Empirical Essays on Corporate Venture Capital, Financial policies, and Liquidity Management

by

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Abstract

This thesis is composed of three self-contained empirical essays in entrepreneurial finance and corporate finance, with the first two exploring the effect of corporate venture capital investments on financial policy and dividend payout. The third examines the impact of COVID-19 on corporate investment and how cash holdings reduce the impact.

Firms invest in corporate venture capital (CVC) for strategic reasons. Consistent with maintaining financial flexibility to fund CVC driven innovation and acquisitions, in Essay one, we find that CVC investing firms hold less debt and more cash. Our results are more pronounced among the highest CVC investors and strategically driven CVC investors as such firms maintain the most conservative financial policies. CVC firms are more likely to acquire using cash and this relationship is more pronounced among strategic CVC firms. Overall, our results are consistent with studies that advance that firms with growth or investment opportunities maintain financial flexibility.

Consistent with the signaling theory that firms usually pay cash dividend to signal positive prospects, Essay two finds that CVC investors pay higher dividends compared to non–CVC firms. Specifically, CVC investment leads to a 9% increase in dividend payout. The results show that the relationship between CVC investment and dividend is driven by strategic CVC investors. There is no statistically significant relationship between CVC and dividend for financially oriented CVC firms. Possible channels that influence the relationship between CVC investment and dividend payout are future profitability and earnings.

In the third essay, using the COVID-19 pandemic as an exogenous shock, we examine the impact of cash holdings on corporate investment during the COVID-19 pandemic. We find that Capital Expenditure and M&A levels decrease by 37% and 71% respectively during the COVID-19 pandemic. However, the impact of COVID-19 on investment is less for firms with accumulated cash. Firms at the 81st percentile of cash holdings maintain capital expenditure and acquisition at pre-COVID-19 levels. Overall, our evidence shows that the COVID-19 pandemic has had an adverse effect on corporate investment activities, but accumulated cash holdings reduce the impact.

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Introduction

0.1 Introduction

Entrepreneurial finance and corporate finance are two vital areas that have attracted significant attention from scholars and practitioners alike. This thesis delves into three distinct yet interconnected areas of study within entrepreneurial finance and corporate finance, focusing on the effects of corporate venture capital (CVC) investments and the COVID-19 pandemic on financial policy and investment strategies.

Essay one explores the relationship between CVC investments and financial policy decisions. Firms often engage in CVC investments to foster innovation and acquire strategic advantages. In this essay, we investigate the financial implications of CVC investments and discover that firms involved in CVC tend to exhibit unique financial characteristics. Specifically, CVC investing firms demonstrate a tendency to hold lower levels of debt while maintaining higher levels of cash reserves. These findings suggest that CVC investments are associated with a greater emphasis on financial flexibility, allowing firms to fund CVC-driven innovation and acquisitions. Moreover, the study reveals that the financial policies of firms engaged in CVC vary based on the intensity and strategic orientation of their CVC investments.

Essay two focuses on the relationship between CVC investments and dividend payouts. Drawing from signaling theory, which suggests that firms use cash dividends as a means of communicating positive prospects to the market, this essay investigates whether CVC investors differ in their dividend policies compared to non-CVC firms. The empirical findings indicate that CVC investors tend to pay higher dividends, resulting in a 9% increase in dividend payout. Notably, this relationship is more pronounced among strategic CVC investors. However, financially oriented CVC firms do not exhibit a statistically significant relationship between CVC investments and dividend payouts. The study also explores potential channels through which CVC investments influence dividend policies, such as future profitability and earnings.

Essay One finds that firms that invest in CVC maintain financial flexibility by holding more cash and less debt to fund CVC-driven innovation and acquisition opportunities. Hence, one could argue that how could CVC investing firms hold cash and increase dividend payments simultaneously? In Essay 2, we also find that CVC firms hold excess cash. If CVC firms hold excess cash then this could probably explain why they are able to maintain financial flexibility and simultaneously signal good future performance through cash dividends. Simutin (2010) finds that excess cash do proxy for growth opportunities and high excess cash firms invest more in the future which is consistent with CVC firms holding excess cash to fund future innovation and investment opportunities. In support of this argument, Opler, Pinkowitz, Stulz, and Williamson (1999) show that firms that hold excess cash are able to surprisingly increase corporate investments and payouts simultaneously.

In the third essay, we examine the impact of the COVID-19 pandemic on corporate investment activities, with a specific focus on the role of cash holdings. By utilizing the pandemic as an exogenous shock, we analyze how firms' investment decisions were affected during this unprecedented crisis. The empirical analysis reveals a significant decline in capital expenditure (37%) and mergers and acquisitions (71%) levels during the pandemic. However, firms with substantial cash reserves mitigate the adverse impact of COVID-19 on their investment activities. Notably, firms in the 81st percentile of cash holdings maintain their pre-pandemic levels of capital expenditure and acquisition. These findings highlight the importance of cash holdings as a protective mechanism against external shocks and the ability of firms to sustain their investment activities even in challenging times.

Overall, the essays presented in this thesis contribute to our understanding of entrepreneurial finance and corporate finance by exploring the effects of CVC investments, dividend payout, and cash holdings on financial policies and investment activities. The findings highlight the importance of financial flexibility and strategic decision-making in shaping firms' financial policies and investment behavior. Moreover, the research provides insights into the potential signaling role of CVC investments and the resilience of firms with accumulated cash holdings in times of economic uncertainty. By expanding our knowledge in these areas, this research contributes to the broader discourse on financial strategy and provides a foundation for future studies in the field of corporate finance.

Chapter 1

Financing a Corporate Venture Capital Program

1.1 Introduction

Corporate venture capital (CVC) i.e., minority equity investments by established corporations in entrepreneurial ventures, started in the 1960s and at the time accounted for on average 7% of the venture capital industry. More recently, CVC investors are funding start up firms at an unprecedented rate. A report by CB Insights documents that CVCs invested over $53 billion in over 2,740 deals in 2018, which accounted for 23% of total venture capital industry (Global CVC Report (2018)). Overall, CVC is an important form of corporate investment and continues to attract many established corporations. The CVC triad is made up of a corporate mother firm (CVC investing firm), a CVC unit and an entrepreneurial venture. The CVC unit, which is established by the corporate mother firm, interacts and maintains contact with many small venture companies that are in search of funding. Acting as an intermediary, CVC units invest, support and monitor new entrepreneurial ventures that are likely to help meet the strategic and financial goals of the corporate mother firm.

Despite the strategic importance of CVC investments, little is known about how CVC investments affect the financial policies of CVC investing firms. One could question whether the scale of CVC is meaningful enough to affect the financial policies of established firms? Mohamed and Schwienbacher (2016) find that the stock market reacts positively to the announcement of CVC investments by parent companies. The authors explain that although CVC investments are small relative to parent companies, announcements are more likely to capture insights into the future strategic orientation of the parent company. Motivated by the strategic reasons behind CVC investment, we predict that CVC investment will affect financial policies of CVC investing firms. We propose that CVC investing firms maintain financial flexibility to ensure that (a) the funds needed to finance CVC driven innovations are available when needed (b) firms can expand their knowledge base through the acquisition of their portfolio companies when it is potentially useful to do so and (c) firms can exercise their growth option through a follow – on investment when uncertainty unfolds to its advantage.

Unlike Independent Venture Capitals (IVCs) that seek purely financial returns, Corporate Venture Capitals (CVCs) pursue strategic objectives. Corporations view CVC investments as an effective way of conducting research and development activities, exploring new technologies, and identifying acquisition opportunities. In a survey of 52 corporate venture programs, Siegel, Siegel, and MacMillan (1988) report that corporations rank exposure to new technologies and markets as the most important objective for investing in a corporate venture capital programs. The declared mission or approach of Shell Ventures on its website states that "We make minority investments that help to develop new technologies and disruptive business model in areas of strategic interest to shell's business".[1] Focusing on a conservative middle ground Lerner (2000, p.675), find that "a dollar of venture capital appears to be about three times more potent in stimulating patenting than a dollar of traditional corporate R&D". Recent studies have also shown that CVC investment leads to an increase in innovation for the parent company (Dushnitsky and Lenox (2005a), Wadhwa, Phelps, and Kotha (2016), Ma (2020)).

Another prominent reason for investing in start-up companies is to identify acquisition opportunities. Recent empirical evidence by Ma (2020) shows that about one-fifth of CVC investing firms acquire their portfolio companies and those acquisitions represent 20% of all acquisitions by those CVC investing firms. The author explains that such strategic acquisitions are related to a higher level of knowledge transfer from the portfolio companies to CVC investing firms. Related to that, Benson and Ziedonis (2010) reveal that CVCs invest to identify entrepreneurial firm acquisitions. The authors show that top CVC investing firms acquired 20 percent of their portfolio companies from 1987 through 2003. In addition, venture investment creates valuable growth options for CVC investing firms. Due to the uncertainty created by CVC investments, investors stage their financing. The option to grow is obtained after the first equity investment. If the venture meets key

[1] source:https://www.shell.com/energy-and-innovation/new-energies/shell-ventures/about.html

milestones, the CVC firm can exercise the growth option through a follow-on or a more substantial investment.

We exploit a sample of CVC units affiliated with US public listed firms from the Refinitiv database and match each CVC unit with a unique corporate parent during 1980 - 2018. We test the relationship between CVC firms and their debt and cash holdings. We denote CVC firm using an indicator variable; one if a firm makes CVC investment in a given year and zero otherwise. We control for a battery of variables that explain cash holdings and debt ratios. First, we find that relative to firms that do not invest in CVCs, on average CVC firms hold less debt and more cash, ceteris paribus. These findings support our hypothesis that CVC investing firms maintain financial flexibility that support CVC driven innovation and acquisition opportunities. Moreover, we find that our results are more pronounced among the *Highest CVC Investors*. Firms that invest at higher levels are likely to have access to a greater number of new ventures and greater access to portfolio companies as such firms have more chances of securing board seats. Such exposure may increase their knowledge stock, improve their understanding of technologies and practices of its portfolio companies on which they may base innovation and acquisition. We explore several channels that influence our results. First, we test whether our results are driven by financial or strategic CVC orientation. We find more pronounced results among strategically driven CVC firms. Second, our results show that CVC firms in industries with high dependence on external finance hold less debt while CVC firms in industries with less dependence on external finance hold more cash. Third, we also find that CVC firms are more likely to offer considerations with cash deals during acquisitions and this relationship is also pronounced among strategic CVC firms. Fourth, we also find that our baseline results apply to different time periods after splitting our sample into before the financial crisis period (1980-2006) and after the financial crisis period (2009-2018).

This paper contributes to two strands of literature. First, our study extends the literature on CVC investment from the perspective of the parent company (CVC investing firm). From the CVC investing firm's perspective, prior researchers have examined the drivers of CVC adoption and termination (Ma (2020), Cabral, Francis, and Kumar (2020), Gaba and Bhattacharya (2012), and Dushnitsky and Lenox (2005a)), CVC syndicate networks (Braune, Lantz, Sahut, and Teulon (2019)), strategic and financial outcomes of CVC investments to parent companies (Ma (2020), Mohamed and Schwienbacher (2016), Benson and Ziedonis (2010) and Dushnitsky and Lenox (2005b)). To the best of our knowledge, our paper is the first paper that links CVC investment to firm financial policies. In particularly, we link strategic CVC investment to conservative financial policies in facilitating acquisition opportunities.

Second, our study adds to the literature that links investment opportunities to cash holdings and debt (Gave and Gaver (1993), Jr and Watts (1992), Opler, Pinkowitz, Stulz, and Williamson (1999a), K.Goyal, Lehn, and Racic (2002)). Such studies show that firms with investment opportunities maintain financial flexibility. Our results are consistent with the view that firms with growth opportunities hold liquid assets to ensure that they will be able to fund profitable investment opportunities when cashflow is low relative to investment Opler, Pinkowitz, Stulz, and Williamson (1999a). Also, our results are consistent with studies that find an inverse relationship between growth opportunities and debt. We add to this literature by using CVC investment as a proxy for investment opportunities. CVC investment could lead to acquisition and innovation opportunities and CVC investing will need to maintain financial flexibility to secure such opportunities. Our study provides financial guidance for firms that might begin a CVC program.

The remainder of the paper is as follows. Section 1.2 describes CVC and the testable hypotheses. Section 1.3 describes the sample, data sources and methodology. In Section 1.4 we test our hypotheses and discuss our results. In Section 1.5, we undertake robustness checks and further analysis. Finally in Section 1.6, we summarize our main findings.

1.2 Background and Hypothesis Development

1.2.1 Background

Corporate Venture Capital is one of the fastest growing portions of the venture capital ecosystem. Trends show that CVCs around the world have invested over $175B between 2013-2018 (Global CVC Report (2018)).

The number of CVC investors fluctuates over-time. One wave of CVC activity occurred in the mid-1980s (until the 1987 stock market crash) and a pronounced flurry of activity was seen in the mid-to-late 1990s that subsided with the plummet in technology companies in 2000 and 2001. Dushnitsky and Lenox (2005b) show that the top 20 CVC investors by 1999 were dominated by (IT) firms that initiated external venturing programs in the 1990s, including prominent investors such as Intel, Cisco Systems, and Microsoft. The over-representation of IT firms among top investors is attributed to several related factors, including uncertainty posed by emerging technologies during the 1990s, concerns about disruptions in core product markets, and corresponding attempts to supplement internal R&D activities with initiatives underway at entrepreneurial firms (Dushnitsky and Lenox (2005a)).

CVC and Independent Venture Capital (IVC) share some similarities but are also characterized by different objectives and corporate structures. More importantly CVCs, differ from IVCs with respect to their strategic mission and objective. IVCs main goal is to pursue financial returns. However, CVCs pursue both financial and strategic goals. Generally, a CVC has a strategic mission to help "grow the business" of the parent company. It achieves this by assisting the parent company to identify new ideas or technologies, develop new products or processes, and enter new markets or enhance existing businesses. In a 2019 survey of over 100 CVCs units by 500 Startups, of those CVCs that succeeded, 55% disclosed that achieving strategic objectives are more important than achieving financial objectives while 17% of the respondents said strategic and financial objectives are equally important (500 Startups' CVC Survey (2019)).[2]

Prior literature highlights several ways through which established firms benefit from CVC activities. We group the literature on CVC investment into several strands. The first strand of literature examines the drivers of CVC adoption and termination. Dushnitsky and Lenox (2005a) reveals that firms with greater cashflows are likely to invest in CVCs. Moreover, Gaba and Bhattacharya (2012) find that corporations tend to establish and are less likely to terminate a CVC unit when their innovation performance is close to their social aspirations. Several other drivers of CVC investments include; the competitiveness of an industry (Basu, Phelps, and Koth (2011); the intellectual property regime (Dushnitsky and Lenox (2005a); Basu, Phelps, and Koth (2011)), technology-related circumstances of a firm (Ma (2020)), a firm's network position (Noyes, Brush, Hatten, and Smith-Doerr (2014)) and job security of managers (Cabral, Francis, and Kumar (2020)).

The second strand of literature examines CVC syndicate networks. Braune, Lantz, Sahut, and Teulon (2019) show that information technology (IT) firms make CVC investments to increase the number of relationships with venture capitalists. The authors reveal that the willingness of industrial companies to maintain their relationships in the VC network drives them to renew their CVC investments. Noyes, Brush, Hatten, and Smith-Doerr (2014) show that a firm's commitment to CVC investments can be explained by its board interlocking networks.

The third strand of literature have examined the strategic benefits of CVC investments to CVC investing firms. Dushnitsky and Lenox (2005b) show a positive relationship between CVC investment and firm patenting rates. Ma (2020) shows that CVCs are used by firms experiencing deteriorating internal innovation to expose themselves to new technologies and regain their innovation edge. CVC investors often secure board seats,

[2] In October 2019, Global venture capital (VC) firm 500 Startups, released the largest Corporate Venture Capital (CVC) report of its kind, which surveyed more than 100 corporate venture capitalists across a wide variety of industries and geographical locations. The report indicates why 500 Startups' believes some corporate venture capital units succeed and others fail, and identifies different models for success that corporate investors can follow, classified as personas. Instead of prescribing a one-size-fits-all approach

or at least board observation rights, which provide them with knowledge of ventures' key activities and technologies. These rights are used to increase the stock of entrepreneurial knowledge. Benson and Ziedonis (2010) also reveal that firms use CVC programs as a way to identify acquisition opportunities. They show that 20 percent of start-ups purchased by top corporate investors were in the venture portfolio of its acquirer. In a similar vein, Ma (2020) shows that about one-fifth of CVC investing firms acquire their portfolio companies and those acquisitions represent 20% of all acquisitions by those CVC investing firms.

The fourth strand of literature examines the impact of CVC investment on the parent company's financial performance. Dushnitsky and Lenox (2006) study the relationship between CVC investment and Tobin's Q. The authors report that compared to their industry peers, CVC investing firms have greater firm value as measured by Tobin's Q. Using primary and secondary data, Zahra and Hayton (2008) show that investments made through CVC funds are positively associated with a corporation's ROE and revenue growth. Mohamed and Schwienbacher (2016) finds that the stock market reacts positively to the announcement of CVC investments by parent companies. The authors explain that though CVC investments are small relative to parent companies, the announcements is more likely to capture insights into the future strategic orientation of the parent company.

