., 2011). As a result, due to increased short-term pressure from institutional investors, managers may cut off their investment in long-term, value-enhancing projects, such as their CVC investment in early-stage startups, to boost the firms' short-term performance. If this interpretation is supported, we should observe firms cut CVC investment in startups with good potentials, which destroys firm value.

We undertake a variety of tests to disentangle these two alternative interpretations. We find that institutional investors induce firms to cut CVC investment in startups that are unrelated to the firms' core business and are of low quality (evidenced by their low eventual successful rates). The negative effect of institutional ownership on CVC investment is more pronounced if the firms have poor past track record on CVC investment. By doing so, institutional investors enhance firms' value in both the short run and long run. Taken together, these findings are consistent with the managerial agency hypothesis that institutional investors reduce agency problems between managers and shareholders by cutting unproductive CVC investment in startups, which enhances firm value.

Our paper is related to two strands of literature. Our paper mainly contributes to the CVC literature. Gompers and Lerner (2000) study how the organizational and compensation structure in CVC-backed startups affect their performance. Dushnitsky and Lenox (2005, 2006) find that corporations with CVC programs enjoy a significant increase in their own innovation output and higher firm values. Chemmanur et al. (2014) explore the innovation output of startups receiving CVC investment, and show that CVC-backed startups are more innovative than IVC-backed startups. Chemmanur and Loutskina (2015) find that, compared to IVC-backed startups, CVC-backed startups access the equity market at an earlier stage in their life cycles and obtain higher IPO market valuations. Benson and Ziedonis (2010) show that takeovers of portfolio companies by CVC parent firms destroy significant value for parent firms' shareholders, even though they are good acquirers of other startups. Ma (2016) finds that firms establish CVC funds after the deterioration of its internal innovation and terminate CVC programs when their innovation recovers. He concludes that CVC investment is motivated by the firm's strategic desire to regain innovation after adverse shocks. Our paper provides a different rationale for firms to engage in CVC activities and points out a potential downside of CVC programs.

Our paper is also related to the large literature on institutional investors (see, e.g., Gillan and Starks (2006); Brav et al. (2017), Edmans and Holderness (2017) for excellent surveys of this literature). Existing papers using the Russell 1000/2000 threshold to address endogeneity have studied the causal effects of institutional investors on stock prices (Chang at al., 2005), mergers and acquisitions (Fich, Harford, and Tran, 2015), firm transparency and information production (Boone and White, 2015), payout policy (Crane et al., 2016), audit quality (Chen, Dong, and Lin, 2016), corporate governance (Mullins, 2014; Appel et al., 2016; and Schmidt and Fahlenbrach, 2017), corporate social responsibility (Chen, Dong, and Lin, 2018), and firm value (Cremers et al., 2017). Our paper contributes to this literature by studying the effect of institutional investors on a special type of firm investment, CVC programs, whose investment process is long, risky, and idiosyncratic. Compared to other studies in this literature, one unique advantage of our setting is that we are able to directly observe the investment projects in question: the startups and their characteristic and quality.

The rest of our paper proceeds as follows. Section 2 describes sample and data. Section 3 discusses the methodology. Section 4 provides our main results and conducts a variety of robustness checks. Section 5 explores plausible underlying mechanisms and tests the value implications. Section 6 concludes.

2. Sample and Data

2.1 Russell 1000/ 2000 Index Assignment

Our methodology relies on changes in Russell 1000 and 2000 index assignment over time. The Russell 1000 is a capitalization-weighted stock market index which comprises the largest 1,000 U.S. stocks as measured by total market capitalization, and the Russell 2000 index comprises the next largest 2,000 U.S. stocks. On the last Friday of June in each year, the Russell reconstitutes the indexes based on each stock's total market capitalization as of the last trading day in May in that year. The index assignment is valid for the next 12 months.

To calculate the end-of-May market capitalization, we use monthly data from the Center for Research in Security Prices (CRSP). Each firms' total market capitalization is measured by the sum of the number of shares outstanding multiplied by price across all classes of common stocks of that firm. We use the CRSP market capitalization to predict stock rankings in the indexes. To control for the end-of-May market capitalization, we impose a set of natural logarithm of market capitalization by varying the polynomial order.

Russell uses stock's available public float to calculate the floated-adjusted market capitalization of each stock and uses it as the index weight. The float-adjusted market capitalization is different from the total market capitalization used to determine the index constituents as the former only captures the value of public-traded shares while the latter takes into account all outstanding shares. We add float-adjusted market capitalization as a control variable in our estimations.

Our initial sample includes 4,455 unique U.S stocks assigned to Russell 1000 and 2000 indexes between 1998 and 2006. 845 of them are within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes, and we use them as our final sample. Summary statistics are presented in Table 1. A typical firm in our sample has a market capitalization of $1.5 billion and float-adjusted capitalization as $1.3 billion.

2.2 Identifying Corporate Venture Capital

To identify CVCs and their parent firms, we start with a list of venture capital firms classified as Corporate PE/Venture in the VentureXpert database. Following Chemmanur et al. (2014), we manually supplement the information of CVCs with other information sources (e.g. Bloomberg, Google). We exclude the CVCs with multiple parent firms, with foreign parent firms, with unknown parent firms, or with financial parent firms (SIC between 2000 and 2999). Each CVC in our sample is affiliated with a unique U.S publicly traded parent firm, which is listed in the Compustat, the CRSP, and the Thomson Reuters databases. Our sample includes 185 parent firms which have a least one CVCs during 1998 to 2006.

We retrieve detailed information on each round of CVC investment from VentureXpert, including the date, the investment amount, and the list of other syndicate VCs. For each startup, we mark its exit status as going public through initial public offerings (IPOs), being merged or acquired (M&As), being written-off, or being under active investment. To identify the date of exits, we retrieve information on IPO deals and M&A deals from the Global New Issues database and the Mergers and Acquisitions database on the SDC Platinum, respectively. If an IPO deal happens after the first round of CVC financing, it is classified as an IPO exit deal. If a completed M&A deal whose target is a startup after its first round of financing and involves no less than 50% of all shares, it is classified as an M&A exit deal. If a startup is involved in more than one M&A exit deal and/or IPO exit deal, it is considered to exiting through the earliest one. If a startup does not receive any VC financing within three years after its last round of financing, we mark the startup as being written off. The date on three years after the last round of financing is considered to be the proxy of exit date. If a startup does not exit through an IPO, M&A or written-off, we label it as being under active investment.

Startups take years to grow before it become mature enough to go public or be acquired by another company. It is likely that CVCs have limited investment horizon and exit from the startups before these startups go public or are acquired. In this case, CVCs may sell their holdings to other VCs and exit from the startups early. To identify the exit date of each CVC from a startup, we combine information on startup exit and CVCs' last round of financing in the startup. If a CVC invests in the last round of recorded financing of a startup, it is considered to be investing the startup until the startup goes public, is acquired, or is written-off. We use startup exit date as a proxy for firm exit date. If a CVC does not invest in a startup's last round of recorded financing, it is considered to exit from the startup early. We use the earliest date in the following two dates to proxy its exit date: the date on three years after its last round of financing or startup exit date.

We then construct the CVC portfolio for each parent firm in each of our sample reconstitution year t (i.e. from end-of-June of year t to end-of-June year t+1), and construct four CVC investment variables, including *CVC dummy*, *No. of portfolio startup*, *No. of new startups*, and *No. of startups staying in portfolio*. The CVC dummy equals one if there is at least one startup in firm i's CVC portfolio at year t, and zero otherwise. *No. of portfolio startup* is the number of startups in firm i's CVC portfolio at year t. *No. of new startups* is the number of new startups that are included in firm i's CVC portfolio at year t but not included at year t-1. *No. of existing startups* is the number of startups that are included in firm i's CVC portfolio in both year t and year t-1.

We report summary statistics in Table 1. A typical firm in our sample has the mean value of the CVC dummy of 0.04, and has 0.13 startups in its portfolio, which is consistent of 0.09 existing startups, and 0.04 new startups.

[Insert Table 1 around here]

2.3 Institutional Ownership

We use mutual fund holding data from Thomson Reuters S12 to calculate institutional ownership in a firm as the percentage of its total market capitalization. For each firm *i* at year *t*, we calculate its institutional ownership at the end of the first quarter after index reconstitution (i.e. end-of-September). Since May 2004, mutual funds are required to report their portfolio holdings every quarter to the SEC. Before May 2004, funds were required to disclose their holdings through Form N-30D twice a year. To address for the missing data in this period, following the existing literature (e.g. Appel et al., 2016), we assume that the fund portfolio stays the same since the earlier reporting date. We use monthly CRSP data on stock prices and adjustment factors to compute the value of institutional holdings at the end of September. Institutional ownership is measured by the value of institutional holdings scaled by firm total market capitalization.