1.2.2 Hypotheses Development

The view that established firms face challenges in initiating ground breaking, radical innovation is well documented in the literature (Henderson (1993) and Tushman and Anderson (1986)). To overcome firm's inability to drive innovations internally, firms exploit knowledge externally (Cohen and Levinthal (1990)). CVC represents an important component of a firm's strategy to exploit knowledge externally. Survey responses show that firms pursue CVC investment for strategic reasons, with the objective of benefiting internal corporate innovation (Siegel, Siegel, and MacMillan (1988)). Siegel, Siegel, and MacMillan (1988) in a survey of 52 corporate venture programs, report that corporations rank exposure to new technologies and markets as the most important objective for investing in a corporate venture capital programs. For example, the declared mission or approach of shell ventures on its website states that " We make minority investments that help to develop new technologies and disruptive business model in areas of strategic interest to shell's business".[3] Lerner (2000) p.675 find that "a dollar of venture capital appears to be about three times more potent in stimulating patenting than a dollar of traditional corporate R&D". Recent studies have also shown that CVC investment leads to an increase in innovation for the parent company (Dushnitsky and Lenox (2005b), Ma (2020)). By investing in CVC, CVC firms get to sit on the boards of portfolio firms and may learn about new technologies or models. Experience with novel, pioneering technologies may increase the probability that established firms will create subsequent breakthrough inventions (Ahuja and Katila (2001)). Hence, we propose that CVC investing firms will need to maintain financial flexibility to fund such breakthrough innovations when they become due.

Another prominent reason for investing in start-up companies is to identify acquisition opportunities. Ma (2020) shows that about one-fifth of CVC investing firms acquire their portfolio companies and those acquisitions represent 20% of all acquisitions by those CVC investing firms. The author explains that such strategic acquisitions are related to a higher level of knowledge transfer from the portfolio companies to CVC investing firms. Consistent with these findings, Benson and Ziedonis (2010) provide further empirical evidence to support the acquisition of CVC portfolio companies by CVC investing firms. The authors show that one out of every five start-ups purchased by CVC investors from 1987 to 2003 were in the venture portfolio company of its acquirer. As aforementioned, CVC investing firms often secure board seats, or at least board observation rights which reduces information asymmetry and helps managers identify acquisition opportunities. Hence we propose that firms, that invest in CVCs will maintain financial flexibility to acquire portfolio companies when it is strategic to do so.

[3] source:https://www.shell.com/energy-and-innovation/new-energies/shell-ventures/about.html

In addition, the real option theory can be used in explaining CVC investments. Prior studies show that investments in venture capital creates valuable real options that are particularly valuable under uncertainty because of the flexibility it affords investors (Li (2008) and Trigeorgis (1993)). Due to the uncertainty created by CVC investments, investors stage their financing. Upon the initial investment in a venture, CVC investing firms have the right but not the obligation to make a subsequent investment and increase their financial commitment. The option to grow is obtained through the first equity investment, and the CVC firm exercises this option if the venture reaches milestones. We propose that CVC investing firms might maintain financial flexibility to exercise these follow-on investment options which might be more substantial in terms of resource commitments.

In summary, we advance that CVC investment represents a strategy to increase a firm's innovation and acquisition opportunities. This competitive strategy will impact a firm's capital structure and cash holdings decision. CVC investing firms maintain financial flexibility to ensure that (a) the funds needed to finance CVC driven innovations are available when needed (b) firms can expand their knowledge base through the acquisition of their portfolio companies when it is potentially useful to do so and (c) firms can exercise their growth option through a follow – on investment when uncertainty unfolds to its advantage.

Prior literature shows that growth opportunities are an important determinant of corporate financial policies. Prior researchers (K.Goyal, Lehn, and Racic (2002), Gave and Gaver (1993) and Jr and Watts (1992)) find that there is an inverse relationship between growth opportunities and debt.

The precautionary motive to hold cash advances the vital role of cash reserves when firms anticipate future growth opportunities. The precautionary motive asserts that, firms with better investment or growth opportunities hold more cash. Opler, Pinkowitz, Stulz, and Williamson (1999a) reveal that firms with strong growth opportunities hold more cash than other firms. This is consistent with the view that firms hold liquid assets to ensure that they will be in a position to keep investing where cash flow is too low relative to investment opportunities and when external funds are expensive. Baskin (1987) also reveal that firms increase their cash holdings when they envisage profitable investment opportunities and also when they want to rapidly pre-empt new opportunities.

Denis and McKeon (2012) show that firms that increase leverage do so to fund investment or operational activities. DeAngelo, Gonçalves, and Stulz (2018) show that a firm's leverage is closely linked to its cash balances. They show that managers of firms typically increase cash holdings by material amounts while deleveraging. Huang and Ritter (2021) show that financing needs are purely motivated by cash needs. They show that firms would have run out of cash a year after debt or equity issuance. Acharya, Almeida, and Campello (2007) show that anticipating investment needs firms either save or issue debt. Firms will prefer to hold higher cash or lower debt depending on their financial constraints and hedging needs.

In summary, firms often engage in CVC investments to foster innovation and acquire strategic advantages. Given these strategic motives, CVC firms are more likely to pursue financial flexibility, allowing CVC firms to fund CVC-driven innovation and acquisitions when they become due.

Hence, we test the following hypothesis;

Hypothesis 1. *CVC investing firms hold less debt than non-CVC investing firms.*

Hypothesis 2. *CVC investing firms hold more cash than non-CVC investing firms.*

1.3 Data and Methodology

1.3.1 Data Collection

We collect a sample of Corporate Venture Capital units affiliated with US public listed firms. We start with a list of CVC firms identified from the Refinitiv database. In the database, we predefine Corporate PE/Venture as a firm type in Eikon. We identified potentially 1037 Unique CVCs for the period 1980-2018. This initial sample served as a starting point for the subsequent data cleaning exercise. As a next step, we drop 31 CVC units described as Undisclosed Investors in the Eikon database leaving us with 1,006.

Using various sources of information such as Google, Factiva, Bloomberg, we manually match CVCs with a unique corporate parent. Accordingly, 438 firms that do not have unique corporate parents were dropped from the sample. The 438 firms dropped include independent and private equity investors, NGOs, and Universities. This leaves 568 CVC firms with unique parent companies. Although we limited our search to US investors, we still identify a substantial number of non-US investors from our sample construction among the 568 remaining firms. This is consistent with the findings of Röhm, Merz, and Kuckertz (2019) . For example, European based firms BMW and Dunnhumby, undertake investment vehicles in the USA and are classified as US based CVC Units in the database although their parent companies are based in Germany and the UK respectively. Hence, we remove 35 CVC units with corporate parents from the excluded geographical regions outside the US. This leaves us with 533 distinct CVC firms, out of which 262 are affiliated with unlisted parent firms. Hence, we end up with a final sample of 271 CVC units that are affiliated with US public listed parent firms which we merge with compustat.

1.3.2 Variable Construction

Capital Structure Measures

To measure capital structure, we use the book measures of total debt and long-term debt. We follow Rajan and Zingales (1995) in constructing our single book debt measure. Thus leverage is defined as total debt divided by total debt plus common shareholder's equity. Total debt is measured by short term debt plus long term debt.

$$BDR1 = (dltt + dlc)/(dltt + dlc + ceq) \tag{1.1}$$

To construct the long-term book debt ratio, we measure long-term book debt ratio as sum of annual book value of long-term debt divided by the total long – term debt plus common shareholder's equity. The long-term to book debt ratio is defined as;

$$BDR2 = dltt/(dltt + ceq) \tag{1.2}$$

For variable definitions of *BDR1* and *BDR2* refer to Table 1.1.

1.3.3 Cash Measure

We construct cash using a traditional measure of cash from the literature. We follow Opler, Pinkowitz, Stulz, and Williamson (1999a) in constructing the Cash variable. Cash is defined as cash and marketable securities scaled by beginning total book assets. Cash is defined as;

$$Cash/TotalAsset = Che/at \tag{1.3}$$

For variable definitions of *Cash* refer to Table 1.1.

1.3.4 Variable of Interest

Our primary independent variable of interest in this study is CVC. *CVC(0/1)* is an indicator variable equal to one if a firm makes a corporate venture capital investment and zero if otherwise.

1.3.5 Control Variables

In the capital structure regressions, we control for *FirmSize*, *Profitability*, *MarketToBook*, *Tangibility*, *Cashflow*, *Research and Development* , *Investments* and *Industry Cashflow volatility*. We also control for *FirmSize*, *Profitability*, *MarketToBook*, *Cashflow*, *Research and Development* , *BDR1*, *Investments*, *Dividend* and *Industry Cashflow volatility* in the *Cash* regression. *FirmSize* is defined as the natural logarithm of total assets. *Research* *and Development* is the ratio of Research and Development scaled by total assets. Firm size has been empirically found to be strongly positively and negatively related to debt and cash holdings respectively (Harris and Raviv (1990), Bevan and Danbolt (2002) and Opler, Pinkowitz, Stulz, and Williamson (1999b)). *Profitability* of a firm is defined as the ratio of the firm's operating income before depreciation to total assets. Firms with higher profitability maintain a relatively lower debt ratio because of its ability to finance itself from internally generated funds. Also prior researchers find that, profitable firms hold more cash (Al-Najjar (2002) and Toy, Stonehill, Remmers, Wright, and Beekhuisen (1974)).*MarketToBook* is measured as the ratio of total book assets less the book value of common equity plus the total market value of equity all divided by the total book assets. *Investments* is also measured as the sum of total acquisitions and capital expenditure scaled by total assets. Growth opportunity has been considered as a significant determinant of capital structure. The literature generally favors a negative relationship between the growth opportunities and debt (Billett, King, and Mauer (2007) and K.Goyal, Lehn, and Racic (2002)). Opler, Pinkowitz, Stulz, and Williamson (1999b) provide evidence that firms with strong growth opportunities hold larger amounts of cash. *Tangibility* is calculated as the ratio of fixed assets to total assets. Delcoure (2007) shows that asset tangibility has a positive effect on firms' capital-structure. Moreover, we control for *Cashflow* of a firm which is measured as the ratio of earnings before interest and taxes scaled by total book assets. Delcoure (2007) reveal that a firm's cash flow affects its debt. *Industry Cashflow volatility* is measured as Standard deviation of industry average cash flows for the previous 10 years, we require at least 3 years of observations. Prior literature document a negative relationship between the cash holding and cash flows. Firms with higher volatility hold more cash. Firms with volatility in cash flows faces a higher possibility of experiencing cash shortages and maintaining an adequate cash level allows the firm to utilize this money during rainy days. Keefe and Yaghoubi (2016) find that a one standard deviation increase from the mean of cash flow volatility implies an approximately 24% decrease in the long-term debt ratio. *Dividend* is an indicator variable: one if a firm pays dividend in a year and zero if otherwise. Based on the trade off theory, the association between dividend payments and cash should be negative, since "dividend-paying firms" can trade off the costs of holding cash by reducing dividend payments (Al-Najjar (2002)). Frank and Goyal (2009) find that dividend-paying firms tend to have lower leverage. We winsorize the variables at the 1% and the 99% level to restrict the impact of outliers. Detailed definitions of all variables as well as their sources are in Table (1.1).

1.3.6 Univariate Statistics

Table 1.2 provides summary statistics of key variables used in this study. We report the mean, standard deviation, 25th percentile, median, and 75th percentile. The means of the two categories of capital structure measures show that the more broadly debt is defined the higher book debt ratios. *BDR1* has a mean of 0.317 which includes short-term debt and long-term debt of a firm. The mean of *BDR1* is greater than *BDR2* which has a mean of 0.253 which measures the long-term debt of a firm. On average, firms hold 31% of assets in cash.

Table 1.3 reports the correlation between the variables used in this study. Table 1.3 shows that CVC investment is positively correlated with *Cash*, *MarketToBook*, *Research and Development* , and *Investments*. Moreover, there is a negative relationship between CVC investment and *BDR1*, *BDR2*, *FirmSize*, *Profitability*, *Tangibility*, *Dividend*. The coefficients between CVC investment and our dependent variables are as expected. The correlation coefficients between *CVC(0/1)* and the measures of debt are -13.1% and -11.3% for *BDR1* and *BDR2* respectively. Lastly, the correlation coefficient between *CVC(0/1)* and *Cash* is 15.6%. We also control for industry and year.

1.4 Testing

1.4.1 Testing Hypothesis 1

To test H1, we estimate;

$$DebtRatio_{i,t} = \alpha + \beta CVC(0/1)_{i,t} + \gamma X_{i,t-1} + \delta_t + \rho_j + \epsilon_{i,t} \tag{1.4}$$

where $DebtRatio_{i,t}$ is a book debt ratio, thus *BDR1* and *BDR2* and $X_{i,t-1}$ is a matrix of lagged control variables listed in Table 1, δ_t represents year dummies and ρ_j is a set of Fama-French 49 industry dummies to control for industry linear trends. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. We cluster standard errors by firm.

Table (1.4) shows estimation results of Eq.(1.4). The table shows that the coefficients associated with *CVC(0/1)* are statistically significant at less than the 1% level of significance in explaining our capital structure measures. Each coefficient associated with *CVC(0/1)* is negative implying that investments in entrepreneurial ventures by established firms have a negative and statistically significant impact on a firm's leverage ceteris paribus. Specifically, the coefficients associated with *CVC(0/1)* are -0.058 and -0.061 using *BDR1* and *BDR2* respectively. We use the results in Column (1) to gauge the economic importance of the relationship between CVC investment and leverage. In Column (1), the coefficient associated with *CVC(0/1)* is -0.058. This coefficient translates to 18 percentage decrease in *BDR1* relative to the sample mean. Overall our results support Hypothesis 1.

1.4.2 Testing Hypothesis 2

To test H2, we estimate;

$$CashHoldings_{i,t} = \alpha + \beta CVC(0/1)_{i,t} + \gamma X_{i,t-1} + \delta_t + \rho_j + \epsilon_{i,t} \tag{1.5}$$

where $CashHoldings_{i,t}$ is measured as cash divided by beginning asset total. $X_{i,t-1}$ is a matrix of lagged control variables listed in Table 1.1. We also control for *BDR1* which is a standard control variable for *Cash* regression. δ_t represents year dummies and ρ_j is a set of Fama-French 49 industry dummies to control for industry linear trends. *CVC(0/1)* is an indicator variable where all levels of investment greater than Zero are assigned the value of one and zero for otherwise. We cluster standard errors by firm.

In Table (1.5), we report the base line regression of Eq.(1.5). The table shows that the coefficient associated with *CVC(0/1)* in column (1) is 0.044 and is statistically significant at less than the 5% level. This coefficient translates to 14 percentage point increase in cash relative to the sample mean. Overall our results support Hypothesis 1. All in all, the findings reported in Table (1.5) supports Hypothesis 2.

All in all, our baseline regressions are consistent with our hypotheses. Our results support our argument that CVC investing firms will need to pursue conservative financial policies to ensure that (a) the funds needed to finance CVC driven innovations are available when needed (b) firms can expand their knowledge base through the acquisition of their portfolio companies when it is potentially useful to do so and (c) firms can exercise their growth option through a follow – on investment when uncertainty unfolds to its advantage.

1.5 Robustness Check and Further Analysis

1.5.1 Firm Fixed Effects

In our main regression, we include year fixed effects and industry fixed effects to control for time and industry trends. However, an empirical challenge associated with estimating a relation between CVC and firm policies is possible omitted variable bias. It is possible that an unobservable time invariant firm characteristic is correlated with CVC. To address this concern, we use a firm fixed effect specification.

After controlling for firm fixed effects, we observe qualitatively similar results as those reported in our baseline regression.[4] In addition, as reported in column (1) and (2) of Table (1.6), CVC investing firms also hold less debt as measured by *BDR1* and *BDR2* after controlling for time invariant firm characteristics. Lastly, consistent with our baseline regression for cash holdings and *CVC(0/1)*, column (3) of Table (1.6) also shows that CVC investing firms hold more cash, ceteris paribus.[5]

1.5.2 Alternative Measure of Independent Variable

As a robustness check, we follow Dushnitsky and Lenox (2006) and measure CVC investment as the log of total corporate venture capital invested ($M) by a firm in a year. The CVC investment variable have been log-transformed because it is highly skewed and kurtotic. This variable has the desirable trait of being continuous. Our results are qualitatively similar to our baseline regression as reported in Table (1.7).

1.5.3 Instrumental Variable Regression

The fixed-effect regressions control for time invariant omitted variables. However, as firms self-select to invest corporate venture capital, the potential problem of time varying omitted variables is still unaddressed. One could argue that is more likely that a time varying omitted variables explain both CVC investment, cash holdings and debt. To deal with this issue, we re-estimate our debt and cash regressions with the IV-3SLS approach. To qualify as a valid instrument for the first stage, a variable need to be strongly correlated with the instrumented regressors (the validity requirement) but uncorrelated with the error term in the second stage regression. Given that CVC is a dummy variable, its first step of the IV-3SLS approach involves a logistic regression and it's likely to generate

[4] For example, the coefficient associated with *CVC(0/1)* is -0.058 in explaining *BDR1* with year and industry fixed effects but has a coefficient of -0.036 when controlling for year and firm fixed effects

[5] For example, the coefficient associated with *CVC(0/1)* is 0.044 in explaining *Cash* with year and industry fixed effects but has a coefficient of 0.024 when controlling for year and firm fixed effects

an incorrect nonlinear first stage. To overcome this challenge, instead of plugging in nonlinear fitted values, we use the nonlinear fitted values as instruments.