To identify whether a mutual fund is a passive investor, we use the methods similar to the ones used in the existing literature (e.g. Appel et al., 2016; Busse and Tong, 2012; Iliev and Lowry, 2015). For each mutual fund in S12, we merge its fund name recorded in CRSP by MFLINKS tables provided by WRDS. A fund is considered to be a passive investor if it is flagged by CRSP as a passive investor or its fund name contains a passive-related string.[3] A fund is considered to be an active investor if it is not identified as a passive investor. Summary statistics on institutional ownership are reported in Table 1. A typical firm in our sample has a passive investor ownership of 4.2%.

2.4 Firm Financial Variables

Firms' accounting and financial information is obtained from Compustat. We construct a number of financial variables as controls, including ROA, market leverage, sales growth, Tobin's

[3] We first upper all fund names and then use the following strings to identify passive investors: INDEX, IDX, INDX, IND, RESSELL, S&P, S & P, S AND P, SANDP, SP, DOW, DJ, MSCI, BLOOMBERG, KBW, NASDAQ, NYSE, STOXX, FTSE, WILSHIRE, MORNINGSTAR, 100, 400, 500, 600, 900, 1000, 1500, 2000, AND 5000. If a fund in S12 cannot be matched to a fund in CRSP, we use its name recorded by S12 to identify whether it is a passive investor.

Q, tangibility, cash holdings, capital expenditure, R&D investment, and M&A intensity. ROA is measured by operating income before depreciation scaled by total assets. Market leverage is calculated as the sum of total long-term debt and debt in current liabilities divided by market value, where market value calculated as closing price multiplied by the number of common shares outstanding plus total long-term debt plus debt in current liabilities plus total preferred stock minus deferred taxes and investment tax credit. Sales growth is measured by year-on-year growth in sales. Tobin's *Q* is market value scaled by total assets. Tangibility is calculated by total net property, plant, and equipment scaled by total assets. Cash holdings is measured by cash and short-term investment scaled by total assets. Capital expenditure is capital expenditure scaled by total assets. R&D investment is calculated as research and development (R&D) expenditure scaled by total assets. M&A intensity is calculated as the firm's merger and acquisition expenditure scaled by its total assets.

3. Methodology

The first hurdle to estimate the role of institutional investors on CVC investment is the endogeneity in institutional ownership. Both institutional ownership and a firm's CVC investment decisions could be affected by certain firm characteristics that may not be observable to econometricians, such as firms' investment opportunities or managerial styles, which leads to the omitted variable problem. Thus, comparing CVC investment decision of firms with different levels of institutional ownership is likely to capture the effect of other unobserved firm characteristics rather than the effect of institutional ownership. Meanwhile, a firm's CVC investment decisions could affect institutional holdings, which lead to the reverse causality concern.

To address these concerns, our identification strategy is to use an instrumental variable approach that relies on the annual reconstructions of Russell 1000 and 2000 indexes. The Russell 1000 index is a capitalization-weighted stock market index which comprises the largest 1,000 U.S. stocks as measured by end-of-May market capitalization, and the Russell 2000 index comprises the next largest 2,000 U.S. stocks. The index weight assigned to each stock has significant impact on the extent of institutional ownership, especially passive investor ownership (e.g. Appel et al., 2016; Boone and White, 2015; Crane et al., 2016; Fich et al, 2015; Lu, 2013; Mullins, 2014; Schmidt, 2012).

This identification strategy essentially compares CVC investment decisions of firms that are at the very bottom of Russell 1000 index and at the very top of Russell 2000. Index reconstitutions provide a source of plausibly exogenous variation in institutional ownership. For firms with close-call rankings, being assigned to which index is an independent, random event (i.e. it is locally exogenous) and thus uncorrelated with firm characteristics. Intuitively, the characteristics of the firm ranked at the 1000th of the Russell 1000 index is similar to the firm ranked at the 1st of Russell 2000 (overall ranking at 1001st). However, this small difference in rankings leads to a discrete change in institutional ownership. This strategy allows us to overcome the limitation of the standard ordinary least squares regression of CVC investment on institutional ownership.

In addition, before market closes at the last trading day of May, firms around the cutoff are unlikely to be able to predict which index they will be assigned to. Our estimation captures the effect of this discrete change in their CVC investment. More importantly, this estimation does not incorporate any observed or unobserved confounding firm characteristics as long as their effect is continuous around the cutoff. Hence, by focusing on these firms falling in the narrow band around the Russell 1000/2000 index cutoff, we can estimate a causal effect of institutional ownership on the firm's CVC investment.

To estimate the role of institutional ownership on firms' CVC investment, we begin with the following model.

$$CVC_{ijt} = \alpha + \beta IO\%_{ijt} + \sum_{n=1}^{N} \theta_n (Ln(Mktcap_{ijt}))^n + \gamma Ln(Float_{it}) + \delta_t + \mu_j + \varepsilon_{ijt} \quad (1)$$

where *i* indexes firm, *j* indexes industry and *t* indexes year. *CVC* is the CVC investment variables of firm *i* of industry *j* in reconstitution year *t* (i.e. from the end-of-June year *t* to the end-of-June year *t*+1). The key variable of interest is institutional ownership (*IO%*), which is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t*. Our identification strategy uses the Russell 2000 indicator (*R2000*) as the instrument variable for institutional ownership. The Russell 2000 indicator equals one if firm *i* is assigned to Russell 2000 at reconstitution year *t*, and zero if it is assigned to Russell 1000. Because the stock constituents of each index are determined by stocks' end-of-May total market capitalization ranking, we impose a robust N-order polynomial set of *Ln*(*Mktcap)*, which is the natural logarithm of end-of-May market capitalization calculated with monthly CRSP files. We use *Ln*(*Mktcap)* up to polynomial order three. During the reconstitution, the Russell uses each stock's available public float to calculate the float-adjusted market capitalization (*Float*) and uses it to determine the portfolio weight. We include the natural logarithm of float-adjusted market capitalization *Ln(Float)* as a control variable.

We restrict our sample to the bottom 100 stocks in Russell 1000 (i.e. between the 901st and the 1000th) and the top 100 stocks in Russell 2000 (i.e. between the 1001st and the 1100th). To address potential concerns that our main results are driven by time-series variation or across-industry variation, we include reconstitution year fixed effects and industry fixed effects in the regressions. Our estimates are identified using within-year and within-industry variation of index assignment. Industry is defined by 3-digit SIC industry code. We cluster standard errors at the industry level to correct for potential serial correlations in the error term.

4. Baseline Results

In this section, we explore whether and how institutional investors affect firms' CVC investment in startups. In Section 4.1, we begin with our main findings on the relation between institutional ownership and CVC investment. In Section 4.2, we conduct a number of additional tests to address various concerns regarding our baseline results. In Section 4.3, we undertake cross-sectional tests to further test the managerial agency hypothesis.

4.1 Main Findings

To investigate the effects of institutional investors on CVC investment, we begin with estimating the effect of Russell 2000 assignments on CVC investment. We first present the results in Figure 1 to visually check the effect of Russell 2000 assignments on CVC investment around the Russell 1000/2000 cutoff. Specifically, we plot *No. of portfolio startups* relative to the market capitalization ranking around the Russell 1000/2000 cutoff in Figure 1 Panel A. *No. of portfolio startups* is the number of startups firm *i* has in its CVC portfolios in reconstitution year *t*. Grey areas represent 95% confidential interval. The figure shows a discontinuity around the Russell 1000/2000 cutoff: we observe that *No. of portfolio startups* is significantly higher in the left-hand side than the one in the right-hand side of the cutoff. This observation points to a likely negative effect of Russell 2000 assignments on firms' CVC investment.

[Insert Figure 1 around here]

As Russell 1000 and 2000 are value-weighted indexes, the index weights assigned to each stock has a significant impact on the extent of passive institutional ownership (e.g. Appel et al., 2016; Boone and White, 2015; Crane et al., 2016; Fich et al, 2015; Lu, 2013; Mullins, 2014; Schmidt, 2012). Our research setting relies on index reconstitutions to address endogenous in institutional ownership. To further shed light on how institutional investors influence CVC investment, in this subsection, we conduct two stage least squared (2SLS) regressions, using Russell index assignment as the instrument variable for institutional ownership.

Specifically, we use institutional ownership scaled by its sample standard deviation as the key independent variables and *R2000* as its instrument variable. We report the 1st-stage regression results in Table 2. The dependent variable is *institutional ownership* and the *R2000* is the main independent variable. All control variables are the same as those in Equation (1). We observe that the coefficient estimates of R2000 are all positive and significant at the 1% level, suggesting that a switch from the bottom of Russell 1000 to the top of Russell is associated with an increase in institutional ownership. This observation is consistent with the rationale of this instrument and the previous literature[4]. The F-statistics in first stage are significantly different from zero, rejecting the null hypothesis that the instrumental variable is weak. This test ensures that our coefficient estimate in the 2nd stage regressions is not biased and our results do not appear to suffer from weak instrument problem.

[Insert Table 2 around here]

We report the 2nd-stage regression results with instrumented *institutional ownership* as the key independent variable in Table 3. Panel A uses *CVC dummy* as the dependent variable. *CVC dummy* equals one if firm *i* has at least one startup in its CVC portfolios, and zero otherwise, in reconstitution year *t*. We observe that the coefficient estimates on *institutional ownership* are positive and statistically significant at 5% level in all columns. The economic effect is sizable: according to the estimation reported in column (3), after a one-standard-deviation increase in institutional ownership, a firm is 5.7% less likely to make CVC investment. The negative effect of institutional investors on CVC investment is robust up to polynomial order three of the market capitalization controls.

[Insert Table 3 around here]

[4] Consistent with the literature, we do not observer a significant impact of Russell reassignment on ownership held in actively managed funds.

We then investigate how institutional ownership affects a firm's CVC portfolio size. Specifically, we use *Ln(No. of portfolio startups)* as the dependent variable and report the results in Panel B. *Ln(No. of portfolio startups)* is the natural logarithm of the number of startups firm *i* has in its CVC portfolios in reconstitution year *t*. The coefficient estimates on *institutional ownership* are negative and significant at the 5% level in all columns, suggesting a negative relation between passive institutional ownership and CVC portfolio size. A one-standard-deviation increase in passive institutional ownership leads to a 9.5% decrease in the firm's CVC portfolio size. Combining these two results, we find that firms with an exogenous increase in institutional ownership due to the assignment of the Russell 2000 index are less likely to make CVC investment and are more likely to have a small CVC portfolio.

One potential concern of our findings is that the difference in CVC portfolio between firms in the bottom Russell 1000 index and the top Russell 2000 index exists even before the index reconstitution. To address this concern, we plot *No. of portfolio startups* at year *t*-1, and report the result in Figure 1 Panel B. Most of the confidential intervals in left and right hand sides coincide, and the fitted lines are not significantly different from each other. The result suggests that we do not observe a discontinuity in CVC investment around the cutoff one year before the index reconstitution year, and hence it suggests that there is no *ex ante* difference in CVC investment. Overall, we find that a discontinuity in CVC portfolio size exists across the Russell 1000/2000 cutoff *ex post* but not *ex ante*, supporting a causal relation between institutional ownership and CVC investment.

We next examine how firms with increased institutional ownership adjust their CVC investment. Specifically, do they shrink their existing portfolios, choose not to initiate new projects, or both? To answer this question, we examine the discontinuity in CVC investment in existing startups and new startups around the index cutoff. Specifically, we use *Ln(No. of existing startups)* and *Ln(No. of new startups)* as dependent variables and re-estimate equation (1). *Ln(No. of existing startups)* is the natural logarithm of the number of startups that are in firm *i*'s CVC portfolio in both year *t* and year *t*-1. *Ln(No. of new startups)* is the natural logarithm of the number of startups that are in firm *i*'s CVC portfolio at year *t* but not included at year *t*-1.

We report the results with *Ln(No. of existing startups)* and *Ln(No. of new startups)* as the dependent variable in Table 3 Panels C and D, respectively. The coefficient estimates on *institutional ownership* are negative and significant at the 5% level in all columns in Panel C. The magnitudes are slightly smaller than the magnitudes in Panel B. This evidence suggests that a firm shrinks about 7.6% of their existing portfolio after a one-standard-deviation increase in passive institutional ownership. In Panel D, the coefficient estimates on institutional ownership are negative but not statistically significant. The magnitudes are around half of the magnitudes in Panel C. This finding suggests that institutional ownership does not affect a firm's propensity to invest in new startup projects. Combining these results, we find that the increase in institutional ownership induces firms to reduce their CVC investment by shrinking their existing portfolios. Firms, however, do not significantly adjust their CVC investment in new startups, i.e. the number of existing startups decreases while the number of new startups does not change.

In this section, using the IV approach, we find that an increase in institutional ownership due to the assignment to top Russell 2000 has a negative, causal effect on CVC initiation and portfolio size. Specifically, the increase in institutional ownership induces firms to reduce their CVC investment by shrinking their existing portfolio firms but does not significantly affect the firms' CVC investment in new startups. Given that all of our results are robust to alternative CVC variables, from now on, we use *Ln(No. of portfolio startups)* as the dependent variable in the following tests if not particularly specified.

4.2 Robustness Checks

In this section, we undertake a number of additional tests to address a variety of potential concerns of our main results. The first concern is about non-switchers, i.e., firms that stay in the same index for more than one year. If our main findings are contributed by these non-switchers, the results may capture other effects than the relation between institutional ownership caused by index assignment and CVC investment. To address this concern, we add firm fixed effect in equation (1) and report the results in Table 4 Panel A.[5] The coefficient estimates on institutional ownership are negative in all columns and statistically significant in the last column with polynomial orders of three. This piece of evidence indicates that the significantly negative relation between institutional ownership and CVC portfolio size is robust to including firm fixed effect, suggesting that our main findings are present for both switchers and non-switchers.

[Insert Table 4 around here]

[5] To avoid multi-collinearity, we do not include industry fixed effect in this test.

Second, in our research setting, we argue that index assignment is locally exogenous and uncorrelated with firm characteristics. To further support to this argument, we impose a set of firm financial variables as additional controls, including market leverage, ROA, sales growth, Tobin's *Q*, tangibility, cash holdings, capital expenditure, R&D investment, and M&A intensity, in our baseline regressions. We present the results in Table 4 Panel B. We observe that the coefficient estimates on institutional ownership are negative and significant at the 5% level in the first two columns and at the 10% level in the last column. These results suggest that our main findings are robust to controlling for firm characteristics, which lends further credence to our main findings.

Third, as our sample includes both firms that are actively making CVC investment and those that are not, one potential concern is that our main findings are mainly contributed by the firms that are not making active CVC investment. To mitigate this concern and have a better understanding on the effect of institutional ownership on CVC investment along the intensive margin, we focus on a subsample of firms that are actively making CVC investment, i.e. firms that have at least one startup in their CVC portfolios. We report the results in Table 4 Panel C. Coefficient estimates on institutional ownership are positive in all columns. In addition, we find that the magnitudes of the institutional ownership coefficient estimates are about 15 times larger than those reported in Table 3 Panel B. This finding suggests that changes in institutional ownership due to index reconstitutions significantly influence these firms' CVC investment, especially for firms that are actively making CVC investment. Note, however, that due to the small sample and the power issue, the tests are not statistically significant.

Finally, although unlikely, it is still possible that some economic shocks occur to particular firms at the same time that drive our results. If this is the case, we would be able to observe similar results in our tests at artificially chosen thresholds that are different from the true threshold, i.e., the Russell 1000/2000 threshold, the cutoff used in the Russell index reconstitution. To address this concern, we conduct a serious of placebo tests to check if we are able to observe a discontinuity in CVC investment at artificially chosen ranking cutoffs other than the true cutoff. Specifically, we first randomly select a cutoff along the spectrum of market capitalization rankings between the 100^{th} and the 1900^{th} rather than the 1000^{th}. We then construct a sample including firms within the 100-bandwidth around this artificial cutoff. We use this artificially chosen cutoff to construct a dummy variable, which equals one if the ranking of a firm is higher than the cutoff and zero otherwise. We replace *R2000* with this new dummy variable and use it as the instrument variable for institutional ownership to estimate equation (1). We repeat this placebo estimation 1,000 times, and plot a histogram of the distribution of the coefficient estimates on institutional ownership from these placebo tests in Figure 2. We also draw a dashed vertical line in each histogram to represent the coefficient estimate on institutional ownership instrumented by *R2000*, our true index reconstitution cutoff dummy.