We use *High VC Concentration State* as our instrumental variable. Previous literature (Butler and Goktan (2013) have documented the importance of location in the VC industry. Established corporations are more likely to invest in CVCs when they operate in a state with high VC activities. Innovative start-up firms choose to locate and operate in high VC concentration states. Established corporations located in such regions are likely to invest in a CVC program with the motive of tapping into the entrepreneurial ideas of the start-up firms. We construct *High VC Concentration State* which measures the percentage of total annual CVC investment per state which is time varying. We calculate the number of CVC investment by state per year and we divide by the total number of CVC investment. Our use of *High VC Concentration State* as an instrument assumes is less likely to be correlated with the debt and cash levels of CVC investing firms except for its effect in facilitating CVC investment. To check this assumption, we include the variable *High VC Concentration State* as a further control in the baseline regressions. The coefficient of the non-instrumented *CVC(0/1)* is still significant, which is consistent with the hypothesis that CVC investment leads to low debt and high cash rather than the *High VC Concentration State*.

In Table (1.8), we estimate the first-stage regression using a logistic regression where the dependent variable is *CVC(0/1)*. We find that our instrument *High VC Concentration State* satisfy the validity requirement since it is positive and statistically significant at the 1% level in explaining *CVC(0/1)*. In unreported results, In stage 2, we use the nonlinear fitted values as instruments. We report the third stage results in Table (1.9). The dependent variables are *BDR1*, *BDR2* and *Cash*. The results in column (1) and column (2) of Table (1.9) shows that the coefficients associated with estimated *CVC(0/1)* are negative and statistically significant at the 1% level in explaining *BDR1* and *BDR2* respectively. In addition, the results in Column (3) of Table (1.9) shows that the coefficient associated with estimated *CVC(0/1)* is positive and statistically significant at 5%

in explaining *Cash*. The IV-3SLS approach supports our findings that CVC investing firms hold less debt and more cash.[6]

1.5.4 Is the scale of CVC meaningful enough to affect financial policies?

Is the scale of CVC meaningful enough to affect the financial policies of established firms? It is possible that CVC activity, follow-on investments and even the potential funding of innovation and acquisition opportunities are not large enough to affect the financial policies of CVC investing firms. In contrast to this line of argument, Mohamed and Schwienbacher (2016) find that the stock market reacts positively to the announcement of CVC investments by parent companies. The authors explain that though CVC investments are small relative to parent companies, the announcements is more likely to capture insights into the future strategic orientation of the parent company. Analogous to Mohamed and Schwienbacher (2016), the scale or amount of a CVC investment may not actually have a direct effect on financial policies but may only capture the strategic direction of firms upon which they will base financial policies. However, we propose that firms that invest in CVCs at much higher levels are likely to pursue the most conservative financial policies as such firms may be exposed to more innovative ideas and acquisition opportunities and will need funds to secure such opportunities. To illustrate this point, consider two firms investing in CVCs at different levels. If one firm invests at high levels and the other invests at low levels, the firm that invests at higher levels sits on more venture boards and has more information about these portfolio companies. Such exposure increases their knowledge stock, improves their understanding of technologies and practices of its portfolio companies on which they may base innovation and acquisition. Dushnitsky and Lenox (2005b) find that greater firm investment in entrepreneurial ventures leads to increases in the investing firm's innovation rate. They write that "The larger a firm's equity investment in new ventures, the greater the stock of entrepreneurial

[6] Identical results obtained using the control function approach of J.M.Wooldridge (2015)

knowledge a firm has access due to either (a) access to a greater number of new ventures (i.e., more opportunities to conduct and learn from due-diligence, as well as board observation rights and witnessing failure), or (b) greater access to their portfolio companies (i.e., greater leverage vis-à-vis the venture and hence more chances to secure board seats and deploy liaisons)" Dushnitsky and Lenox (2005b, p.619).

In anticipation of funding CVC driven innovations and acquisition opportunities, we expect that our results are more pronounced among firms that invests at high levels. Such firms are more likely to pursue the most conservative financial policies . Hence, we construct investment levels into *Highest CVC Investors*, *Average CVC Investors* and *Lowest CVC Investors*. Each year we rank CVC investment into terciles and these different levels of intensity are compared with non-CVC firms, with the top tercile representing CVC investors with the highest CVC investment amounts as a percentage of total assets. The firms in the bottom tercile are referred to as the firms with low CVC investment amounts as a percentage of total assets.

Collectively, the results reported in Table (1.10) are conceptually similar to our baseline regression but the magnitude is much larger for the *Highest CVC Investors*. For example, the coefficient associated with *CVC(0/1)* is -0.058 in explaining *BDR1* in our baseline regression while the coefficient for the *Highest CVC Investors* is -0.108. Also, the coefficient associated with *CVC(0/1)* is 0.044 in explaining *Cash* in our baseline regression while the coefficient for the *Highest CVC Investors* is 0.055. However, we find no evidence that the financial policies of the *Lowest CVC Investors* are affected by CVC investment.

1.5.5 CVC Investments by Program Goal

By far, our results show that CVC investment affects the financial policies of CVC investing firms. We argue that CVC firms maintain financial flexibility to secure strategic future investment opportunities. If this argument is true, we expect our results to be pronounced among strategically focused CVC firms. Following (Ma (2020), Dushnitsky and Lenox (2006)), we categorize CVCs into strategic or financially driven by collecting information disclosed during the announcement of its venturing program. For each CVC in the sample, we search for media coverage, and corporate news at initiation using Nexis, Google, and Factiva. We limit our analysis to CVC firms which we are able to determine the objective of the CVC program.

Of the 271 CVC firms in our sample, we are able to confidently determine the program orientation for 173 firms.[7] Of these firms, 70% stated a strategic motivation for starting their program, and 30% stated financial motivation for starting their CVC program.[8]

The analysis in Table (1.11) is similar to our baseline regression with the addition of two terms *CVC(0/1)*Strategic* and *CVC(0/1)*Financial*.[9] We find a negative, significant relationship between *CVC(0/1)*Strategic* and our measures of total debt and long-term debt; *BDR1* and *BDR2* respectively. We also find a significant positive relationship between *CVC(0/1)*Strategic* and *Cash*. However, we find no statistically significant relationship between *CVC(0/1)*Financial* and our measure of total debt and cash holdings; *BDR1* and *Cash* respectively. Nonetheless, we find a significant negative relationship between *CVC(0/1)*Financial* and long-term debt. In summary, our findings show that while CVC investors pursue financial flexibility during CVC investments, our results are more pronounced among strategically focused CVC firms.

[7] A special thank you to Song Ma of Yale Management School for sharing his data on the objectives of CVC programs with us. We had a match of this and we categorize other firms which are not captured in his data.

[8] A CVC program was coded as financially driven when the following or similar statements were made "the first priority of Oracle's venture effort is financial returns"(Oracle ventures; venture capital arm of Oracle Corp), "companies that provide the potential for outstanding financial returns"(Chevron Technology Ventures; venture capital arm of Chevron Corp) On the other hand, a CVC program was coded as strategically driven when the following or similar statements were made "Agilent Ventures .... will actively partner with Agilent to jointly develop new technologies and products" (Agilent ventures; venture capital arm of Agilent Technologies Inc) "... invests in products or services that have the potential to provide benefits to UPS, or strategically are aligned to UPS business objectives." (The UPS Strategic Enterprise Fund; venture capital arm of United Parcel Service) "eighteen94 capital will invest in emerging businesses in both Kellogg's core categories and adjacent categories, ... that could lead to long-term, mutual growth opportunities." (eighteen94 capital; venture capital arm of Kellogg Company)

[9] *CVC(0/1)*Strategic* is an interaction variable between *CVC(0/1)* and *Strategic*. *CVC(0/1)* is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. *Strategic* is an indicator variable equal to one if a firm runs a strategically driven CVC program and zero if otherwise.*CVC(0/1)*Financial* is an interaction variable between *CVC(0/1)* and *Financial*. *Financial* is an indicator variable equal to one if a firm runs a financially driven CVC program and zero if otherwise.

1.5.6 How do CVC firms pay for acquisitions?

Do CVC firms use cash to acquire firms? In this section, we investigate how CVC firms pay for their acquisitions. We begin our analysis by collecting M&A data from the SDC database and we merge it with our sample CVC and Non - CVC data.

M&A Data Collection

The analysis is performed on a cross section of M&A deals conducted by CVCs and non-CVC firms. We collect acquisition data from Refinitive Securities Data Corporation's (SDC) Platinum U.S. Mergers and Acquisitions (M&A) Database from January 1980 to December 2018. To be included in our sample, the following conditions must be satisfied:

- The acquisition or deal status must be "completed"
- The target is a private US firm (we use private firms because mostly CVCs invest in start-ups or private firms)
- Acquiring firms are U.S public listed firms
- The transaction value must not be less than $1m
- The bidder is acquiring more than 50 percent of the target firm.
- Neither the acquirer nor the target is a utility or a financial institution
- We exclude acquisitions where the target or acquirer is an American Depository Receipt (ADR), Real Estate Investment Trust (REIT), or a closed-end fund

This process leads us to a sample of 13,247 deals within our sample period. We then match the SDC database with our CVCs and their control firms (non-CVC firms) on the six-digit CUSIP reported by SDC and the first six-digits of the nine-digits CUSIP reported by the WRDS database.The final matched sample of CVC and Non-CVC firms consists of 2,656 acquisition deals. For our empirical tests, we focus on acquisitions with cash deals.

Empirical Test

We empirically study whether CVC firms acquire with cash deals. We measure cash deals as acquisitions with cash offer. Cash offer is a dummy variable equal to one if a firm pays for an acquisition with cash and zero otherwise. We construct our logistic regression as follows;

$$\begin{aligned} \textit{Cash Deals}_{i,t} &= \alpha + \beta \textit{CVC Firm}_{i,t} + \gamma \textit{Acquirer Firm Characteristics}_{i,t} \\ &+ \lambda \textit{Deal Characteristics}_{i,t} + \delta_t + \epsilon_{i,t} \end{aligned} \tag{1.6}$$

where $\textit{Cash Deals}_{i,t}$ is the dependent variable and is an indicator variable equal to one if a firm's consideration offered for an acquisition includes cash and zero otherwise. $\textit{Acquirer Firm Characteristics}_{i,t}$ is a matrix of control variables of the acquirer firm listed in Table 1, $\textit{Deal Characteristics}_{i,t}$ measures the *Deal Size* and *Deal Competitiveness* which are both defined in Table 1.1. δ_t represents year dummies and ρ_j is a set of Fama-French 49 industry dummies to control for industry linear trends. $\textit{CVC Firm}_{i,t}$ is the variable of interest and is an indicator variable equal to one if a firm has a CVC program and zero if otherwise.

The results in Table (1.12) show that *CVC Firm* are more likely to acquire with cash deals compared with non-CVC firms. The significant positive result is consistent with why *CVC Firm* maintain financial flexibility when investing in entrepreneurial firms. The coefficient of *CVC Firm* in explaining cash deal acquisitions is 0.308 and it is significant at the 5% level of significance. The marginal effect of the coefficient of *CVC Firm* on *Cash Deals* is 0.052. This means that if a firm runs a CVC program, there is a 5.2% higher probability that it will offer a payment consideration which includes cash during an acquisition.

Our earlier analysis in Table (1.11) shows that strategically driven CVC firms pursue the most conservative financial policies in anticipation of financing future growth opportunities. As a next step, we examine whether the relationship between CVC firms and cash acquisitions are more pronounced among strategic CVC investors. The results in Column (2) of Table (1.12) show that the coefficient of *CVCFirm*Strategic* in explaining cash acquisitions is 0.531 and it is significant at the 1% level of significance. The marginal effect of the coefficient of *CVCFirm*Strategic* on *Cash Deals* is 0.094. This means there is a 9.4% higher probability that strategically driven CVC investors will offer a payment consideration which includes cash during an acquisition. However, we find no statistically significant relationship between *CVCFirm*Financial* and cash acquisitions. This is consistent with the insignificant relationship between *CVC(0/1)*Financial* and *Cash* in Table (1.11). This further analysis reveals that the relationship between CVC firms and cash acquisitions are more pronounced among strategically driven CVC firms.

1.5.7 External Finance Dependence

We examine whether our findings apply to industries that are relatively more in need of external finance compared to industries that are less dependent on external finance. We follow Rajan and Zingales (1998) and rank industries by their external finance dependence. First, for each firm, we compute the ratio of capital expenditures minus cash flows from operations over capital expenditures. To construct industry-level measures, we use the industry median at the three-digit SIC code. High and low subsamples are made of firms above and below the sample median respectively

Restricting our sample to industries with high dependence on external finance, Column (1) and (2) of Table (1.13) show that CVC firms hold less debt compared to non-CVC firms. Firms in such industries are more likely to depend on external finance in financing investment opportunities. This explains why CVC firms in industries with high dependence on external finance maintain financial flexibility through low debt holdings. Such low debt holdings increases future borrowing capacity which CVC firms could use to finance future CVC driven acquisition and innovation opportunities. However, we find no evidence that CVC firms hold more cash in industries with high dependence on external finance.

Restricting our sample to industries with less dependence on external finance, Column (6) of Table (1.13) shows that CVC firms in industries with less dependence on external finance pursue financial flexibility through cash holdings. Firms in such industries are less likely to depend on external finance, they are more likely to build up cash to finance investment opportunities. This could explain why CVC firms in industries with less dependence on external finance hold more cash compared to non-CVC firms. While we expect firms in such industries to hold more cash, CVC firms compared with non-CVC firms will need to build more cash in anticipation of securing future CVC driven innovation and acquisition opportunities. Lastly, we find no evidence that CVC firms hold less debt in industries with less dependence on external finance.

In summary, our results show that CVC firms in industries with high dependence on external finance hold less debt while CVC firms in industries with less dependence on external finance hold more cash.

1.5.8 CVC investment on capital structure and cash holdings; before and after the financial crisis

In our baseline regression, we estimate our model over the entire sample period from 1980 to 2018. To investigate whether our findings apply to different time periods, we split up the sample into two time periods, namely before the financial crisis period ranging from 1980 to 2006, and the period after the financial crisis period ranging from 2009 to 2018.

Table (1.14) summarizes the empirical results. Columns (1) to (3) refer to the period before the crisis. Columns (4) to (6) report the estimates for the post-crisis period. Our estimation results point out to consistent results for both sample periods which also applies to our baseline results. Overall, we find that our findings are not affected by different time periods.

1.5.9 Entropy balancing estimation

Whereas the documented difference in the Cash and debt output between CVC investing firms and non CVC investing firms appears to be due to CVC investment, our baseline results could be attributed to other potential interpretations. One possible interpretation is that CVC investing firms might differ radically from non CVC investing firms (control group). For example, it is well established in the literature that CVC investing firms are large firms and such differences in firm characteristics may be driving our results.

To address the concern that CVC investing firms are inherently different from non-CVC investing firms, we implement entropy balancing of Hainmueller and Xu (2013). Entropy balancing creates balanced samples between the treatment and control group. It involves a reweighting scheme that directly incorporates covariate balance into the weight function that is applied to the sample units. This recalibration of the unit weights effectively adjusts for systematic and random inequalities. In contrast to other preprocessing methods such as nearest neighbor matching where units are either discarded or matched (weights of zero or one), the reweighting scheme in entropy balancing reweights units to achieve balance, but at the same time keeps the weights as close as possible to the base weights to prevent information loss and thereby retains efficiency for the subsequent analysis.

We match firms on mean of size and all the control variables used in the baseline regression. By using this matching procedure, we ensure that the treatment firms (CVC investing firms) are equivalent to the control firms (non CVC investing firms), which alleviates concern that differences in firm characteristics influence our results. In unreported results, we also use the nearest neighbor matching method which reduces our sample to 29000 firm year observations over our sample period and our results are qualitatively similar in this unreported analysis. As reported in Table 1.15 , we find that, even after controlling for firm characteristics using Entropy balancing estimation, CVC investing firms still hold less debt and more cash.

1.6 Conclusion

Corporate Venture Capital (CVC) investments have become increasingly important and continue to attract many public companies. Unlike Independent Venture Capitals (IVCs) that are established for purely financial returns, CVCs pursue strategic objectives. Despite the strategic importance of CVC investments, there is no research about how CVC investments affect the financial policies of CVC investing firms.

We fill this gap by investigating whether CVC investments affect debt and cash holdings of CVC investing firms. Firms invest in CVCs for strategic reasons. Prior research shows that CVC investment leads to innovation and acquisitions for the CVC investing firm (Ma (2020), Mohamed and Schwienbacher (2016), Dushnitsky and Lenox (2006), Benson and Ziedonis (2010) and Dushnitsky and Lenox (2005b). Moreover, CVC investment creates growth options for firms which can be exercised through a substantial follow-on investment. Motivated by the strategic reasons behind CVC investment, we propose that CVC investing firms maintain financial flexibility to ensure that (a) the funds needed to finance CVC driven innovations are available when needed (b) firms can expand their knowledge base through the acquisition of their portfolio companies when it is potentially useful to do so and (c) firms can exercise their growth option through a follow – on investment when uncertainty unfolds to its advantage. Consistent with our predictions, we find that CVC investing firm hold less debt and more cash. Moreover, we find that our results are more pronounced among the highest CVC investing firms. Furthermore, we find that our results are more pronounced among strategically driven CVC firms. In addition, our results show that CVC firms in industries with high dependence on external finance hold less debt while CVC firms in industries with less dependence on external finance hold more cash. Moreover, we also find that CVC firms are more likely to offer considerations with cash deals during acquisitions and this relationship is also pronounced among strategic CVC firms. We also find that our baseline results apply to different time periods before the financial crisis period ranging from 1980 to 2006, and the period after the financial crisis period ranging from 2009 to 2018. Our study provides financial guidance for firms that might begin a CVC program.

1.7 Credit Authorship Statement

Bernard Tawiah: Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft. Michael O'Connor Keefe: Conceptualization, Methodology, Writing – review & editing, Supervision.

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Table 1.1: Variable definitions

This table provides the definition of the key variables used. Accounting data are from Compustat and CVC Investment data is from Refinitiv database

Variable	Definition
BDR1	The ratio of short plus long-term debt to short plus long-term debt plus common shareholder's equity
BDR2	The ratio of long – term debt to long – term debt plus common shareholder's equity
Cash	Cash and marketable securities scaled by beginning total book assets
CVC(0/1)	*CVC(0/1)* is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise.
FirmSize	Natural logarithm of total book assets
Research and Development	Research and Development Expenditure scaled by beginning total book assets
Profitability	Operating income before depreciation scaled by beginning total book assets
MarketToBook	Ratio of total book assets less the book value of common equity plus the total market value of equity all divided by the total book assets
Tangibility	The assets tangibility of a firm is the ratio of net property, plant and equipment scaled by beginning total book assets
Cashflow	Ratio of earnings before interest and taxes scaled by beginning total book assets
Investments	Sum of total acquisitions and capital expenditures scaled by beginning total book assets
Capital Expenditure	Capital expenditure scaled by beginning total book assets
Dividend	Indicator variable; One if a firm pays dividend in a year and zero if otherwise
Industry Cashflow volatility	Standard deviation of industry average cash flows for the previous 10 years, we require at least 3 years of observations
High VC Concentration State	The number of CVC investment by state per year divided by the total number of CVC investment
LnCVCInvestment	The log of total corporate venture capital invested ($M) by a firm in a year.
External Finance Dependence	The ratio of capital expenditures minus cash flows from operations over capital expenditures. Industry level measures is the industry median at the three digit SIC code.
*CVC(0/1)*Strategic*	Interaction variable between *CVC(0/1)* and *Strategic*. *CVC(0/1)* is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. *Strategic* is an indicator variable equal to one if a firm runs a strategically driven CVC program and zero if otherwise.
*CVC(0/1)*Financial*	Interaction variable between *CVC(0/1)* and *Financial*. *CVC(0/1)* is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. *Financial* is an indicator variable equal to one if a firm runs a financially driven CVC program and zero if otherwise.
Deal Characteristics	
Deal Size	Value of transaction scaled by asset total of acquiring firm
Deal Competitiveness	Indicator variable; One if the number of bidders for a deal is greater than one and zero otherwise

Table 1.2: Summary Statistics

This table presents summary statistics of the variables used in this study from 1980 to 2018. All the variables are winsorized at 1% level in both tails of the distribution before the summary statistics are calculated. The table reports the number of observations, mean, 25th percentile, median, 75th percentile and standard deviation. Variable generations are provided in the in Table 1.1

Variable	Observation	mean	p25	p50	p75	sd
BDR1	246,175	0.317	0.008	0.248	0.515	0.643
BDR2	246,443	0.253	0	0.129	0.406	0.401
Cash	228,034	0.310	0.025	0.096	0.295	0.820
CVC(0/1)	247,398	0.005	0	0	0	0.073
LnCVCInvestment	247,398	0.034	0	0	0	0.477
FirmSize	228,201	4.341	2.589	4.290	6.083	2.598
Profitability	227,723	-0.188	-0.050	0.097	0.183	1.713
MarketToBook	207,395	6.067	1.062	1.620	3.000	30.250
Tangibility	227,945	0.350	0.0983	0.244	0.486	0.362
Cashflow	227,824	-0.244	-0.095	0.051	0.129	1.706
Research and Development	241,112	0.110	0	0	0.050	0.370
Industry Cashflow volatility	232,090	1.156	0.151	0.371	1.814	1.500
Capital Expenditure	224,123	0.092	0.017	0.043	0.096	0.160
Investments	234,252	0.089	0.020	0.051	0.112	0.109
Dividend	247,395	0.268	0	0	0	0.443
High VC Concentration State	241,556	0.068	0	0.024	0.095	0.095

Table 1.3: Correlations:This table presents the pairwise correlation coefficients between variables in Essay 1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
CVC(0/1)	1.000														
Cash	0.156	1.000													
BDR1	-0.131	-0.250	1.000												
BDR2	-0.113	-0.219	0.973	1.000											
Industry Cashflow volatility	0.006	-0.326	0.681	0.697	1.000										
Acquisition	0.002	-0.031	0.048	0.046	0.065	1.000									
Capital Expenditure	0.056	-0.042	-0.226	-0.052	-0.014	-0.175	-0.461	1.000							
FirmSize	-0.383	-0.178	0.193	0.180	0.247	0.228	-0.347	1.000							
Profitability	-0.112	-0.013	-0.324	-0.364	-0.453	-0.457	0.018	0.074	1.000						
MarketToBook	0.183	0.565	-0.252	-0.250	-0.410	-0.388	0.299	-0.127	0.363	1.000					
Research and Development	0.117	0.450	-0.023	0.002	-0.153	-0.133	0.535	-0.150	-0.251	0.133	1.000				
Tangibility	-0.072	-0.418	0.074	0.055	0.167	0.152	-0.092	0.005	0.149	-0.208	-0.284	1.000			
Cashflow	-0.125	0.030	-0.307	-0.348	-0.438	-0.441	0.000	0.100	0.967	0.385	-0.247	0.031	1.000		
Dividend	-0.192	-0.338	0.099	0.057	0.146	0.103	-0.273	0.338	0.251	-0.205	-0.293	0.321	0.231	1.000	
Investments	0.004	-0.168	-0.041	-0.061	-0.009	-0.019	-0.008	-0.047	0.179	0.002	-0.0612	0.349	0.110	0.050	1.000

Table 1.4: Testing Hypothesis 1 - CVC Investment and Capital Structure

This table reports estimation results of Eq (1.4) which estimates the baseline regression of the effect of CVC Investment on capital structure. *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)
VARIABLES	*BDR1*	*BDR2*
CVC(0/1)	-0.058***	-0.061***
	(0.020)	(0.018)
FirmSize	0.038***	0.039***
	(0.002)	(0.001)
Profitability	-0.021	-0.021**
	(0.028)	(0.012)
MarketToBook	-0.002***	-0.000**
	(0.000)	(0.000)
Tangibility	0.196***	0.167***
	(0.015)	(0.010)
Cashflow	0.035	-0.032***
	(0.028)	(0.012)
Research and Development	-0.131***	-0.048***
	(0.030)	(0.011)
Investments	0.060***	0.071***
	(0.020)	(0.012)
Industry Cashflow volatility	0.001***	0.001
	(0.002)	(0.001)
Dividend	-0.134***	-0.086***
	(0.005)	(0.004)
Constant	0.236***	0.096***
	(0.030)	(0.024)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	171,493	171,493
R^2	0.073	0.113

Table 1.5: Testing Hypothesis 2 - CVC Investment and Cash Holdings

This table reports estimation results of Eq (1.5) which estimates the baseline regression of the effect of CVC Investment on Cash Holdings. *Cash* is the dependent variable. *Cash* is measured as cash and marketable securities scaled by beginning total book assets. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

VARIABLES	*Cash*
CVC(0/1)	0.044**
	(0.019)
FirmSize	-0.025***
	(0.001)
Profitability	-0.155***
	(0.040)
MarketToBook	0.003***
	(0.000)
Cashflow	0.130***
	(0.037)
Research and Development	0.392***
	(0.032)
BDR1	-0.043***
	(0.004)
Investments	-0.203***
	(0.017)
Industry Cashflow volatility	0.009***
	(0.001)
Dividend	0.002
	(0.003)
Constant	0.203***
	(0.021)
Year Fixed Effects	Yes
Industry Fixed Effects	Yes
Observations	171,633
R^2	0.183

Table 1.6: Effect of CVC Investment on Capital Structure and Cash Holdings - Firm Fixed Effects

This table reports estimation results of Eq (1.4) and Eq (1.5) which estimates the baseline regression of the effect of CVC Investment on capital structure and cash holdings while controlling for firm fixed effects. *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *Cash* is measured as cash and marketable securities scaled by beginning total book assets.*CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
VARIABLES	*BDR1*	*BDR2*	*Cash*
CVC(0/1)	-0.036***	-0.030**	0.024**
	(0.013)	(0.015)	(0.012)
Control Variables	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	171,493	171,493	171,633
R^2	0.358	0.439	0.408

Table 1.7: Effect of CVC Investment on Capital Structure and Cash Holdings - Alternative Measure

This table reports estimation results of Equation (1.4) Equation (1.5) which estimates the baseline regression of the effect of CVC Investment on capital structure and cash holdings while using an alternative measure of CVC. The independent variable is *LnCVCInvestment* which is measured as the log of total corporate venture capital invested ($M) by a firm in a year. Our dependent variables are *BDR1*, *BDR2*, and *Cash*. *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *Cash* is measured as cash and marketable securities scaled by beginning total book assets. Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
VARIABLES	*BDR1*	*BDR2*	*Cash*
LnCVCInvestment	-0.008**	-0.009***	0.006**
	(0.003)	(0.003)	(0.003)
Control Variables	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	171,493	171,493	171,633
R^2	0.073	0.113	0.184

Table 1.8: First stage of 3SLS regression

This table reports the estimation results of the first stage regression using a logistic regression. Our instrumental variable is *High VC Concentration State*. To measure our *High VC Concentration State*, we estimate the number of CVC investment by state per year and we divide by the total number of CVC investment. Table 1.1 defines the variables. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

VARIABLES	*CVC(0/1)*
High VC Concentration State	4.950***
	(0.300)
FirmSize	0.991***
	(0.026)
Profitability	-0.001**
	(0.000)
MarketToBook	0.029***
	(0.003)
Cashflow	4.409***
	(0.403)
Research and Development	1.505***
	(0.120)
Tangibility	-2.407***
	(0.192)
Investments	0.597
	(0.431)
Industry Cashflow volatility	-0.231
	(0.027)
Dividend	-0.057
	(0.081)
Year Fixed Effects	Yes
Industry Fixed Effects	Yes
Observations	171,440
R^2	0.414

Table 1.9: Third stage of 3SLS regressions

This table reports the estimation results of the second stage regression of the 2SLS regression. We re-estimate our baseline regressions of *CVC(0/1)* on *BDR1*, *BDR2* and *Cash*. Our instrumental variable is *High VC Concentration State*. To measure our *High VC Concentration State*, we estimate the number of CVC investment by state per year and we divide by the total number of CVC investment. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1.1 defines the variables. All control variables are lagged. Bootstrapped standard errors are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	Dependent Variables		
Independent Variables	*BDR1*	*BDR2*	*Cash*
$\widehat{CVC(0/1)}$	-0.233***	-0.341***	0.211***
	(0.081)	(0.064)	(0.069)
Control Variables	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	171,428	171,428	171,526
R^2	0.075	0.110	0.170

Table 1.10: CVC Investment levels

This table reports the effect of CVC investment levels on capital structure and cash holdings. Our dependent variables are *BDR1*, *BDR2* and *Cash*. We re-estimate our baseline regression in Eq(1.4) and Eq(1.5). *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *Cash* is measured as cash and marketable securities scaled by beginning total book assets. The independent variables are; *Highest CVC Investors*, *Average CVC Investors* and *Lowest CVC Investors*. Each year we rank *CVC(0/1)* into terciles based on investment levels. *Highest CVC Investors* represents CVC investors with the highest CVC investment amounts as a percentage of total assets. *Average CVC Investors* represents CVC investors with the average CVC investment amounts as a percentage of total assets. *Lowest CVC Investors* represents CVC investors with the lowest CVC investment amounts as a percentage of total assets.Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
VARIABLES	*BDR1*	*BDR2*	*Cash*
Highest CVC Investors	-0.108***	-0.095***	0.055**
	(0.028)	(0.024)	(0.022)
Average CVC Investors	-0.048*	-0.058**	-0.005
	(0.027)	(0.025)	(0.024)
Lowest CVC Investors	-0.024	-0.034	0.017
	(0.026)	(0.025)	(0.016)
Control Variables	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	171,493	171,493	171,633
R^2	0.014	0.016	0.183

Table 1.11: CVC Investment by Program Goal

This table breaks down CVC Investment by the espoused goal of the CVC program. We re-estimate our baseline regression in Eq(1.4) and Eq(1.5), with the addition *CVC(0/1)*Strategic* and *CVC(0/1)*Financial* as our independent variables. *CVC(0/1)*Strategic* is an interaction variable between *CVC(0/1)* and *Strategic*. *CVC(0/1)* is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. *Strategic* is an indicator variable equal to one if a firm runs a strategically driven CVC program and zero if otherwise. *Financial* is an indicator variable equal to one if a firm runs a financially driven CVC program and zero if otherwise. Our dependent variables are *BDR1*, *BDR2* and *Cash*. *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *Cash* is measured as cash and marketable securities scaled by beginning total book assets.Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
VARIABLES	*BDR1*	*BDR2*	*Cash*
*CVC(0/1)*Strategic*	-0.068**	-0.069***	0.065**
	(0.028)	(0.026)	(0.031)
*CVC(0/1)*Financial*	-0.045	-0.076*	0.027
	(0.047)	(0.039)	(0.034)
FirmSize	0.037***	0.038***	-0.024***
	(0.002)	(0.001)	(0.001)
Profitability	-0.024	0.022**	-0.165***
	(0.028)	(0.011)	(0.037)
MarketToBook	-0.002***	-0.000**	0.003***
	(0.000)	(0.000)	(0.000)
Tangibility	-0.045	-0.076*	0.027
	(0.047)	(0.039)	(0.034)
Cashflow	0.042	-0.030***	0.131***
	(0.028)	(0.011)	(0.037)
Research and Development	-0.133***	-0.049***	0.403***
	(0.030)	(0.011)	(0.032
Investments	0.062***	0.074***	-0.203***
	(0.020)	(0.012)	(0.016)
Industry Cashflow volatility	0.001	0.002	0.005***
	(0.002)	(0.002)	(0.001)
Dividend	-0.138***	-0.088***	0.000
	(0.005)	(0.004)	(0.003)
Tangibility	-0.138***	-0.088***	
	(0.015)	(0.010)	
BDR1			-0.044***
			(0.004)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	171,493	171,493	171,633
R^2	0.074	0.113	0.185

Table 1.12: Do CVC firms acquire with *Cash Deals*

This table reports the logistic regression on how *CVC Firm* pay for acquisitions as estimated in Eq (1.6). *Cash Deals* is the dependent variable and is an indicator variable equal to one if a firm's consideration offered for an acquisition includes cash and zero otherwise. *CVC Firm*, *CVCFirm*Strategic* and *CVCFirm*Financial* are the variables of interest. *CVC Firm* is an indicator variable equal to one if a firm has a CVC program and zero if otherwise. *CVCFirm*Strategic* is an interaction variable between *CVC Firm* and *Strategic*. *Strategic* is an indicator variable equal to one if a firm runs a strategically driven CVC program and zero if otherwise.*CVCFirm*Financial* is an interaction variable between *CVC Firm* and *Financial*. *Financial* is an indicator variable equal to one if a firm runs a financially driven CVC program and zero if otherwise. *Acquirer Firm Characteristics* is a matrix of control variables of the acquirer firm listed in Table 1, *Deal Characteristics* measures the *Deal Size* and *Deal Competitiveness* which are both defined in Table 1.1. Bootstrapped standard errors are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	Dependent Variable	
Variables	*Cash Deals*	*Cash Deals*
CVC Firm	0.308**	
	(0.153)	
*CVCFirm*Strategic*		0.531***
		(0.175)
*CVCFirm*Financial*		-0.410
		(0.298)
FirmSize	0.151***	0.149***
	(0.030)	(0.029)
MarketToBook	-0.062**	-0.063**
	(0.031)	(0.031)
Cash	0.807***	0.780***
	(0.186)	(0.185)
BDR1	0.449***	0.457***
	(0.164)	(0.163)
Tangibility	-0.996***	-0.975***
	(0.308)	(0.309)
Industry Cashflow volatility	-0.123	-0.123
	(0.076)	(0.076)
Research and Development	-1.248**	-1.174*
	(0.632)	(0.631)
Deal Size	-0.099	-0.099
	(0.080)	(0.080)
Deal Competitiveness	1.643***	1.643***
	(0.344)2	(0.344)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	2,416	2,416
R^2	0.207	0.179

Table 1.13: External Finance Dependence

Panel A reports the effect of CVC investment levels on capital structure and cash holdings. The regressions are estimated separately for subsamples of firms formed on the basis of industry-level measures of external finance dependence. External finance dependence is the industry-median proportion of investment not financed by cash flows from operations. The high and low subsamples are made of firms above and below the sample median respectively. Panel B reports the mean and standard deviation of our subsamples Our dependent variables are *BDR1*, *BDR2* and *Cash*. We re-estimate our baseline regression in Eq(1.4) and Eq(1.5). *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *Cash* is measured as cash and marketable securities scaled by beginning total book assets. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	Panel A					
	High Dependence			Low Dependence		
	BDR1	*BDR2*	*Cash*	*BDR1*	*BDR2*	*Cash*
CVC(0/1)	-0.051*	-0.107***	-0.011	-0.042	-0.012	0.052**
	(0.027)	(0.018)	(0.026)	(0.031)	(0.030)	(0.023)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50,457	50,457	51,559	50,471	50,471	52,135
R^2	0.066	0.112	0.213	0.065	0.106	0.134
	Panel B:Mean and standard deviation of our subsamples					
	High Dependence			Low Dependence		
	BDR1	*BDR2*	*Cash*	*BDR1*	*BDR2*	*Cash*
Mean	0.359	0.271	0.272	0.281	0.226	0.362
Standard Deviation	0.562	0.390	0.847	0.825	0.479	0.823