[Insert Figure 2 around here]

Panel A displays the coefficient estimate distribution using *Ln(No. of portfolio startups)* as the dependent variable. The polynomial orders are one, two, and three in these figures, respectively. The histograms are centered at zero, which suggests that the effect of institutional ownership on CVC portfolio size is absent at artificial market capitalization ranking cutoffs. We then use the *Ln(No. of existing startups)* and *Ln(No. of new startups)* as the dependent variables and conduct the same placebo tests. We present histograms for these two dependent variables in Panels B and C, respectively. The coefficient estimates on institutional ownership estimated from artificially chosen cutoffs are also centered at zero. This evidence demonstrates that the relation between institutional ownership and CVC investment is unlikely to be driven by other economic shocks or by chance, and therefore our main estimates are unlikely spurious.

In this section, we conduct four additional analyses to mitigate a variety of potential concerns regarding our main findings. Our placebo tests suggest that the discontinuity in CVC investment is absent at other artificially chosen market capitalization ranking cutoffs other than the real Russell 1000/2000 cutoff and our main findings are unlikely driven by chance.

4.3 Cross-sectional Tests

To provide further evidence that tests the managerial agency hypothesis, we undertake a number of cross-sectional tests to explore how heterogeneity in firms' exposures to managerial agency issues alters our baseline results. Our first test uses the G-index constructed by Gompers, Ishii, and Metrick (2003) to capture a firm's exposure to managerial agency issues. Firms with a high G-index have a lower level of shareholder protections and their managers are more entrenched. As a result, these firms typically suffer more serious managerial agency problems. If institutional investors are able to mitigate agency problem by cutting managers' over-investment in CVCs, we expect that the negative effect of institutional ownership on CVC investment is more pronounced for firms with more entrenched managers, i.e., high G-index.

To test this conjecture, we obtained firm-level G-index information from Institutional Shareholder Services (ISS). We sort firm-year observations by the G-index value prior to the Russell index assignment. We construct a dummy, *high G-index dummy*, that equals one if the G-index value is in the top tercile and zero if it is in the bottom tercile. We include *high G-index dummy* and its interaction term with *IO%* into equation (1) and conduct the 2SLS tests and report the results in Table 5 Panel A. The coefficient estimates on *IO%* are positive and significant, which suggests that institutional ownership is positively related to a firm's CVC investment if the firm is subject to a low level of managerial agency problem (i.e., its G-index value is low). More importantly, the coefficient estimates on *IO%×high G-index dummy* are negative and significant at the 5% level in all columns, suggesting that, if a firm is subject to a more serious managerial agency problem, an increase in institutional ownership due to Russell index assignment leads to a cut in the firm's CVC investment. These findings are consistent with the managerial agency hypothesis that the external monitoring by institutional investors mitigates agency problem and induces firms to cut their CVC investment.

[Insert Table 5 around here]

Our second cross-sectional test relies on a "busy" board proxy. Cremers and Nair (2005) point out that external and internal governance are complements. The effect of institutional investor monitoring is stronger if a firm does not have sufficient internal monitoring by board *ex ante*. Fich and Shivdasani (2006) argue that "busy" board is one of the reasons for poor internal monitoring and weak governance. Firms having "busy" boards are more likely to suffer from managerial agency problem. If institutional investors mitigate agency problem by cutting over-investment in CVC projects, we expect that our baseline results are more pronounced for firms with "busy" boards.

To test this conjecture, we collect director data from the BoardEx database. To measure "busy" boards, following the existing literature (e.g. Faulkender and Yang, 2010), we calculate the average number of other boards a firm's directors serve on. *Busy board dummy* equals one if the average number of other boards a firm's directors serve on is on the top tercile and zero if it is in the bottom tercile. We include *busy board dummy* and *IO%×busy board dummy* in equation (1) and conduct the 2SLS tests. Table 5 Panel B presents the results. The coefficient estimate on *IO%* are positive and significant in all columns, which suggests that institutional ownership is positively related to a firm's CVC investment if the firm is subject to a low level of managerial agency problem (i.e., boards play a better monitoring role). The coefficient estimates on *busy board dummy* are positive and significant in all columns, suggesting a positive relation between CVC investment and serious managerial agency problems measured by "busy" boards. More importantly, the coefficient estimates on *IO%×busy board dummy* are negative in all columns and statistically significant in the last two columns, suggesting that institutional investors help mitigate managerial agency problems when firms have "busy" boards. These findings give support to the managerial agency hypothesis.

The third cross-sectional test makes use of the firm's technology features. As pointed out by Scharfstein and Stein (2000), specialized investment makes firm managers hard to be replaced and effectively entrench them. As a result, entrenched managers could enjoy the private, non-pecuniary benefits of control and their firms are subject to a high level of managerial agency problems. Dispersive technology falls in the category of specialized investment because it spans across different technological areas and difficult to manage. Hence, if a firm has more dispersive technology, its manager would have more bargaining power and are more entrenched, causing more serious agency problems. To measure a firm's technology dispersion, we make use of the firm's patenting information which is collected from Google USPTO Bulk Downloads (available at https://www.google.com/googlebooks/uspto.html). We use a firm's patents granted within five years before the index reassignment to calculate its technology dispersion, which is calculated as the Herfindahl-Hirschman index (HHI) based on 3-digit patent technology class. If a firm has a low level of the HHI, its technology is more dispersive and it is subject to a higher level of management entrenchment. We construct a dummy, *dispersive technology dummy*, that equals one if the HHI is in the top tercile and zero if it is in the bottom tercile.

We include the *dispersive technology dummy* and its interaction term with *IO%* in equation (1) and report the 2SLS estimation results in Table 5 Panel C. The coefficient estimates on *IO%* are positive in all columns and statistically significant in the last two columns, which suggests that institutional ownership is positively related to a firm's CVC investment if the firm is subject to a low level of managerial entrenchment problem (i.e., the firm's technology is less dispersed). The coefficient estimates on *dispersive technology dummy* are positive and significant in all columns, suggesting a positive relation between CVC investment and serious managerial entrenchment problems. More importantly, the coefficient estimate on the interaction term is negative and significant at the 10% level in the first column and the 5% in the last two columns. These observations suggest a more pronounced negative effect of institutional ownership on CVC investment when firm managers are more likely to be entrenched, i.e., firms have more dispersive technology.

In this section, we use heterogeneity in firms' exposures to managerial agency problems, captured by the G-index, "busy" boards, and dispersive technology, and find that firms with high *ex ante* managerial agency problems are more likely to shrink CVC portfolio after an increase in institutional ownership due to Russell index assignments. These findings provide further support to the managerial agency hypothesis that institutional investors mitigate agency problems by cutting firms' investment in CVC projects that are beyond their optimal investment levels.

5. Underlying Mechanisms and Firm Value

Our evidence so far shows that institutional investors influence a firm's CVC investment strategy by cutting its investment in startups. In this section, we explore plausible underlying mechanisms through which institutional investors affect firms' CVC investment in startups.

The reduction in CVC investment due to increased institutional ownership could be due to two plausible reasons, which could either enhance or destroy firms' value. First, as pointed out by Scharfstein and Stein (2000), specialized investment, such as CVC investment in early-stage, whose development process is long, risky, and idiosyncratic, could effectively entrench firm management. In addition, managers with career concerns who want to grandstand (see, for example, Gompers (1996)) could overinvest in startups that may not necessarily best serve shareholders' interests. Hence, firm managers could make CVC investment in startups to entrench themselves or to best serve their own interests at the expense of shareholders, which reduces firm value. Institutional investors who have strong incentives to achieve high return on their holdings could play roles to mitigate these agency problems between managers and shareholders (Carleton et at., 1998; Del Guercio and Hawkins, 1999; Romano, 1993). Compared to retail investors, institutional investors are repeated market players and their widespread portfolios could allow them to more effectively monitor the firms (Black, 1992). Hence, cutting CVC investment in startups after an increase in institutional ownership could enhance firm value.

Second, institutional investors could impose short-term pressures on managers to meet near-term earnings goals (e.g., Bushee, 1998, 2001). Graham et al. (2005) show that, in a survey of 401 U.S. CFOs, a majority of them admit that they are willing to sacrifice long-term firm value to meet the desired short-term earnings targets due to their own career, wealth, and external reputation concerns. If managers miss the consensus earnings forecasts, there could be a significant decline in the firms' stock prices (Bartov et al., 2002); CEO bonuses decrease (Matsunaga and Park, 2001), and management turnover probability increases (Mergenthaler et al., 2011). As a result, due to increased short-term pressure from institutional investors, managers may cut off their investment in long-term projects, such as their CVC investment in early-stage startups, to boost the firms' short-term performance. As a result, cutting CVC investment in startups after an increase in institutional ownership could destroy firm value.

To shed light on whether institutional investors enhance or destroy firm value by cutting the firms' CVC investment, we make use of a unique feature of our research setting, i.e., our ability to observe the characteristics and exit outcomes of investment projects in question: the startup companies. We examine whether the reduction in CVC investment is related to the firm's core business in Section 5.1, and how our main findings vary with the track record of the firms' CVC investment in Section 5.2. In Section 5.3, we study the underlying quality of firm startups abandoned by firms with increased institutional ownership after index reconstitutions. Finally, we answer a "bottom-line" question regarding the economic value implications of reductions in a firm's CVC investment after increased institutional ownership caused by index reconstitutions. We examine both short- and long-term market value reaction of the firm's new CVC investment after index reconstitutions in Section 5.4

5.1 Core versus Non-Core Business

To explore whether cutting in CVC investment due to increased institutional ownership enhances or destroys firm value, we first examine business relatedness of startups and the CVC parent firms. CVC investment in startups that are unrelated to a firm's core business is likely to be outside of managers' expertise and subject to the agency problems, pointed out by Scharfstein and Stein (2000) and Gompers (1996), and hence is likely to be value-destroying. Managers who pursue such CVC investment are likely doing so for their own private benefit instead of to enhance firm value. Increase institutional ownership due to index reconstitutions could mitigate misaligned incentives between managers and shareholders and thus curtail CVC investment in these startups. In contrast, institutional investors keep CVC investment in startups that are related to the firm's core business, which should enhance firm value.

We divide startups invested by our sample firms into two groups: startups in the same industry *j* with the firm *i* ("core-business" startups) and startups in industries other than firm *i*'s industry ("non-core business" startups). We then construct the variables *Ln(No. of startups in core business)*, which is the natural logarithm of the number of "core-business" startups in the firm's CVC portfolio, and *Ln(No. of startups in non-core business)*, which is the natural logarithm of the number of "non-core business" startups in the firm's CVC portfolio. We then use them as the dependent variables and estimate Equation (1), and report the results in Table 6 Panel A and B, respectively. Coefficient estimates on institutional ownership are negative but not statistically significant in Panel A, which suggests that an increase in institutional ownership does not affect a firm's investment in startups that are related to their core business. We, however, find that significant and negative coefficient estimates on institutional ownership in all columns in Panel B. This finding suggests that an increase in institutional ownership leads to a cut to the firm's investment in startups that are tangential to the firm's core business. Putting these two observations together, our finding supports the managerial agency hypothesis that institutional investors improve a firm's governance on its CVC investment by inducing the firm to cut the investment in startups that are not related to the firm's core business.

[Insert Table 6 around here]

In summary, we find that after an exogenous increase in institutional ownership, firms shrink their CVC portfolios by cutting investment in startups that are tangential to their core business. They, however, keep investment in startups that are related to their core business. This finding suggests that cutting investment in startups that are unrelated to a firm's main business is a plausible channel through which institutional investors affect firms' CVC investment.

5.2 Firms' Track Record on CVC Investment

To further explore the managerial agency hypothesis that institutional investors help enhance firm value by cutting the firm's unproductive CVC investment, we examine whether the effect of institutional investors on the firm's CVC investment varies with the firm's past CVC investment experience. Our conjecture is that if the firm does not have a good track record in terms of CVC investment in startups in the past, their CVC investment is likely unproductive due to managerial agency problems. Hence, the effect of institutional ownership on the firms' CVC investment should be more pronounced for the firms that have poor past CVC investment track record.

To measure a firm's past CVC investment track record, we first classify investment outcomes of startups that have received CVC investment from our sample firms. There are typically three pathways that a startup ends up with: going public, being acquired by another company, and liquidation. Studies in existing literature (e.g., Bottazzi et al., 2008; Gompers and Lerner, 2000; Sørensen, 2007; Tian, 2011; and Tian and Wang, 2014) treat going public and being acquired by another company as successful exit pathways for startups. We thus define a successful exit of a CVC investment if the startup invested by the firm either goes public or is acquired by another company. If a startup ends up with being written off or liquidated, we classify it as a failed exit outcome for the firm's CVC investment.

Based on startup exit pathways, we construct *Ln(No. of failed projects)* as a proxy for a firm's track record on its CVC investment, which is the natural logarithm of the number of startups that firm *i* has invested and failed by year *t*. We include this variable and its interaction term with institutional ownership in equation (1). We use *R2000* and *R2000×Ln(No. of failed projects)* as the instrument variables for *IO%* and *IO%×Ln(No. of failed projects)*. The dependent variable is *Ln(No. of portfolio startups)*. We report the regression results in Table 7.

[Insert Table 7 around here]

Coefficient estimates on institutional ownership are significantly negative in all columns. This result is consistent with our baseline findings and suggests that an increase in institutional ownership leads to a cut in the firm's CVC investment. More importantly, the coefficient estimates on *IO% ×Ln(No. of failed projects)* are negative and significant at the 5% level in all columns, suggesting that if a firm has a poor track record for its CVC investment (i.e., more failed CVC projects in the past), it is more likely to shrink its CVC portfolio after an increase in institutional ownership due to being assigned to the top of Russell 2000. In other words, institutional ownership has a more pronounced effect on CVC investment for firms with poor CVC investment track record. These findings are consistent with the managerial agency hypothesis that institutional investors help enhance firm value by cutting the firm's unproductive CVC investment.

In summary, we attempt to uncover the underlying mechanism through which institutional investors exert influence on the firm's CVC investment. We find that, after an increase in institutional ownership due to index reconstitutions, firms cut their CVC investment in startups that are tangential to their core business but keep the same level of CVC investment in startups that are related to their core business. Meanwhile, we find that the effect of increased institutional ownership on reduced CVC investment is more pronounced for firms with poor track record in CVC investment. These findings are consistent with the managerial agency hypothesis that institutional investors help mitigate agency problems and cut firms' unproductive CVC investment, which help enhance firms' value.

5.3 Quality of Abandoned Startups

In this section, we examine the quality of startups that are abandoned by firms after an increase in institutional ownership due to index reconstitutions. From earlier tests, we find that firms cut their investment in startups after an increase in institutional ownership. If our conjecture that institutional investors help mitigate agency problems, we should observe that the startups abandoned by firms are low quality ones.

To test this conjecture, we collect information on the eventual exit pathways of startups that are abandoned by the firms (i.e., startups that exit after they receive the last round from the firms). Following the exiting literature (e.g., Bottazzi et al., 2008; Gompers and Lerner, 2000; Sørensen, 2007; and Tian, 2011), we assume that if a startup ends up with either going public or acquisitions, it has a higher quality; If a startup is written-off, it has a lower quality. Based on the eventual exit pathway of each startup, we construct the *success dummy*, which equals one if a startup eventually ends up with either going public or being acquired and zero if it is written-off after the last round of financing by the firms.

We estimate equation (1) with the dependent variable replaced with *success dummy* and report the regression results in Table 8. The observation unit in this analysis is abandoned startup-firm. We observe that the coefficient estimates on institutional ownership are negative and statistically significant in all columns, suggesting that startups abandoned by firms after an increase in institutional ownership due to index reconstitution are generally low quality startups as they are less likely to exit successfully. This finding is consistent with the managerial agency hypothesis that institutional investors reduce agency problems between managers and shareholders by cutting unproductive CVC investment in low-quality startups.

[Insert Table 8 around here]

5.4. Firm Value

The findings in above two sections provide suggestive evidence that institutional investors mitigate agency problems by cutting the firms' unproductive CVC investment in startups and enhance firms' value. In this section, we provide more direct evidence on the value consequences of CVC investment after institutional ownership increases due to index reconstitutions. We undertake two tests.