Table 1.14: CVC investment on capital structure and cash holdings; before and after the financial crisis

This table reports the effect of CVC investment levels on capital structure and cash holdings. The sample is split into two time periods, namely before the financial crisis period ranging from 1980 to 2006, and the period after the financial crisis period ranging from 2009 to 2018. Our dependent variables are *BDR1*, *BDR2* and *Cash*. We re-estimate our baseline regression in Eq(1.4) and Eq(1.5). *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *Cash* is measured as cash and marketable securities scaled by beginning total book assets. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	1980-2006			2009-2018		
	BDR1	*BDR2*	*Cash*	*BDR1*	*BDR2*	*Cash*
CVC(0/1)	-0.050**	-0.076***	0.036**	-0.094***	-0.065**	0.068***
	(0.023)	(0.021)	(0.017)	(0.033)	(0.030)	(0.023)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	123,428	123,428	130,288	45,561	45,561	46,975
R^2	0.054	0.091	0.178	0.087	0.117	0.199

Table 1.15: Entropy Balancing Estimation

This table examines the effect of *CVC(0/1)* on *BDR1*, *BDR2* and *Cash* from the entropy balanced sample. We match firms on the mean moments of all the control variables used in the baseline regression. Our dependent variables are *BDR1*, *BDR2* and *Cash*. *BDR1* and *BDR2* are book measures of total debt and long-term debt respectively. *Cash* is measured as cash and marketable securities scaled by beginning total book assets. *CVC(0/1)* is the variable of interest and is indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1 defines the variables. All control variables are lagged. Linearized standard errors are shown in parentheses with less than 1%, 5%, and 10% levels of statistical significance denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	*BDR1*	*BDR1*	*BDR2*	*BDR2*	*Cash*	*Cash*
CVC(0/1)	-0.035***	-0.031**	-0.025**	-0.020*	0.017**	0.012*
	(0.013)	(0.012)	(0.011)	(0.011)	-0.007	(0.006)
Constant	0.303***	0.357***	0.288***	0.339***	0.295***	0.257***
	(0.049)	(0.059)	(0.045)	(0.055)	(0.024)	(0.036)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	166,831	166,831	166,831	166,831	166,849	166,849
R-squared	0.118	0.155	0.124	0.166	0.329	0.372
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Chapter 2

Corporate Venture Capital and Dividend Payout

2.1 Introduction

Corporate venture capital (CVC), minority equity investments in entrepreneurial firms, has increased more than tenfold over the past decade as established corporations continue to invest in innovations and business models that will drive the future of their industry. More than 75 of Fortune 100 have a Corporate Venture Capital unit. CVC programs have become integral parts of innovation activities of many large corporations, such as 3M, Alphabet Inc, Adobe Systems, Chevron Corporation, BMW, Pfizer, Alibaba, Intel, Cisco, Dell, General Electric, Johnson & Johnson, Novartis, Walt Disney, BP, Shell, Microsoft, and many more. They allow corporations to explore innovative ideas externally and identify acquisition opportunities. Despite the strategic importance of CVC investments, little is known about how CVC investments affect the financial policies of CVC investing firms. Recently, finance scholars have started to explore the link between CVC and the financial policies of CVC firms. Tawiah and Keefe (2022) find that CVC investment affects the financial policies of CVC investors. Specifically, the authors find that firms that invest in CVC maintain financial flexibility by holding more cash and less debt. However, little is known about whether and how CVC investment affects firms' dividend payout decisions. This paper responds to the call to explore further implications of CVC investments for firm level outcomes by focusing on dividends.

To this end, we develop and empirically test two CVC views of dividends. The first view, called "the value creation" channel posits that CVC may positively affect firm value and earnings, which in turn affects dividend policy. Prior studies show that CVC investment leads to an increase in innovation for the parent company (Dushnitsky and Lenox (2005b), Ma (2020)). Previous studies also show that corporate innovation helps firm increase market share, improve performance, grow significantly faster and help increase market value and future earnings (Herrera (2015), Plečnik, Yang, and Zhang (2021), Roper (1997) and Bronwyn H. Hall and Trajtenberg (2005)). Dushnitsky and Lenox (2006) also show that CVC investors experience greater firm value. Hence, one can expect managers from CVC firms to have more confidence in future corporate performance, and hence, be more motivated to signal future profitability through cash dividends. The second view, called the "investment opportunity" channel, argues that CVC may create high growth opportunities, which in turn encourages firms to hold cash or invest instead of paying out cash dividends. Aside corporate innovation, another prominent reason why firms invest in CVC is to identify acquisition opportunities. Ma (2020) shows that about one-fifth of CVC investing firms acquire their portfolio companies and those acquisitions represent 20% of all acquisitions by those CVC investing firms. Benson and Ziedonis (2010) provide further empirical evidence to support the acquisition of CVC portfolio companies by CVC investing firms. This competitive acquisition and innovation strategy creates growth opportunities for CVC firms. Firms with high growth opportunities are likely to pay lower dividends since they have lower free cash flows and less flexibility in their dividend policy. These firms may also pay lower dividends to reduce their reliance on costly external financing.

The study exploits a sample of CVC units affiliated with US public listed firms from the Refinitiv database and match each CVC unit with a unique corporate parent during 1980 - 2018. The study tests the relationship between CVC firms and their dividend payouts. CVC firm is an indicator variable set to one if a firm makes CVC investment and zero otherwise. The paper controls for a battery of variables that explain dividend payout. The main results of this study support the first view. The results provide evidence that CVC firms tend to have a higher dividend payout. Several tests are conducted to investigate possible endogeneity issues. First, the results are robust to firm fixed effects and an IV-2SLS specification which controls for both firm time invariant and time varying omitted variables, respectively. Second, the results are robust to alternative measurements of CVC and dividend payout. Third, after controlling for firm characteristics using matched sample and entropy balancing estimation the results still hold.

Also, the study tests whether the findings are driven by financially or strategically oriented CVC firms. The results show that the relationship between CVC investment and dividend is driven by strategic CVC investors. There is no statistically significant relationship between CVC and dividend for financially oriented CVC firms. The paper explores two channels that influence the relationship between CVC investment and dividend payout. These channels are future profitability and earnings.

This paper contributes to two strands of literature. First, this study extends the literature on CVC investment from the perspective of the parent company. From the CVC investing firm's perspective, prior researchers have examined the drivers of CVC adoption and termination (Ma (2020); Joseph J. Cabral and Kumar (2020); Gaba and Bhattacharya (2012); and Dushnitsky and Lenox (2005a)), CVC syndicate networks (Eric Braune and Teulon (2019)), financial policies (Tawiah and Keefe (2022)), strategic and financial outcomes of CVC investments to parent companies (Ma (2020); Mohamed and Schwienbacher (2016)); (Benson and Ziedonis (2010)) and Dushnitsky and Lenox (2005b)). Second, the paper contributes to the broad literature on the determinants of firm dividend policy: agency problems, governance and monitoring (Brockman, Tresl, and Unlu (2014); De, Amedeo, and Ozkan (2015); Short, Zhang, and Keasey (2002); John, Knyazeva, and Knyazeva (2015); and La Porta, Lopez-de-Silanes, Shleifer, and Vishny (2000)), corporate social responsibility (Adrian, Hu, and Schwiebert (2018)), industry peers (Adhikari and Agrawal (2018) and Grennan (2019)), signaling effect (Miller and Modigliani (1961b) and Deeptee and Roshan (2009b)), carbon risk (Balachandran and Nguyen (2018)), and executive overconfidence/risk preference (Caliskan and Doukas (2015) and Deshmukh, Goel, and Howe (2013)). This study extends prior work by examining the effect of CVC investment on corporate managers' decisions to pay dividends. This paper is the first paper that links CVC investment to dividend payout. The study reports empirical evidence that clearly clarifies the role of CVC in dividend policy.

The remainder of the paper is as follows. Literature review is conducted in section 2.2. Hypotheses are developed in Section 2.3. Section 2.4 describes the sample, data sources and methodology. Section 2.5 tests the hypotheses and discuss the results. Robustness checks and further analysis are conducted in Section 2.5 & 2.6. Finally in Section 2.7, the main findings are summarized.

2.2 Background and Literature Review

2.2.1 Corporate Venture Capital

CVC refers to equity investments by established corporations in entrepreneurial or innovative ventures. Established corporations usually set up separate entities in place to manage their CVC programs. Typically, a CVC is made up of a triad. The CVC triad consists of a parent firm (CVC investing firm), a CVC unit and an entrepreneurial venture. The CVC unit, which is established by the corporate parent firm, interacts and maintains contact with many private-held ventures that are in search of funding. Acting as an intermediary, CVC units invest, support and monitor new entrepreneurial ventures that are likely to help meet the strategic and financial goals of the corporate parent.

Corporate Venture Capitals (CVCs) invest for both strategic and financial reasons. In financially focused CVC programs, the primary goal of CVC investment is to earn returns on investments. In strategically focused CVC programs, the goal of CVC investment is to derive strategic benefits to the parent company. CVCs contributes to startups that are developing complementary products, as such products may increase the demand for the corporate parent's own products (Dushnitsky and Lenox (2006)). Also CVCs use their investments to learn about potential targets (Sykes (1990)). Consistent with these strategic motives of investing in CVC, prior research reveal the benefits of investing in CVC. Dushnitsky and Lenox (2005b) show a positive relationship between CVC investment and firm patenting rates. Ma (2020) shows that CVCs are used by firms experiencing deteriorating internal innovation to expose themselves to new technologies and regain their innovation edge. Benson and Ziedonis (2010) also reveal that firms use CVC programs as a way to identify acquisition opportunities.

Prior literature have also examined drivers of CVC initiation and termination. These drivers include innovation performance (Dushnitsky and Lenox (2005a)), the intellectual property regime (Dushnitsky and Lenox (2005a); Sandip Basu and Koth (2011)), network (Erik Noyes and Smith-Doerr (2014)), technology-related circumstances of a firm (Ma (2020)) and job security of managers (Joseph J. Cabral and Kumar (2020)). Some emerging literature highlights the role of CVC investment on corporate financial policies such as cash holdings and capital structure (Tawiah and Keefe (2022)).

2.2.2 Dividend

This section discusses some recent studies in the dividend policy literature and important insights regarding payout behavior. Mitton (2004) examines the role of governance in dividend payment. The author finds that good governance firms pay higher dividends and in case of weak governance, Hu and Kumar (2004) find that managers are disciplined to pay more dividends. Adrian, Hu, and Schwiebert (2018) investigate whether Corporate Social Responsibility (CSR) affects firms' dividend policy. The authors find firms with higher CSR scores tend to have a higher dividend payout ratio. Rakotomavo (2012) also examines the relationship between investment in CSR and unexpected dividends and finds that CSR investments do not take away from expected dividends. Adhikari and Agrawal (2018) use a US sample for the period 1965–2010 to show that dividends are shaped in response to industry peers. Their findings reveal that the dividend payments of smaller and younger firms are influenced by industry peers' similar size and age. Consistent with this findings, Grennan (2019) finds that firms speed up the time taken to make a dividend change by about 1.5 quarters and payments increase by 16% in response to peer changes.

Lee and Mauck (2016) add to the dividend signaling literature, for US market for the period 1963–2013 and explore the nexus of dividend initiation, increase announcements and idiosyncratic risk. They find that dividend initiation and increase in payouts is associated with higher announcement abnormal returns. Prior researchers (Miller and

Modigliani (1961b) and Deeptee and Roshan (2009b)) provide support for dividend as a signalling effect.

Balachandran and Nguyen (2018) investigates the relationship between carbon risk and dividend payout. They find that the probability of paying dividend and dividend payout ratio is lower for firms in the highest-emitting industries (polluters) relative to non-polluters, subsequent to ratification of the Kyoto Protocol. Hauser (2013) investigates how the global financial crisis affected dividend policy. The author uses a life-cycle model to predict the propensity of dividend payout for US firms for the period 2006–2009. The author finds that dividend payment significantly decreased in 2008 and 2009 and dividend policy changed in response to the global financial crisis. In another study, Krieger, Mauck, and Pruitt (2021) examine the impact of COVID-19 on dividend cuts and omissions. They find that the proportion of firms that reduced their dividend payments was three to five times higher during the second quarter of 2020 than any other quarter since the beginning of their sample period in 2015.

2.3 Hypotheses Development

CVC investment affects dividend policy through two major channels. One is the "value creation" channel and the other one is the "investment opportunity" channel. The value creation channel depicts that CVC investment may affect firm value or earnings, which in turn affects dividend policy.

Survey responses show that firms pursue CVC investment for strategic reasons, with the objective of benefiting corporate innovation. Robin Siegel (1988) in a survey of 52 corporate venture programs, report that corporations rank exposure to new technologies and markets as the most important objective for investing in a corporate venture capital program. Recent studies have also shown that CVC investment leads to an increase in innovation for the parent company (Dushnitsky and Lenox (2005b), Ma (2020)). Prior researchers show that corporate innovation helps firm increase market share, improve performance, grow significantly faster and help increase market value and future earnings (Herrera (2015), Plečnik, Yang, and Zhang (2021), Roper (1997) and Bronwyn H. Hall and Trajtenberg (2005)). Plečnik, Yang, and Zhang (2021) find a positive relationship between innovation output and future earnings. Gu (2005) also finds that patent citation impact, a leading indicator of technology firms' innovation capabilities, is positively associated with future earnings. Given the positive relationship between CVC investments and innovation, one may also expect a positive relationship between CVC investments and future earnings. Prior studies show that earnings are a key determinant of dividend policy (Zhou and Ruland (2006a), Healy and Palepu (1988)). Firms with higher earnings ability are more likely to pay more in dividends. Dushnitsky and Lenox (2006) shows that firms that pursue corporate venture capital experience more value creation, compared to firms who do not. The authors show that the results are more pronounced for strategically focused CVC firms as such firms use CVC to attaining a window on technology.

Given the strategic benefits firms gain from CVC investment, CVC firms may be more motivated to signal good future performance through cash dividends. The signaling theory argues that managers pay cash dividends as a credible signal to the market for the prediction of future earnings and increase in the future cash flows. Many studies provide support for the signalling effect (Miller and Modigliani (1961a), Chemmanur, Paeglis, and Simonyan (2009), Chemmanur and Tian (2014) and Konstantinos Bozos and Ramgandhi (2011)). Miller and Modigliani (1961a) show that dividend may have a signaling effect. Deeptee and Roshan (2009a)) also provide support for dividend as a signaling effect. The authors reveal that dividend changes convey information about a firm's future profits. Using data from the London Stock Exchange (LSE) Konstantinos Bozos and Ramgandhi (2011) also lend support to the dividend signaling theory. Consistent with the value creation channel and the signaling theory, the study tests the hypothesis;

Hypothesis 1. *All else being equal, CVC firms pay higher dividends*

In contrast, the investment opportunity channel argues that CVC may create high growth opportunities, which in turn encourages firms to hold cash or invest instead of paying out cash dividends. A number of factors have been identified in previous empirical studies to influence the dividend payout ratios of firms including investment opportunities. Dividend decision is taken along investment and financing decisions. Previous studies shows that there is a direct link between dividend payout, firm growth and financing needs. Higgins (1972) shows that payout ratio is negatively related to a firm's need for funds to finance growth opportunities. CVC investments create growth opportunities for CVC investing firms. Aside corporate innovation, another prominent reason why firms invest in CVC is to identify acquisition opportunities. Ma (2020) shows that about one-fifth of CVC investing firms acquire their portfolio companies and those acquisitions represent 20% of all acquisitions by those CVC investing firms. Benson and Ziedonis (2010) provide further empirical evidence to support the acquisition of CVC portfolio companies by CVC investing firms. The authors show that one out of every five start-ups purchased by CVC investors from 1987 to 2003 were in the venture portfolio company of its acquirer. CVC investment represents a strategy to increase a firm's innovation and acquisition opportunities. Lerner (2000) p.675 find that "a dollar of venture capital appears to be about three times more potent in stimulating patenting than a dollar of traditional corporate R&D". This competitive acquisition and innovation strategy creates growth opportunities for CVC firms. Firms with high growth opportunities are likely to pay lower dividends since they have lower free cash flows and less flexibility in their dividend policy. These firms may also pay lower dividends to reduce their reliance on costly external financing. CVC firms might have to cut back on dividend payout so they can reserve more cash to fund innovation and acquisition opportunities when they become due.

Amidu and Abor (2006) show a significant negative relationship between growth opportunities and dividend payout. Motivated by this we also test the following competing hypothesis;

Hypothesis 2. *All else being equal, CVC firms pay lower dividends*

2.4 Data and Methodology

2.4.1 Data Collection

I collect a sample of corporate venture capital units affiliated with US public listed firms. I start with a list of CVC firms identified from the Refinitiv database. In the database, I predefine Corporate PE/Venture as a firm type in Eikon. I identified potentially 1037 Unique CVCs for the period 1980-2018. This initial sample served as a starting point for the subsequent data cleaning exercise. As a next step, I drop 31 CVC units described as Undisclosed Investors in the Eikon database leaving us with 1,006.

Using various sources of information such as Google, Factiva, Bloomberg, we manually match CVCs with a unique corporate parent. Accordingly, 438 firms that do not have unique corporate parents were dropped from the sample. The 438 firms that were dropped include independent and private equity investors, NGOs, and Universities. This leaves 568 CVC firms with unique parent companies. Although I limited our search to US investors, I still identify a substantial number of non-US investors from our sample construction among the 568 remaining firms. This is consistent with the findings of Röhm, Merz, and Kuckertz (2019) . For example, European based firms BMW and Dunnhumby, undertake investment vehicles in the USA and are classified as US based CVC Units in the database although their parent companies are based in Germany and the UK respectively. Hence, I remove 35 CVC units with corporate parents from the excluded geographical regions outside the US. This leaves me with 533 distinct CVC firms, out of which 262 are affiliated with unlisted parent firms. Hence, I end up with a final sample of 271 CVC units that are affiliated with US public listed parent firms which I merge with compustat.

2.4.2 Variable Construction

Dividend Measure

To measure dividend, I use an intensity measure. *Dividend* is cash dividend scaled by sales. Dividend to sales ratio can be more robust than dividend payout ratio for several reasons. R. La Porta (2000) note that because sales are less dependent on accounting conventions, they are less subject to manipulation or smoothing through accounting practices, compared to earnings.

2.4.3 Variable of Interest

Our primary independent variable of interest in this study is CVC. *CVC(0/1)* is an indicator variable equal to one if a firm makes a corporate venture capital investment and zero if otherwise.

2.4.4 Control Variables

In the regressions, we control for *FirmSize*, *Profitability*, *BDR1*, *Cash*, *MarketToBook*, *Tangibility*, *Earnings Yield*, *Research and Development* , *Investments* and *Industry Cash-flow volatility*. *Research and Development* is the ratio of Research and Development scaled by total assets. Fama and French (2001) find that US firms with higher R&D investments pay out substantially less or sometimes pay nothing compared to other firms. *Profitability* is measured as operating income before depreciation scaled by total book asset. The level of profitability is a determining factor in dividend payouts. Julian, Benavides, Berggrun, and Perafan (2016) show that dividend payout is positively linked to profitability. *MarketToBook* is measured as the ratio of total book assets less the book value of common equity plus the total market value of equity all divided by the total book assets. *Investments* is also measured as the sum of total acquisitions and capital expenditure scaled by total assets. Rozeff (1982) finds that firms with higher market-to-book value and good investment opportunities retain more funds and record lower dividend payout ratios. *Earnings Yield* is earnings before interest and tax scaled by the total market value of equity. Companies with high earnings yields may have the potential to pay higher dividends because they have strong earnings and cash flows to support dividend payments (Jitmaneeroj (2016)) *Tangibility* is calculated as the ratio of fixed assets to total assets. *FirmSize* is defined as the natural logarithm of sales. Rozeff (1982) show that large firms are more likely to pay dividends. *Industry Cashflow volatility* is measured as Standard deviation of industry average cash flows for the previous 10 years, we require at least 3 years of observations. Firms experiencing earning or cashflow volatility find it difficult to pay dividend, such firms would therefore pay less or no dividend (Amidu and Abor (2006)). *BDR1* is the ratio of short plus long-term debt to short plus long-term debt plus common shareholder's equity. Tamimi and Takhtaei (2014) reveal a positive and significant relationship between company age and dividend ratio, but a negative and significant association between financial leverage and dividend. *Firm Age* is the natural logarithm of the number of years a firm has been listed in the merged CRSP/Compustat database. *Cash* is defined as cash and marketable securities scaled by beginning total book assets. Prior studies find a significant relationship between cash and dividend payout Opler, Pinkowitz, Stulz, and Williamson (1999). We winsorize the variables at the 1% and the 99% level to restrict the impact of outliers. Detailed definitions of all variables as well as their sources are in Table (2.1).

2.5 Testing

To test H1 and H2, I estimate;

$$Dividend_{i,t} = \alpha + \beta CVC(0/1)_{i,t} + \gamma X_{i,t-1} + \delta_t + \rho_j + \epsilon_{i,t} \tag{2.1}$$

where $Dividend_{i,t}$ is a cash dividend scaled by sales. $X_{i,t-1}$ is a matrix of lagged control variables listed in Table 2.1, δ_t represents year dummies and ρ_j is a set of Fama-French 49 industry dummies to control for industry linear trends. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. I cluster standard errors by firm.

In Table (2.4), I report the base line regression of Eq (2.1). The table shows that the coefficient associated with *CVC(0/1)* in column (1) is 0.012 and is statistically significant at less than the 1% level. The result is significant not only statistically but also economically. Based on the coefficient, all else being equal, a one standard deviation increase in CVC investment increases dividend payout by 0.0009 (0.012*0.076), which amounts to a (0.0009/0.010) 9% increase in dividend payout. All in all, the baseline regression is consistent with hypotheses 1. The results support the argument that CVC investing firms usually pay higher cash dividends to signal positive prospects, given the strategic benefits of investing in CVC.

2.5.1 Firm Fixed Effects

In the main regression, the study includes year fixed effects and industry fixed effects to control for time and industry trends. However, an empirical challenge associated with estimating a relation between CVC and firm policies is possible omitted variable bias. Firm fixed effects control for any time-invariant firm-specific factors related to both CVC investment and dividend payout. This method alleviates concerns relative to time-invariant omitted variables. The results are robust to the firm fixed effects.[1].

2.5.2 Alternative Measure of CVC and Dividend

I conduct a robustness check on the measure of the independent and dependent variables. Following Dushnitsky and Lenox (2006), I redefine CVC investment as the the log[2] of total corporate venture capital invested ($M) by a firm in a year. I also redefine dividend as (1) cash dividend scaled by asset total and (2) cash dividend scaled by earnings. Column (1)

[1]In Table (2.5), the coefficient associated with *CVC(0/1)* is 0.004 when controlling for year and firm fixed effects and is statistically significant at the 5% level of significance

[2]The CVC investment variable have been log-transformed because they were highly skewed and kurtotic. This variable has the desirable trait of being continuous.

of Table (2.6) reports the effect of *LnCVCInvestment* on our baseline measure of *Dividend* while column (2) and (3) re-estimates the baseline regression with alternate measures of *Dividend*. The results are robust to the alternative measure of CVC and dividend.

2.5.3 Consideration of Share Repurchases

Prior research show that repurchase and dividend can be viewed as substitutes (Grullon and Michaely (2002); Jagannathan, Stephens, and Weisbach (2000)). Many of the theoretical arguments that address dividend policy can be attributed to share repurchase as well. These include the early signaling model of Bhattacharya ((1979). These models broadly state that dividends and share repurchases are credible signal of the firm's future prospects. Thus the signaling hypothesis, will imply that share repurchase is a credible signal of the future performance of a firm. In support of the signaling hypothesis and our baseline results, we test whether there is any association between CVC investment and share repurchases.

Therefore,following the methods of (Ye, Deng, Liu, Szewczyk, and Chen ((2019); Evgeniou and Vermaelen ((2017) and Floyd, Li, and Skinner ((2015)) this paper measures *Repurchases* as a dummy variable that equals 1 if a firm repurchases shares in year t and 0 otherwise. We substitute *Dividend* for *Repurchases*, and we report the results. In Table (2.7). The results show that there is a significant positive relationship between CVC investment and share repurchases.

2.5.4 Instrumental Variable Regression

The study further address endogeneity concerns by using the instrumental variable - three-stage least squares (IV-3SLS) approach. It is possible that time varying omitted variables explain both CVC and dividend. To address this, I use an instrumental variable that is correlated with the endogenous explanatory variable (CVC investment) but is unrelated to the error term in the baseline equation.

Following Tawiah and Keefe (2020), I use *High VC Concentration State* as the instrumental variable. The importance of location in the venture capital industry has been established in the literature (Butler and Goktan (2013). "Corporations are more likely to invest in CVC when they operate in a state with high VC activities. Innovative start-up firms choose to locate and operate in high VC concentration states. Established corporations located in such regions are likely to invest in a CVC program with the motive of tapping into the entrepreneurial ideas of the start-up firms" (Tawiah and Keefe (2020), p.7)

High VC Concentration State is the percentage of total annual CVC investment per state which is time varying. The number of CVC investment by state per year is calculated and is then divided by the total number of CVC investment per year. *High VC Concentration State* is used as an instrument because it is less probable to be correlated with dividend payout of CVC investing firms except for its effect in facilitating CVC investment. To validate this assumption, *High VC Concentration State* is included as a further control in the baseline regression and the coefficient of the non-instrumented *CVC(0/1)* is still significant. This confirms that the higher dividend payout is caused by CVC investment rather than the instrumental variable (*High VC Concentration State*).

The first stage regression is reported in Table (2.8), the coefficient on *High VC Concentration State* is positive and statistically significant at 1% level in explaining CVC. This shows that the instrumental variable is highly correlated with our endogenous variable, *CVC(0/1)*. Given that CVC is a dummy variable, its first step of the IV-3SLS approach involves a logistic regression and it's likely to generate an incorrect nonlinear first stage. To overcome this challenge, instead of plugging in nonlinear fitted values, we use the nonlinear fitted values as instruments. In unreported results, In stage 2, we use the nonlinear fitted values as instruments. The third stage results is reported in Table (2.9). The results show that coefficient associated with estimated *CVC(0/1)* is positive and statistically significant at the 1% level in explaining *Dividend*. Overall, the results of the IV-3SLS regressions provide empirical support to the prediction that cvc investment is positively related to dividend payout.

2.5.5 Matched Sample and Entropy Balancing

CVC firms might differ from non-CVC firms. Thus, one could argue that selection bias might exist in the sample and that could be driving the results. To mitigate this concern, the study considers a matched sample of non-treated firms based on the likelihood of being treated. In the first stage of the propensity score matching a logit model using covariates of all the control variables is employed. In the second stage, each treated firm is matched with the closest propensity scores based on the probabilities calculated in the first stage of the regression (logit model). Lastly, the entropy balancing model of Hainmueller and Xu (2013) is employed on the matched sample which helps to ensure comparability of the treatment and the control group. This technique assigns a weight to each observation of the control group directly so that the mean moments of the control variables of the reweighted control group are equal to the mean moments of the treated group.

As reported in Panel A of Table (2.10), the results show that, even after controlling for firm characteristics, CVC firms still pay higher dividends compared to non-CVC firms. This alleviates concern that differences in firm characteristics influence the results. In panel B, we report the mean of the control variables for the treated and non-treated group.

2.5.6 Strategic and Financially Oriented CVC Firms

The main results of this study shows a positive relationship between CVC investment and dividend payout. This supports the value creation channel of CVC investment on dividend payout. If this argument is true, one can expect that CVC investment will create greater value for strategically oriented CVC firms. Dushnitsky and Lenox (2006) show that CVC firms that adopt a strategic orientation experience greater value creation than firms that adopt a purely financial orientation. Hence, the relationship between CVC and dividend payout is expected to be pronounced among strategically oriented CVC firms as such firms will be well placed to signal good future prospects.

Following (Tawiah and Keefe (2022), Ma (2020) and Dushnitsky and Lenox (2006)), the research coded CVC programs into strategic or financially oriented by collecting information disclosed during the announcement of venturing programs. For each CVC firm in this study, extensive search is conducted to determine the program objective during the announcement of the CVC fund formation using Nexis, Google, Factiva, Bloomberg etc. Overall, 70% of these firms stated a strategic orientation for starting their program, and 30% stated a financial orientation for starting a CVC program.[3] The study espoused CVC objectives for 173 CVC firms and this data matches with Tawiah and Keefe (2022).

The analysis in Table (2.12) is similar to our baseline regression. The variables of interest are *CVC(0/1)*Strategic* and *CVC(0/1)*Financial*. *CVC(0/1)*Strategic* is an interaction variable between *CVC(0/1)* and *Strategic*. *CVC(0/1)* is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. *Strategic* is an indicator variable equal to one if a firm runs a strategically oriented CVC program and zero if otherwise. *CVC(0/1)*Financial* is an interaction variable between *CVC(0/1)* and *Financial*. *Financial* is an indicator variable equal to one if a firm runs a financially oriented CVC program and zero if otherwise. I find a positive and statistically significant relationship between *CVC(0/1)*Strategic* and *Dividend*. However, I find no statistically significant relationship between *CVC(0/1)*Financial* and *Dividend*. The results show

[3] A CVC program was coded as strategically oriented when the following or similar statements were made "Agilent Ventures .... will actively partner with Agilent to jointly develop new technologies and products" (Agilent ventures; venture capital arm of Agilent Technologies Inc) "...invests in products or services that have the potential to provide benefits to UPS, or strategically are aligned to UPS business objectives." (The UPS Strategic Enterprise Fund; venture capital arm of United Parcel Service) On the other hand, a CVC program was coded as financially oriented when the following or similar statements were made "the first priority of Oracle's venture effort is financial returns"(Oracle ventures; venture capital arm of Oracle Corp), "companies that provide the potential for outstanding financial returns"(Chevron Technology Ventures; venture capital arm of Chevron Corp)

that the relationship between CVC investment and dividend payment is driven by strategically oriented CVC firms.

2.6 Mechanism

2.6.1 CVC Investments and Excess Cash Holdings

Tawiah and Keefe (2022) find that firms that invest in CVC maintain financial flexibility by holding more cash and less debt to fund CVC-driven innovation and acquisition opportunities. Hence, one could argue that how could CVC investing firms hold cash and increase dividend payments simultaneously? Maintaining financial flexibility and increasing dividend payment could possibly be linked with excess cash holdings. One possible explanation is that CVC firms could hold excess cash in order to pursue these two competing strategies. Opler, Pinkowitz, Stulz, and Williamson (1999) show that firms that hold excess cash are able to surprisingly increase corporate investments and payouts to shareholders. Hence, in this section, the study investigates whether CVC investment leads to excess cash.

Estimation of Excess Cash

Prior studies (Opler, Pinkowitz, Stulz, and Williamson (1999), Simutin (2010)) explore the determinants of cash holdings and this study uses their approach as a guide for determining excess cash. The following model is estimated;

$$\begin{aligned} Cash_{i,t} = \alpha &+ \beta_1 FirmSize_{i,t} + \beta_2 Profitability_{i,t} + \beta_3 MarketToBook_{i,t} \\ &+ \beta_4 Cashflow_{i,t} + \beta_5 Research\ and\ Development\ _{i,t} + \beta_6 BDR1_{i,t} + \beta_7 Investments_{i,t} \\ &+ \beta_8 Industry\ Cashflow\ volatility_{i,t} + \beta_9 Div(0/1)_{i,t} + \rho_j + \epsilon_{i,t} \end{aligned} \tag{2.2}$$

Cash is defined as cash and marketable securities scaled by beginning total book assets and the independent variables are defined in Table 2.1. δ_t represents year dummies and ρ_j is a set of Fama-French 49 industry dummies. The predictions from the estimated models can be interpreted as generating an optimal level of cash holdings which can be used to define excess cash firms.

Excess cash firms are those that maintain cash greater than 1.5 standard deviations above that predicted by model for any year,

$$EC_{i,t} = ACash_{i,t} - (BCash_{i,t} + 1.5\sigma_i) \tag{2.3}$$

where $EC_{i,t}$ is excess cash for firm i in time t, $ACash_{i,t}$ is actual cash, $BCash_{i,t}$ is the baseline cash holdings estimated from Eq. (2.2) and σ is the standard deviation of the time-series of the firm's cash holdings.

Next, we examine whether CVC investment leads to excess cash holdings. To examine this relationship, we test the model below;

$$EC_{i,t} = \alpha + \beta \mathit{CVC(0/1)}_{i,t} + \gamma X_{i,t-1} + \delta_t + \epsilon_{i,t} \tag{2.4}$$

where $EC_{i,t}$ is the measure of excess cash. $X_{i,t-1}$ is a matrix of lagged control variables listed in Table 2.1, δ_t represents year dummies. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. We cluster standard errors by firm.

Table (2.13) shows that there is a statistically significant positive relationship between CVC investment and excess cash. CVC firms invest in entrepreneurial firms to explore innovation and acquisition opportunities, hence CVC firms will need to maintain financial flexibility in order to fund future innovation and acquisition opportunities when they become due. Excess cash can be used to fund these CVC driven innovation and acquisition opportunities. Simutin (2010) finds that excess cash do proxy for growth opportunities and high excess cash firms invest more in the future which is consistent with

CVC firms holding excess cash to fund future innovation and investment opportunities. Also, if CVC firms hold excess cash then this could probably explain why they are able to maintain financial flexibility and simultaneously signal good future performance through cash dividends. In support of this argument, Opler, Pinkowitz, Stulz, and Williamson (1999) show that firms that hold excess cash are able to surprisingly increase corporate investments and payouts simultaneously.

2.6.2 CVC Investments and Earnings

Dividend payout is strongly linked to current or future earnings of companies. Arnott and Asness (2003) find that future earnings growth is associated with high dividend payout. This shows that high dividend payout is a sign of strong future earnings. Conducting a company-by-company analysis of the relationship between payout and future earnings growth, Zhou and Ruland (2006b) find that high dividend paying firms experience strong future earnings growth. Given the strategic benefits of investing in CVC, future earnings is likely to increase and managers of CVC firms might signal future prospects through cash dividends.