First, we examine whether increased institutional ownership due to index reconstitutions leads to better CVC investment decision made by the firms, which creates short-term value for the firms' shareholders. To answer this question, we focus on firms' stock abnormal return on their new CVC investment announcement date. If increased institutional ownership induces firm managers to make value-increasing CVC investment, we expect to observe a positive effect of institutional ownership due to index reconstitutions on CVC investment announcement returns.

We use Fama-French (1993) 3-factor model augmented by a momentum factor (Carhart, 1997), i.e., the Fama-French-Carhart 4-factor model, to calculate equity abnormal returns at the CVC announcement date. We use the announcement return of each round of investment made by firm *i* during year *t* as the dependent variable and estimation equation (1). The unit of observation in this analysis is financing round-firm. We report the results in Table 9 Panel A. The coefficient estimates on institutional ownership are positive in all columns and significant at the 5% level in the last two columns, suggesting a positive market reaction upon the announcement of a new CVC investment made by the firms whose institutional ownership increases due to index reconstitutions. This finding is consistent with the managerial agency hypothesis that institutional investors mitigate agency problems and induce firm managers to make good CVC investment, which is reacted positively by the market.

[Insert Table 9 around here]

Second, we examine whether increased institutional ownership due to index reconstitutions lead a higher long-term value of the firms. Because improvement in performance takes time to manifest, one does not expect to observe the relation between institutional ownership and stock market performance for firms that just switch indexes. To mitigate this concern, we construct two switcher variables, namely *switch2000to1000* and *switch1000to2000*. *Switch2000to1000* is a dummy variable that equals one if a firm is assigned to Russell 2000 index at year *t*-1 and assigned to Russell 1000 index at year *t*, and zero otherwise. *Switch1000to2000* is a dummy variable that equals one if a firm is assigned to Russell 1000 index at year *t*-1 and assigned to Russell 2000 index at year *t*, and zero otherwise.

In Table 9 Panel B, we estimate our baseline regressions and replace the dependent variable with Tobin's *Q* in equation (1). We include the two switcher variables, namely *switch2000to1000* and *switch2000to1000*, as control variables. We observe that the coefficient estimates on institutional ownership are positive and statistically significantly in all columns. These findings suggest that an increase in institutional ownership due to index reconstitutions has a positive effect on the firms' Tobin's *Q*.

Putting all findings together, our results in this section suggest that increased institutional ownership leads firms to cut CVC investment in startups that are unrelated to the firms' core business and are of low quality. The negative effect of institutional ownership on CVC investment is more pronounced for firms that have poor track record on CVC investment. These findings are consistent with the managerial agency hypothesis. By doing so, institutional investors enhance firms' value both in the short run and long run.

6. Conclusion

In this paper, we have examined the effect of institutional investors on firms' CVC investment in startups. To establish causality, we rely on plausibly exogenous variation in institutional ownership generated by annual reconstitutions of the Russell 1000 and 2000 indexes. We find that institutional investors induce firms to cut their CVC investment and this effect is more pronounced for firms that are subject to more serious managerial agency problems. Further tests show that institutional investors induce firms to cut CVC investment in startups that are unrelated to the firms' core business and are of low quality evidenced by their low eventual successful rates, as well as when firms have poor track record on CVC investment. By doing so, institutional investors enhance firms' value. Our paper uncovers a previously under-explored dark side of CVC programs – their giving rise to managerial agency problems.

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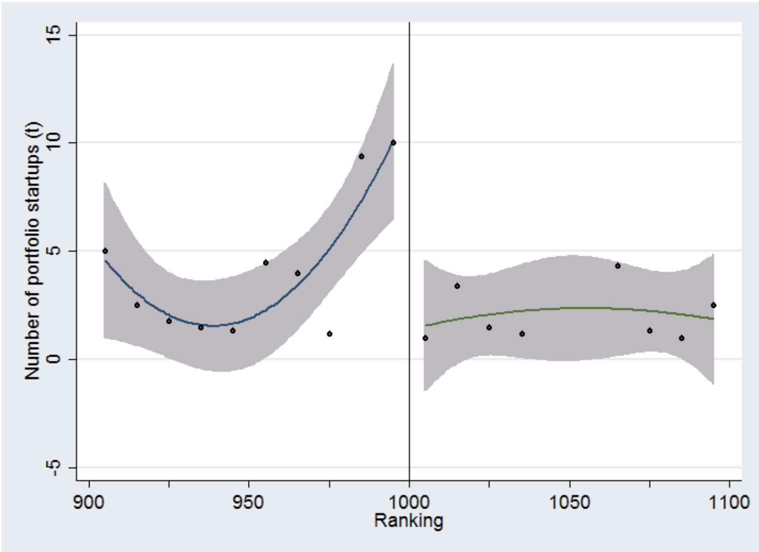
Figure 1: Portfolio Size around the Russell 1000/2000 Cutoff

This figure plots the portfolio size of firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. Solid lines plot the fitted value for firms at the left and right hand sides of the cutoff, respectively. Grey areas represent the 95% confidential interval. *No. of portfolio startups* is the number of startups firm *i* holds in its CVC portfolios.

Panel A: No. of portfolio startups around the cutoff



Panel B: No. of portfolio startups (t-1) around the cutoff

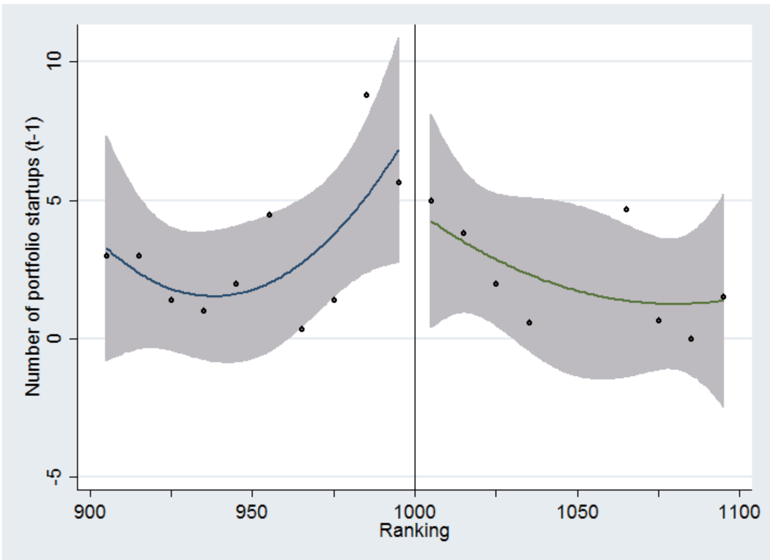
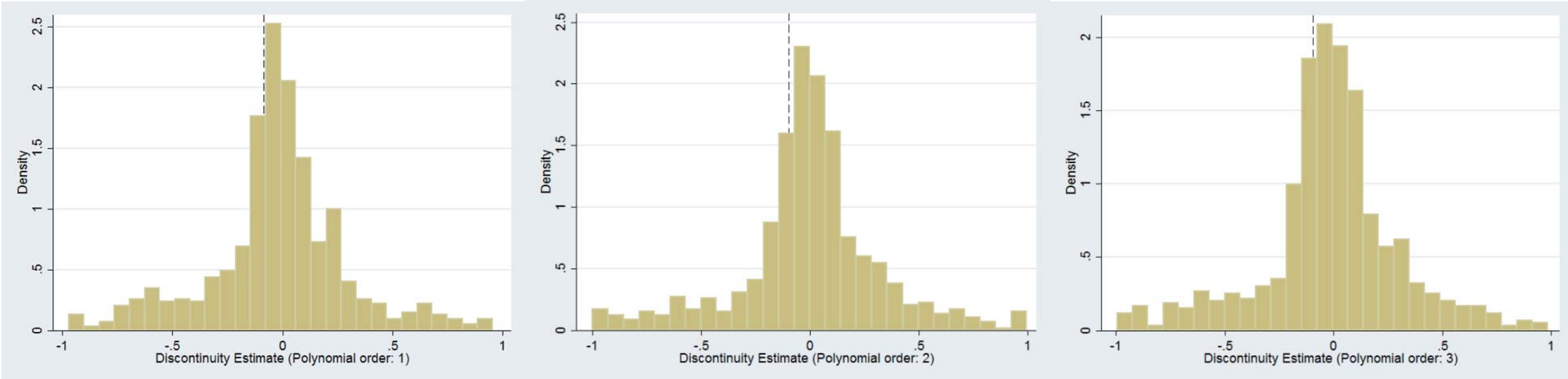