In this section, the paper empirically study whether CVC investment leads to earnings in the future.

$$Earnings_{i,t} = \alpha + \beta\, CVC(0/1)_{i,t-k} + \gamma X_{i,t-1} + \delta_t + \epsilon_{i,t}, \tag{2.5}$$

where $Earnings_{i,t}$ is the dependent variable and is measured as earnings before interest and tax scaled by total book asset. $X_{i,t-1}$ is a matrix of lagged control variables listed in Table 2.1, δ_t represents year dummies. and ρ_j is a set of industry dummies to control for industry linear trends. $CVC(0/1)_{i,t-k}$ is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. This analysis seeks to examine the effect of a firm's CVC investment in prior years on *Earnings*.

Table (2.14) presents the result of the analysis. I find a positive and statistically significant relationship between CVC investment in prior years and *Earnings*. This shows that CVC investment leads to future earnings and it is a potential channel through which CVC affects dividend payout.

2.6.3 CVC Investments and Profitability

The level of profitability is a determining factor in dividend payouts. Julian, Benavides, Berggrun, and Perafan (2016) show that dividend payout is positively linked to profitability. Nissim and Ziv (2001) find that dividend changes provide information about the level of profitability in subsequent years. Given the strategic benefits of investing in CVC, CVC firms might be more profitable and managers of CVC firms might signal future profitability through cash dividends.

In this section, I empirically study whether CVC investment leads to profitability in the future.

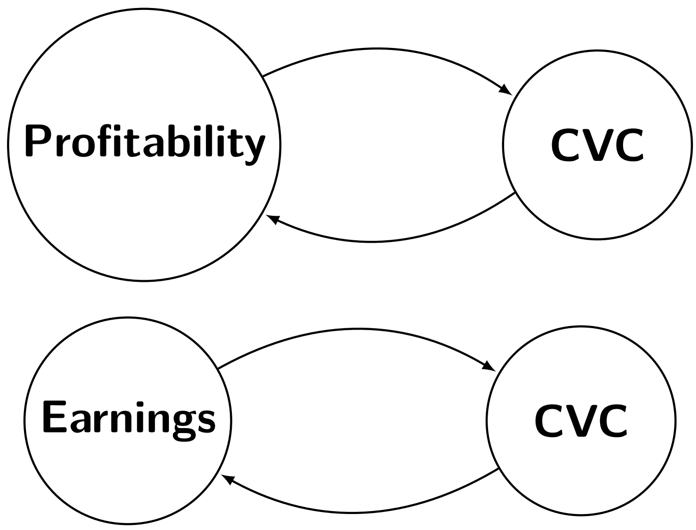
$$\mathit{Profitability}_{i,t} = \alpha + \beta \mathit{CVC(0/1)}_{i,t-k} + \gamma X_{i,t-1} + \delta_t + \epsilon_{i,t}, \tag{2.6}$$

where $Profitability_{i,t}$ is the dependent variable and is measured as operating income before depreciation scaled by total book asset. $X_{i,t-1}$ is a matrix of lagged control variables listed in Table 2.1, δ_t represents year dummies. and ρ_j is a set of industry dummies to control for industry linear trends. $\mathit{CVC(0/1)}_{i,t-k}$ is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. This analysis seeks to examine the effect of a firm's CVC investment in prior years on *Profitability*.

Table (2.15) presents the results of our analysis. I find a positive and statistically significant relationship between CVC investment in prior years and *Profitability*. This shows that CVC investment leads to future profitability and it is a channel through which CVC affects dividend payout.

2.6.4 Loop Effect

The mechanisms used in this study suggests that CVC investments leads to future profitability and earnings. However, One could argue that, profitable parent firms are likely to invest in CVC. Hence, there is the possibility of a bidirectional process and possibly a feedback loop. By collaborating with start-ups, parent firms can benefit from their fresh perspectives and approaches to problem solving, gain a competitive advantage which can further increase their profitability and their earnings. This is likely to lead to a positive feedback loop as shown in the diagram below.



To empirically study whether profitable firms or firms with high earnings invest in CVC, we estimate the equations below;

$$CVC(0/1)_{i,t} = \alpha + \beta Profitability_{i,t} + \gamma X_{i,t-1} + \delta_t + \epsilon_{i,t}, \tag{2.7}$$

$$CVC(0/1)_{i,t} = \alpha + \beta Earnings_{i,t} + \gamma X_{i,t-1} + \delta_t + \epsilon_{i,t}, \tag{2.8}$$

where $CVC(0/1)_{i,t}$ is the dependent variable in both equations, and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. $Profitability_{i,t}$ is the variable of interest in Eq. (2.7) and is measured as operating income before depreciation scaled by total book asset. $Earnings_{i,t}$ is the variable of interest in Eq. (2.8) and is measured as earnings before interest and tax scaled by total book asset. $X_{i,t-1}$ is a matrix of lagged control variables listed in Table 2.1, δ_t represents year dummies. and ρ_j is a set of industry dummies to control for industry linear trends.

Table (2.16) presents the results of our analysis. I find a positive and statistically significant relationship between *Profitability* and CVC investment. In addition, the study also finds a statistically significant relationship between *Earnings* and CVC investment. The results show that there is a potential feedback loop between profitability/earnings and CVC investment.

2.7 Conclusion

I examined how CVC investments influence dividend payout. This study empirically shows that CVC investing firms experience an increase in dividend payout. I find that CVC investment enhances future earnings and profitability and managers of CVC firms increase dividend payment to signal future performance. Also, the study tests whether the findings are driven by financially or strategically oriented CVC firms. The results show that the relationship between CVC investment and dividend is driven by strategic CVC investors. There is no statistically significant relationship between CVC and dividend for financially oriented CVC firms. This findings contribute to the existing literature that explores the determinants of dividend payout. Also the study extends the literature on CVC investment. CVC firms can draw upon this findings in their decision-making process as they consider financial policy concerning dividend payout.

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Table 2.1: Variable definitions

This table provides the definition of the key variables used. Accounting data are from Compustat and CVC Investment data is from Refinitiv database

Variable	Definition
Dividend	Cash Dividend scaled by sales
CVC(0/1)	*CVC(0/1)* is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise.
BDR1	The ratio of short plus long-term debt to short plus long-term debt plus common shareholder's equity
Cash	Cash and marketable securities scaled by beginning total book assets
FirmSize	Natural logarithm of total sales
Research and Development	Research and Development Expenditure scaled by beginning total book assets
Profitability	Operating income before depreciation scaled by total book asset
MarketToBook	Ratio of total book assets less the book value of common equity plus the total market value of equity all divided by the total book assets
Earnings Yield	Ratio of earnings before interest and taxes scaled by market value of equity
Tangibility	The assets tangibility of a firm is the ratio of net property, plant and equipment scaled by beginning total book assets
Investments	Sum of total acquisitions and capital expenditures scaled by beginning total book assets
Capital Expenditure	Capital expenditure scaled by beginning total book assets
Industry Cashflow volatility	Standard deviation of industry average cash flows for the previous 10 years, we require at least 3 years of observations
High VC Concentration State	The number of CVC investment by state per year divided by the total number of CVC investment
LnCVCInvestment	The log of total corporate venture capital invested ($M) by a firm in a year.
Earnings	Ratio of earnings before interest and taxes scaled by beginning total book assets
Firm Age	Natural logarithm of the number of years a firm has been listed in the merged CRSP/Compustat database

Table 2.2: Summary Statistics

This table presents summary statistics of the main variables used in this study from 1980 to 2018. All the variables are winsorized at 1% level in both tails of the distribution before the summary statistics are calculated. The table reports the number of observations, mean, 25th percentile, median, 75th percentile and standard deviation. Variable generations are provided in the in Table (2.1)

Variable	Observation	mean	p25	p50	p75	sd
Dividend	180,284	0.010	0	0	0.004	0.075
CVC(0/1)	180,284	0.006	0	0	0	0.076
LnCVCInvestment	180,284	0.037	0	0	0	0.501
FirmSize	180,284	4.687	3.039	4.614	6.304	2.419
Profitability	180,284	-0.127	-0.060	0.054	0.114	1.054
MarketToBook	180,284	3.046	1.062	1.457	2.355	12.979
Tangibility	180,284	0.286	0.091	0.216	0.419	0.242
Research and Development	180,284	0.120	0	0	0.061	0.391
Earnings	180,284	-0.257	-0.105	0.045	0.111	1.594
Industry Cashflow volatility	180,284	1.156	0.151	0.371	1.814	1.500
Investments	180,284	0.086	0.022	0.053	0.110	0.101
Earnings Yield	180,284	-0.074	-0.080	0.048	0.122	0.665
Firm Age	180,284	1.849	1.098	1.945	2.639	0.976

Table 2.3: Correlations: This table presents the pairwise correlation coefficients between variables in Essay 2.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
CVC(0/1)	1.000												
Div(0/1)	0.044	1.000											
Dividend	0.046	0.829	1.000										
LnCVCInvestment	0.968	0.045	0.050	1.000									
FirmSize	0.142	0.223	0.216	0.143	1.000								
Cashflow	0.017	0.095	0.070	0.016	0.347	1.000							
BDR1	0.002	-0.020	-0.006	0.002	0.133	0.133	0.160	1.000					
Cash	-0.007	-0.009	0.001	-0.007	-0.047	-0.299	0.084	1.000					
MarketToBook	-0.003	-0.026	-0.022	-0.002	-0.225	-0.667	-0.139	0.264	1.000				
Research and Development	-0.005	-0.097	-0.074	-0.004	-0.169	-0.257	-0.087	-0.154	0.117	1.000			
Investments	-0.007	-0.014	0.010	-0.007	0.082	0.028	0.048	0.116	-0.024	-0.107	1.000		
Tangibility	-0.020	0.062	0.098	-0.021	0.149	0.059	0.124	0.173	-0.063	-0.193	0.427	1.000	
Industry Cashflow volatility	0.017	0.038	0.075	0.019	0.148	-0.088	-0.036	0.004	0.064	0.159	-0.084	-0.091	1.000

Table 2.4: CVC Investment and Dividend Payout

This table reports estimation results of Equation (2.1) which estimates the baseline regression of the effect of CVC Investment on dividend payout. *Dividend* is the dependent variable. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 2.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)
VARIABLES	*Dividend*
CVC(0/1)	0.012***
	(0.004)
FirmSize	0.002***
	(0.000)
Profitability	0.002***
	(0.000)
BDR1	-0.003***
	(0.000)
Cash	-0.001***
	(0.000)
MarketToBook	0.000***
	(0.000)
Research and Development	0.000
	(0.000)
Investments	-0.015**
	(0.001)
Tangibility	0.007***
	(0.002)
Industry Cashflow volatility	-0.000
	(0.000)
Earnings Yield	0.002***
	(0.000)
Firm Age	0.000
	(0.000)
Constant	0.012**
	(0.005)
Year Fixed Effects	Yes
Industry Fixed Effects	Yes
Observations	154,248
R-squared	0.091

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.5: CVC Investment and Dividend Payout - Firm Fixed Effects

This table reports estimation results of Equation (2.1) which estimates the baseline regression of the effect of CVC Investment on dividend payout while controlling for firm fixed effects. *Dividend* is the dependent variable, which is cash dividend scaled by sales. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 2.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)
VARIABLES	*Dividend*
CVC(0/1)	0.004***
	(0.002)
FirmSize	0.001***
	(0.000)
Profitability	0.001***
	(0.000)
BDR1	-0.001***
	(0.000)
Cash	-0.000***
	(0.000)
MarketToBook	0.000***
	(0.000)
Research and Development	0.002***
	(0.000)
Investments	-0.002**
	(0.000)
Tangibility	-0.011***
	(0.001)
Industry Cashflow volatility	-0.000
	(0.000)
Earnings Yield	0.000**
	(0.000)
Firm Age	-0.000
	(0.000)
Constant	0.011***
	(0.001)
Year Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	154,248
R-squared	0.564

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.6: CVC Investment and Dividend Payout - Alternative Measures

This table reports estimation results of Equation (2.1) which estimates the baseline regression of the effect of CVC investment on dividend payout while using alternative measures of CVC and dividend. The independent variable are *CVC(0/1)* and *LnCVCInvestment*. *LnCVCInvestment* is the log of total corporate venture capital invested ($M) by a firm in a year. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. In column (1) the dependent variable is *Dividend* which is cash dividend scaled by sales, in column (2) dividend is measured as cash dividend scaled by asset total and in column (3), dividend is measured as cash dividend scaled by earnings. Table 2.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
VARIABLES	*Dividend*	*Dividend/Asset Total*	*Dividend/Earnings*
LnCVCInvestment	0.002***		
	(0.001)		
CVC(0/1)		0.006**	0.021**
		(0.003)	(0.010)
FirmSize	0.002***	0.002***	0.130***
	(0.000)	(0.000)	(0.000)
Profitability	0.002***	0.001***	0.002***
	(0.000)	(0.000)	(0.001)
BDR1	-0.003***	-0.003***	-0.017***
	(0.000)	(0.000)	(0.001)
Cash	-0.001***	-0.001***	-0.003***
	(0.000)	(0.000)	(0.000)
MarketToBook	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Research and Development	0.000	0.001*	0.004**
	(0.000)	(0.000)	(0.002)
Investments	-0.015**	-0.011***	-0.094**
	(0.001)	(0.001)	(0.006)
Tangibility	0.007***	0.003***	0.020***
	(0.002)	(0.001)	(0.006)
Industry Cashflow volatility	-0.000	-0.000**	-0.002***
	(0.000)	(0.000)	(0.001)
Earnings Yield	0.002***	0.001**	0.008***
	(0.000)	(0.000)	(0.001)
Firm Age	0.000	0.001***	0.008***
	(0.000)	(0.000)	(0.001)
Constant	0.010**	0.009***	0.064***
	(0.004)	(0.004)	(0.020)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	154,248	154,248	154,248
R-squared	0.091	0.104	0.100
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 2.7: CVC Investment and Share Repurchases

This table reports estimation results of the effect of CVC Investment on share repurchases. *Repurchases* is the dependent variable and is a dummy variable that equals 1 if a firm repurchases shares in year t and 0 otherwise. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)
VARIABLES	*Repurchases*
CVC(0/1)	0.061***
	(0.022)
FirmSize	-0.006*
	(0.003)
Profitability	0.019
	(0.021)
BDR1	0.005
	(0.004)
Cash	-0.001
	(0.055)
MarketToBook	0.000
	(0.000)
Research and Development	0.005
	(0.008)
Investments	0.025
	(0.068)
Tangibility	0.090
	(0.084)
Industry Cashflow volatility	-0.017
	(0.021)
Earnings Yield	-0.002
	(0.002)
Firm Age	-0.174
	(0.390)
Constant	1.000***
	(0.000)
Year Fixed Effects	Yes
Industry Fixed Effects	Yes
Observations	83,135
R-squared	0.090
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 2.8: First stage of 3SLS regression

This table reports the estimation results of the first stage regression using a logistic regression. Our instrumental variable is *High VC Concentration State*. To measure *High VC Concentration State*, the study estimates the number of CVC investment by state per year and is divided by the total number of CVC investment. Table 2.1 defines the variables. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

VARIABLES	*CVC(0/1)*
High VC Concentration State	5.187***
	(0.307)
FirmSize	1.007***
	(0.021)
MarketToBook	0.024***
	(0.003)
Research and Development	2.796***
	(0.135)
Tangibility	-2.407***
	(0.192)
Investments	1.484***
	(0.469)
Industry Cashflow volatility	-0.155***
	(0.025)
Earnings Yield	-0.286***
	(0.068)
Year Fixed Effects	Yes
Industry Fixed Effects	Yes
Observations	155,554
Pseudo R-squared	0.345
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 2.9: Third stage of 3SLS regressions

This table reports the estimation results of the second stage of the 3SLS regression. The study re-estimates the baseline regressions of *CVC(0/1)* on *Dividend*. *High VC Concentration State* is the instrumental variable. To measure *High VC Concentration State*, the number of CVC investment by state per year is calculated and is then divided by the total number of CVC investment. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 2.1 defines the variables. All control variables are lagged. Bootstrapped standard errors are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	Dependent Variables
Independent Variables	*Dividend*
$\widehat{CVC(0/1)}$	0.042***
	(0.012)
Control Variables	Yes
Year Fixed Effects	Yes
Industry Fixed Effects	Yes
Observations	154,224
R-squared	0.083
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 2.10: Panel A: Matched Sample and Entropy Balancing

This table examines the effect of *CVC(0/1)* on *Dividend* from the matched and entropy balanced sample. First, the study finds the nearest neighbor match for the CVC (treated) firms. Then the treated and control firms are matched on the mean moments of all the control variables used in the baseline regression. The dependent variable is *Dividend*, which is cash dividend scaled by sales. *CVC(0/1)* is the variable of interest and is indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 2.1 defines the variables. All control variables are lagged. Linearized standard errors are shown in parentheses with less than 1%, 5%, and 10% levels of statistical significance denoted by ***, **, and *, respectively.