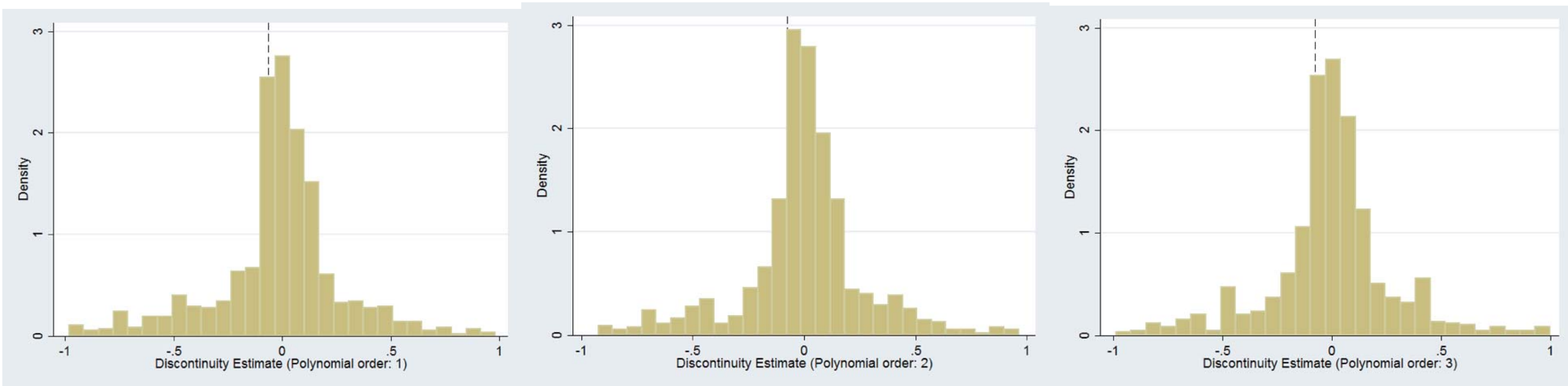
Figure 2: Placebo Tests

This figure plots the histogram of the distribution of regression estimates from placebo tests with up to polynomial order three. The x-axis represents the coefficient estimates from a placebo test that artificially assumes an alternative cutoff for stock rankings other than the Russell 1000/2000 threshold, based on end-of-May market capitalization. The dashed vertical lines represent the coefficient estimates estimated from the true Russell 1000/2000 cutoff.

Panel A: No. of portfolio startups



Panel B: No. of existing startups



Panel C: No. of new startups

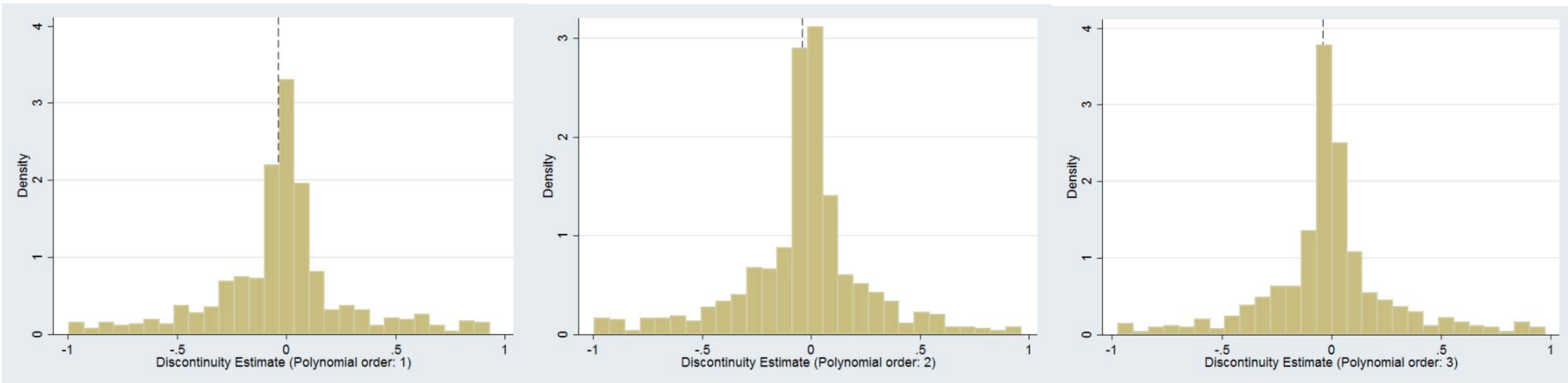


Table 1: Summary Statistics

This table reports descriptive summary statistics of the main variables used in our study, including *CVC dummy*, *No. of portfolio startups*, *No. of existing startups*, *No. of new startups*, *market capitalization*, *float-adjusted capitalization*, *passive investor ownership*, *market leverage*, *ROA*, *sales growth*, *Tobin's Q*, *tangibility*, *cash holdings*, *capital expenditure*, *R&D investment* and *M&A intensity*. Our sample includes firms within 100-bandwidth around the Russell 1000/2000 cutoff during 1998 to 2006. All variables are winsorized at the 1% level.

	N	Mean	Median	Std. Dev.
CVC Variables				
CVC dummy	1,649	0.037	0.000	0.189
No. of portfolio startups	1,649	0.129	0.000	0.949
No. of existing startups	1,649	0.086	0.000	0.701
No. of new startups	1,649	0.044	0.000	0.436
No. of failed projects	1,649	0.027	0.000	0.368
Other Variables				
Market capitalization (billion dollar)	1,649	1.475	1.441	0.399
Float-adjusted capitalization (billion dollar)	1,649	1.280	1.283	0.484
IO (%)	1,649	4.179	3.795	2.733
Financial Variables				
Market leverage	1,334	0.206	0.147	0.210
ROA	1,334	0.135	0.133	0.115
Sales growth	1,334	0.284	0.124	0.636
Tobin's Q	1,334	2.171	1.499	2.119
Tangibility	1,334	0.272	0.197	0.232
Cash holdings	1,334	0.423	0.238	0.621
Capital expenditure	1,334	0.276	0.092	0.558
R&D investment	1,334	0.049	0.000	0.115
M&A intensity	1,334	0.052	0.000	0.130

Table 2: Institutional Ownership and CVC Investment – 1st Stage Results

This table presents the 1st stage regression results of estimating equation (1) with 2SLS regressions. Our sample includes firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use *R2000* as the instrument variable for institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *IO%* is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t* divided by its standard deviation. Polynomial order equals one, two, and three in columns (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Industry and year fixed effects are included in all specifications. Industry is defined by 3-digit SIC. Standard error is clustered at industry level. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	IO% (scaled by standard deviation)		
	(1)	(2)	(3)
R2000	0.325***	0.338***	0.315***
	(0.037)	(0.037)	(0.041)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
F-statistics in first stage	12.42***	12.42***	12.38***
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Table 3: Institutional Ownership and CVC Investment – 2nd Stage Results

This table presents the second-stage results of estimating equation (1) with 2SLS regressions. Our sample includes firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use *R2000* as the instrument variable for institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *IO%* is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t* divided by its standard deviation. Each panel uses *CVC dummy*, *Ln(No. of portfolio startups)*, *Ln(No. of old startups)*, and *Ln(No. of new startups)* as the dependent variable, respectively. *CVC dummy* equals one if firm *i* holds at least one startup in its CVC portfolios at reconstitution year *t*, and zero otherwise. *Ln(No. of portfolio startups)* is measured by the natural logarithm of the number of startups firm *i* holds in its CVC portfolios at reconstitution year *t*. *Ln(No. of existing startups)* is measured by the natural logarithm of the number of startups which are included in firm *i*'s CVC portfolio at both year *t* and year *t*-1. *Ln(No. of new startups)* is measured by the natural logarithm of the number of startups which are included in firm *i*'s CVC portfolio at year *t* but not included at year *t*-1. Polynomial order equals one, two, and three in columns (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Industry and year fixed effects are included in all specifications. Industry is defined by 3-digit SIC. Standard error is clustered at industry level. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: CVC dummy

	(1)	(2)	(3)
IO%	-0.051**	-0.058**	-0.057**
	(0.023)	(0.026)	(0.025)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Panel B: Ln(No. of portfolio startups)

	(1)	(2)	(3)
IO%	-0.084**	-0.097**	-0.095**
	(0.042)	(0.049)	(0.048)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Panel C: Ln(No. of existing startups)

	(1)	(2)	(3)
IO%	-0.064**	-0.078**	-0.076**
	(0.029)	(0.038)	(0.037)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Panel D: Ln(No. of new startups)

	(1)	(2)	(3)
IO%	-0.038	-0.041	-0.040
	(0.027)	(0.028)	(0.028)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Table 4: Robustness Checks

This table presents the results of estimating equation (1) using the 2SLS regressions. Our sample includes firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use *R2000* as the instrument variable for institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *IO%* is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t* divided by its standard deviation. All specifications use *Ln(No. of portfolio startups)* as the dependent variables, which is measured by the natural logarithm of the number of startups firm *i* holds in its CVC portfolios at reconstitution year *t*. Polynomial order equals one, two, and three in columns (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Panel A includes firm and year fixed effects. Panel B and C include industry and year fixed effects. The set of firm financial control variables in Panel B includes market leverage, ROA, sales growth, Tobin's *Q*, tangibility, cash holdings, capital expenditure, R&D investment and M&A intensity. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Control for non-switchers

	Ln(No. of portfolio startups)		
	(1)	(2)	(3)
IO%	-0.068	-0.102	-0.093*
	(0.053)	(0.064)	(0.056)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Panel B: Firm financial variable controls

	Ln(No. of portfolio startups)		
	(1)	(2)	(3)
IO%	-0.094**	-0.113**	-0.102*
	(0.044)	(0.053)	(0.054)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Financial variable control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	717	717	717
Observations	1,334	1,334	1,334

Panel C: Conditional on active periods

	Ln(No. of portfolio startups)		
	(1)	(2)	(3)
IO%	-1.434	-1.539	-1.533
	(1.043)	(1.320)	(1.312)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	37	37	37
Observations	71	71	71

Table 5: Cross-sectional Tests

This table presents the results of estimating equation (1) with 2SLS regressions. Our sample includes firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use *R2000* as the instrument variable for institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *IO%* is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t* divided by its standard deviation. We use *Ln(No. of portfolio startups)* as the dependent variable, which is measured by the natural logarithm of the number of startups firm *i* holds in its CVC portfolios at reconstitution year *t*. *High G-index dummy* equals one if the G-index is in the top tercile and zero if it is in the bottom tercile. *Busy board dummy* equals one if average number of boards is in the top tercile and zero if it is in the bottom tercile. *Dispersive technology dummy* equals one if the *Herfindahl-Hirschman* index of a firm's patent class is in the top tercile and zero if it is in the bottom tercile. Polynomial order equals one, two, and three in columns (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Industry and year fixed effects are included in all specifications. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Shareholder Rights

	Ln(No. of portfolio startups)		
	(1)	(2)	(3)
IO%	0.098*	0.097*	0.096*
	(0.057)	(0.057)	(0.057)
IO%×high G-index dummy	-0.144**	-0.143**	-0.142**
	(0.067)	(0.065)	(0.064)
High G-index dummy	0.181*	0.180*	0.178*
	(0.106)	(0.102)	(0.101)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	392	392	392
Observations	748	748	748

Panel B: Busy Board

	Ln(No. of portfolio startups)		
	(1)	(2)	(3)
IO%	0.326*	0.191*	0.191*
	(0.195)	(0.104)	(0.105)
IO%×busy board dummy	-0.377	-0.331*	-0.334*
	(0.236)	(0.195)	(0.197)
Busy board dummy	0.824*	0.754*	0.760*
	(0.478)	(0.404)	(0.408)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	351	351	351
Observations	566	566	566

Panel C: Dispersive Technology

	Ln(No. of portfolio startups)		
	(1)	(2)	(3)
IO%	0.230	0.454*	0.448*
	(0.144)	(0.274)	(0.272)
IO%×dispersive technology dummy	-0.312*	-0.302**	-0.302**
	(0.188)	(0.142)	(0.142)
Dispersive technology dummy	0.556*	0.511**	0.511**
	(0.316)	(0.223)	(0.223)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	226	226	226
Observations	365	365	365

Table 6: Core versus Non-Core Business

This table presents the results of estimating equation (1) with 2SLS regressions. Our sample includes firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use *R2000* as the instrument variable for institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *IO%* is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t* divided by its standard deviation. Each panel uses *Ln(No. of startups in core business)* and *Ln(No. of startups in non-core business)* as the dependent variable, respectively. *Ln(No. of startups in core business)* is measured by the natural logarithm of the number of startups in firm *i*'s portfolio and in the same industry *j* at reconstitution year *t*. *Ln(No. of startups in non-core business)* is measured by the natural logarithm of the number of startups in firm *i*'s portfolio and in the other industries than *j* at reconstitution year *t*. Polynomial order equals one, two, and three in columns (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Industry and year fixed effects are included in all specifications. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Core business

	Ln(No. of startups in core business)		
	(1)	(2)	(3)
IO%	-0.019	-0.021	-0.021
	(0.019)	(0.019)	(0.019)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Panel B: Non-core business

	Ln(No. of startups in non-core business)		
	(1)	(2)	(3)
IO%	-0.081**	-0.092*	-0.091*
	(0.041)	(0.048)	(0.047)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Table 7: Firms' CVC Investment Track Record

This table presents the results of estimating equation (1) with 2SLS regressions. Our sample includes firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use *R2000* as the instrument variable for institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *IO%* is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t* divided by its standard deviation. We use *Ln(No. of portfolio startups)* as the dependent variable, which is measured by the natural logarithm of the number of startups firm *i* holds in its CVC portfolios at reconstitution year *t*. *Ln(No. of failed projects)* is measured by the natural logarithm of the number of startup projects that firm *i* has invested in and exited through writing off before year *t*. Polynomial order equals one, two, and three in columns (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Industry and year fixed effects are included in all specifications. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Ln(No. of portfolio startups)		
	(1)	(2)	(3)
IO%	-0.075*	-0.081*	-0.080*
	(0.042)	(0.045)	(0.044)
IO%×Ln(No. of failed projects)	-0.197**	-0.193**	-0.194**
	(0.093)	(0.093)	(0.093)
Ln(No. of failed projects)	1.149***	1.138***	1.139***
	(0.249)	(0.247)	(0.248)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	845	845	845
Observations	1,649	1,649	1,649

Table 8: Quality of Abandoned Startups

This table presents the results of estimating equation (1) with 2SLS regressions. Our sample includes all startups which firms exit when firms are within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use the *R2000* as the instrument variable for passive institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *Passive institutional ownership* (%) is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t*. *Passive institutional ownership* (%) is scaled by its standard deviation. We use *success dummy* of abandoned startups as the dependent variable. Conditional on a firm exits a startup at year *t*, *success dummy* equals one if a startup ends up with going public or being acquired at year *t* or later, and zero otherwise. Polynomial order equals one, two, and three in column (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Industry and year fixed effects are included in all specifications. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Successful exit dummy of abandoned startups		
	(1)	(2)	(3)
IO%	-0.851**	-0.599***	-0.596***
	(0.410)	(0.218)	(0.215)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float controls	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	56	56	56

Table 9: Value Implications

This table presents the results of estimating equation (1) with 2SLS regressions. Our sample includes firms within 100-bandwidth around the cutoff between the Russell 1000 and 2000 indexes during 1998 to 2006. We use *R2000* as the instrument variable for institutional ownership. *R2000* is a dummy which equals one if the firm is assigned to Russell 2000 index at year *t*, and zero if it is assigned to Russell 1000 index. *IO%* is measured by the value by holdings of passive investors scaled by total market capitalization at the end of September at reconstitution year *t* divided by its standard deviation. Panel A uses CAR[0,0] as the dependent variable, which is the abnormal return at round investment announcement date measured by Fama-French four factor model. Panel B uses Tobin's *Q* as the dependent variable. Polynomial order equals one, two, and three in columns (1), (2) and (3), respectively. All specifications include *floated-adjusted market capitalization* as a control variable. Industry and year fixed effects are included in all specifications. All variables are winsorized at the 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Announcement Returns

	CAR[0,0]		
	(1)	(2)	(3)
IO%	0.015	0.011**	0.011**
	(0.012)	(0.005)	(0.005)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	107	107	107

Panel B: Long-term Firm Value

	Tobin's *Q*		
	(1)	(2)	(3)
IO%	0.760*	0.730*	0.728*
	(0.429)	(0.422)	(0.420)
Bandwidth	100	100	100
Polynomial order	1	2	3
Float control	Yes	Yes	Yes
Switcher controls	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Number of unique firms	808	808	808
Observations	1,565	1,565	1,565