Variables	Dividend
CVC(0/1)	0.004***
	(0.001)
FirmSize	0.004***
	(0.001)
Profitability	0.059***
	(0.016)
BDR1	0.002
	(0.002)
Cash	0.001***
	(0.001)
MarketToBook	0.001**
	(0.000)
Research and Development	0.021***
	(0.005)
Investments	-0.023**
	(0.009)
Tangibility	0.024***
	(0.003)
Industry Cashflow volatility	0.008***
	(0.001)
Earnings Yield	-0.003
	(0.002)
Firm Age	0.000
	(0.000)
Year Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	8679
R-squared	0.223
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 2.11: Panel B

	Panel B:Mean of our treated and control groups; pre-matching and post-matching			
	Pre-Matching		Post-Matching	
	Treated Group	Control Group	Treated Group	Control Group
FirmSize	8.761	4.438	8.761	8.759
BDR1	0.337	0.314	0.337	0.337
Cash	-0.025	0.065	-0.025	-0.025
MarketToBook	2.582	3.056	2.582	2.582
Investments	0.078	0.086	0.078	0.078
Research and Development	0.094	0.120	0.094	0.094
Industry Cashflow volatility	1.393	1.030	1.393	1.393
Tangibility	0.227	0.286	0.227	0.227
Earnings Yield	0.062	-0.056	0.062	0.062
Cashflow	0.101	-0.128	0.101	0.101

Table 2.12: Strategic and Financially Oriented CVC Firms

This table breaks down CVC Investment by the espoused goal of the CVC program. The study re-estimates the baseline regression in Eq(4) and Eq(5), with the addition *CVC(0/1)*Strategic* and *CVC(0/1)*Financial* as our independent variables. *CVC(0/1)*Strategic* is an interaction variable between *CVC(0/1)* and *Strategic*. *CVC(0/1)* is an indicator variable equal to one if a firm makes a cvc investment and zero if otherwise. *Strategic* is an indicator variable equal to one if a firm runs a strategically oriented CVC program and zero if otherwise. *Financial* is an indicator variable equal to one if a firm runs a financially oriented CVC program and zero if otherwise. The dependent variable is *Dividend*, which is cash dividend scaled by sales. Table 2.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

VARIABLES	*Dividend*
*CVC(0/1)*Strategic*	0.012**
	(0.005)
*CVC(0/1)*Financial*	0.014
	(0.012)
FirmSize	0.002***
	(0.000)
Profitability	0.001***
	(0.000)
BDR1	-0.002***
	(0.000)
Cash	-0.001***
	(0.000)
MarketToBook	0.000***
	(0.000)
Research and Development	0.002***
	(0.001)
Investments	-0.016***
	(0.002)
Tangibility	0.008***
	(0.002)
Industry Cashflow volatility	-0.000
	(0.000)
Earnings Yield	0.002***
	(0.000)
Firm Age	0.000
	(0.000)
Constant	0.012**
	(0.005)
Year Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	154,248
R-squared	0.022
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 2.13: CVC Investment and Excess Cash

This table reports estimation results of Equation (2.4) which estimates the baseline regression of the effect of CVC Investment on excess cash. *Excess Cash* is the dependent variable, which is measured as excess cash estimated in equation (2.3). *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)
VARIABLES	*Excess Cash*
CVC(0/1)	0.026**
	(0.011)
FirmSize	-0.089***
	(0.003)
Profitability	0.002***
	(0.000)
BDR1	0.033***
	(0.004)
MarketToBook	0.002***
	(0.000)
Research and Development	-0.182***
	(0.035)
Investments	0.111***
	(0.015)
Cashflow	-0.033
	(0.028)
Industry Cashflow volatility	-0.004***
	(0.001)
Earnings Yield	0.103***
	(0.023)
Div(0/1)	0.038***
	(0.003)
Constant	-0.229***
	(0.012)
Year Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	154,248
R-squared	0.100
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 2.14: CVC Investment and Future Earnings

This table reports estimation results of Eq. (2.5), which estimates the effect of CVC Investment on future earnings. The dependent variable is earnings. This table examines how prior years *CVC(0/1)* affects *Earnings*. *Earnings* is the dependent variable and it is measured as earnings before interest and tax scaled by total book asset. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 2.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

VARIABLES	*Earnings*
CVC(0/1) $_{t-3}$	0.003**
	(0.002)
CVC(0/1) $_{t-4}$	0.003**
	(0.001)
CVC(0/1) $_{t-5}$	0.003**
	(0.001)
FirmSize	-0.003***
	(0.001)
Profitability	1.059***
	(0.007)
MarketToBook	-0.003***
	(0.001)
BDR1	0.001
	(0.003)
Cash	-0.001***
	(0.000)
Industry Cashflow volatility	0.000
	(0.000)
Firm Age	-0.002
	(0.001)
Constant	-0.031**
	(0.007)
Year Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	118,139
R-squared	0.988

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.15: CVC Investment and Future Profitability

This table reports estimation results of Eq. (2.6), which estimates the effect of CVC Investment on future profitability. The dependent variable is profitability. We find out how prior years *CVC(0/1)* affects profitability. *Profitability* is measured as operating income before depreciation scaled by total book asset. *CVC(0/1)* is the variable of interest and is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 2.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

VARIABLES	*Profitability*
CVC(0/1) $_{t-3}$	0.005***
	(0.001)
CVC(0/1) $_{t-4}$	0.002**
	(0.001)
CVC(0/1) $_{t-5}$	0.003***
	(0.001)
FirmSize	-0.002***
	(0.000)
Earnings	0.980***
	(0.003)
MarketToBook	-0.001***
	(0.000)
BDR1	0.002*
	(0.001)
Cash	0.004***
	(0.001)
Industry Cashflow volatility	0.000
	(0.000)
Firm Age	-0.005
	(0.001)
Constant	0.046***
	(0.004)
Year Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	118,139
R-squared	0.995
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 2.16: Loop Effect

This table reports estimation results of Equation (2.7) and (2.8) , which estimates the effect of *Profitability* on *CVC(0/1)* and the effect of *Earnings* on *CVC(0/1)* respectively. We find out whether profitability and earnings leads to CVC investment. *Profitability* is measured as operating income before depreciation scaled by total book asset. The dependent variable is *CVC(0/1)* which is an indicator variable equal to one if a firm makes cvc investment and zero if otherwise. Table 2.1 defines the variables. All control variables are lagged. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

VARIABLES	*CVC(0/1)*	*CVC(0/1)*
Profitability	3.765***	
	(1.082)	
Earnings		3.281***
		(1.096)
FirmSize	1.088***	1.088***
	(0.067)	(0.067)
BDR1	-0.218	-0.255
	(0.262)	(0.267)
Cash	-0.143***	-0.134***
	(0.039)	(0.038)
BDR1	0.002*	0.002*
	(0.001)	(0.001)
Research and Development	1.156***	1.070***
	(0.280)	(0.277)
Investments	-0.796	-0.688
	(0.632)	(0.623)
Tangibility	-1.403**	-1.052*
	(0.641)	(0.631)
Industry Cashflow volatility	0.031	0.034
	(0.056)	(0.056)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	118,139	118,139
R-squared	0.995	0.995
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Chapter 3

Cash Holdings and Corporate Investment ; Evidence from COVID-19

3.1 Introduction

The COVID-19 pandemic represents an exogenous shock to economic activities. The shock was sudden and disrupted many business operations leading to plummeting revenues and cashflows. US Bureau of Economic Analysis reports that corporate profits in the United States dropped 11.8% to USD 1,569.2 billion in the second half of 2020, the sharpest decline in corporate profits since the last quarter of 2008, amid the coronavirus crisis. In an unexpected crisis like this, firms cut back funds allocated for corporate investment as they focus on increasing their precautionary savings. Forbes reveals that mergers and acquisitions (M&A) levels in the United States declined more than 50% in the first quarter of 2020 to $253 billion compared to the first quarter of 2019 (Forbes (2020)).

In this study, we empirically examine the effects of cash holdings on corporate investment prior to and during the COVID-19 pandemic. Our sample consists of quarterly data on publicly traded US firms available on Compustat from January 2018 to June 2020. Firms hold cash for various reasons. The idea of precautionary cash holdings is that firms hold cash to insure against unanticipated cash flow shocks. COVID-19 represents an exogenous shock, which is unexpected event not caused by the firm, and represents the type of shock firms attempt to insure against by holding cash. The COVID-19 pandemic has adversely impacted production, supply chains, and revenue streams.

Barry, Campello, Graham, and Ma (2021a) survey CFOs to gather companies' internal plans, in response to COVID-19. The authors reveal that on average CFOs expected a 10% negative impact on their revenue growth. Although COVID-19 is not a financial crisis, the adverse effect on operating income could affect operations of firms and lead to financial distress. Barry, Campello, Graham, and Ma (2021a) report that firms with high financial flexibility[1] had higher projections of capital expenditure growth during

[1] Financial flexibility measure captures CFOs' (survey-based) assessments, reflecting both the availability of internal funds and access to external financing

the pandemic while firms with less financial flexibility expected a reduction in capital expenditure growth.

Despite the negative impact of COVID-19, firms with accumulated cash are better positioned to maintain investment or acquisition programs during the pandemic. Prior researchers show that borrowing capacity depends on a firm's operational cash flows (Tirolea (1997). Lian and Ma (2018) reveals that 80% of US non-financial firms' corporate debt is based on the going-concern value of cash flows from firm's operations. The authors find that a standard borrowing constraint restricts total debt as a function of cash flows measured using operating earnings. The authors further reveal that creditors focus on EBITDA (earnings before interest, taxes, depreciation and amortization) as a key metric in issuing debt. Hence, the demand shock of COVID-19 is likely to reduce operating earnings which restricts a firm's ability to take on debt to finance investment. However, firms with accumulated cash holdings can forego debt financing and continue investing.

In addition, firms with accumulated cash do not need to increase their cash for precautionary reasons and such firms do not also need to cut back on their non-cash assets or investments as compared to firms with less cash. Hence, we expect firms with more cash to keep investing during the ongoing pandemic. However, firms with less cash during this ongoing COVID-19 crisis might forgo profitable investment opportunities and cut back on their investments. Though COVID-19 is not a financial crisis, the unanticipated disruption in business activities could put pressure on operating earnings leaving many firms with increased borrowing constraints thereby restricting their ability to borrow to finance investment programs.

The COVID-19 pandemic serves as an exogenous shock which helps in understanding the importance of cash holdings on corporate investments. We investigate two measures of corporate investment; namely *Capital Expenditure* and *Acquisition*. In our test, the variable of interest is the interaction between *Cash* and *Covid(0/1)*. We find that Capital Expenditure and M&A levels decrease by 37% and 71% respectively during the COVID-19 pandemic. However, the impact of COVID-19 on investment is less for firms with accumulated cash. Specifically, firms at the 81st percentile of cash holdings maintain capital expenditure and acquisition at pre-COVID-19 levels. Our results also show that the number of COVID-19 state reported cases and COVID-19 related deaths are negatively related to corporate investments. However, we still find that cash holdings reduces the impact of COVID-19 on corporate investment. In addition, we find that, COVID-19 leads to an increase in external finance; measured by Debt and Equity Issuance, however, we find that cash-rich firms reduce their use of external finance. This suggests that investment activities of cash-rich firms are not necessarily influenced by external financing during the COVID-19 pandemic. The study also shows that the policy intervention, the Coronavirus Aid, Relief, and Economic Security (CARES) Act did not matter for our findings in the short-term and cash continues to overcome the impact of COVID-19 on corporate investment. We acknowledge that there may exist fundamental differences among industries. Hence as a robustness test we first re-estimate our baseline regression for different industries. The study also examines the impact of COVID-19 on corporate investment among financially constrained firms and firms with low and high growth/investment opportunities. Overall, our evidence shows that the COVID-19 pandemic has had an adverse effect on corporate investment activities, but accumulated cash holdings reduces the impact.

Our paper contributes to several strands of literature. First, we add to the literature on the value of financial flexibility. Prior studies have examined the value of financial flexibility in explaining firm policies such as capital structure, corporate payout policies, investments and firm value (Gamba and Triantis (2008), Denis (2011), and Byoun (2011). Our paper provides evidence on the value of financial flexibility through cash holdings in explaining corporate investment during a crisis period.

Second, we add to the literature that explores the consequences of holding excess cash. Previous literature (Pinkowitz, Stulz, and Williamson (2006), Dittmar and Mahrt-Smith (2007)) have investigated the downside of excess cash holdings. Such papers argue that excessive cash holdings could give room for managerial abuse due to agency problems.

However, our results indicate that during a negative shock like COVID-19, financial flexibility through cash holdings become valuable and our results provide support for the precautionary motive of holding cash.

Third, we add to the young and burgeoning literature on COVID-19 and firms. Most of the recent works have examined the stock market reaction of firms to the ongoing COVID-19 pandemic and stock returns have been linked with the environmental and social ratings of firms, operational flexibility and pre-COVID-19 balance sheet strength (Fahlenbrach, Rageth, and Stulz (2020) and Albuquerque, Koskinen, Yang, and Zhang (2020)). Few papers have examined the impact of COVID-19 on firm decisions. For example, Francis, Garcia, and Sharma (2020) examines the impact of COVID-19 on corporate borrowing. Other studies have examined the impact of COVID-19 on firm performance (Shen, Fu, Pan, Yu, and Chen (2020) and Hu and Zhang (2021)). To the best of our knowledge, we are the first to study the effect of financial flexibility on corporate investment amidst the ongoing COVID-19 pandemic. More recently other studies have also examined the impact of financial flexibility on corporate investment (Zheng (2021) and Barry, Campello, Graham, and Ma (2021b)).

Fourth, our paper contributes to the literature that links a crisis to finance. Prior literature links the great financial crisis (GFC) to corporate behavior and policies such as corporate debt maturity, corporate spending, corporate investment(Almeida, Campello, Laranjeira, and Weisbenner (2009),Campello, Graham, and Harvey (2010), Duchin, Ozbas, and Sensoy (2010),Özgür Arslan-Ayaydin, Florackis, and Ozkan (2014)). Most of these papers have examined the role of financial flexibility in mitigating or aggravating the impact of the GFC on corporate investment and policies. However, the human and economic cost of the ongoing COVID-19 pandemic is unprecedented, at least since the 1918 influenza pandemic. The US government is spending twice as much to lessen the impact of the COVID-19 pandemic as they spent in stimulus packages following the GFC (Uren, 2020). Hence, examining how financial flexibility affects corporate investment during the COVID-19 pandemic demonstrate the value of financial flexibility during this unprecedented time. Our results are consistent with Özgür Arslan-Ayaydin, Florackis, and Ozkan (2014) who show firms with financial flexibility invest more during the financial crisis.

The remainder of the paper is as follows. In section 3.2 we formulate our hypothesis. In section 3.3 describes data and variable construction. Section 3.4 describes our methodology and tests the relationship between financial flexibility and corporate investment. In section 3.5, we discuss the results. In section 3.6, we discuss robustness tests. Finally in section 3.7, we conclude and summarize our main findings.

3.2 Literature Review and Hypothesis Development

Private firms entered the COVID-19 crisis with high levels of debt which might restrict their ability to take on more debt. The Institute for International Finance (2020) estimates that non-financial corporate debt outstanding was US$75 trillion as at September 2019. "Non-financial corporations in emerging markets alone will need to pay back or refinance more than US$700 billion during 2020, which does not include the new financing needs that arise as a result of the COVID-19 crisis" (Didier, Huneeus, Larrain, and Schmukler (2021), pg.7). Hence, financial flexibility through corporate cash holdings allows firms to minimize the amount of debt they take to finance their operations and fund investment opportunities.

Prior literature highlights the value of financial flexibility and how financial flexibility explains corporate investment during crisis. We group the literature on financial flexibility, corporate investment and crisis/pandemics into several strands. The first strand of literature examines the value of financial flexibility. Denis and Sibilkov (2010) find that firms with higher cash holdings tend to invest at a higher rate. The authors also show that higher cash holdings are associated with greater investment for constrained firms and that investment is more positively associated with value in constrained compared to unconstrained firms. Faulkender and Wang (2006) show that the value of cash is higher in high-growth firms. Gamba and Triantis (2008) examine the impact of financial flexibility on firm value. They find that firms with high levels of financial flexibility should be valued at a premium compared to firms with less financial flexibility. Pinkowitz, Stulz, and Williamson (2006) report that a one-dollar increase in cash holdings is associated with an increase in firm value of \$0.33 in countries with high corruption and an increase of \$0.91 in countries with low corruption.

Denis (2011) also reveal that firms with poor corporate governance dissipate cash quickly in ways that significantly reduce operating performance. This negative impact of large cash holdings on future operating performance is cancelled out if the firm is well governed. Another strand of literature examines how crises affects corporate policies and the importance of financial flexibility during the 2007-2008 financial crises. Using the financial crisis to assess the effect of financial contracting on real corporate policies, Almeida, Campello, Laranjeira, and Weisbenner (2009) find that firms whose long-term debt was largely maturing right after the third quarter of 2007 reduced their investment in capital expenditure compared to similar firms with debt maturity due well after the crisis.

Campello, Graham, and Harvey (2010) surveyed 1,050 Chief Financial Officers (CFOs) in the U.S., Europe, and Asia to directly assess their corporate spending plans based on their firms credit constraints during the financial crises. They reveal that constrained firms planned deeper cuts in spending, employment, and capital spending. They further reveal that the inability to borrow externally caused many firms to bypass attractive investment opportunities, with 86% of constrained U.S. CFOs saying their investment in attractive projects was restricted during the credit crisis of 2007-2008. Using the financial crisis as an exogenous shock to the supply of external finance for non-financial firm, Duchin, Ozbas, and Sensoy (2010) study the effect of the financial crisis on corporate investment. They find that corporate investment declines significantly following the onset of the crisis, with firms with low cash or firms that operate in industries dependent on external finance experiencing the greatest decline in corporate investment. In a related study, Özgür Arslan-Ayaydin, Florackis, and Ozkan (2014) study the impact of financial flexibility on the investment and performance of East Asian firms during the Asian crisis and 2007 financial crisis. The authors find that firms that are financially flexible prior to crisis have a greater ability to take investment opportunities and perform better during crisis compared to firms with less financial flexibility. Most of these papers have examined the role of financial flexibility in mitigating or aggravating the impact of the GFC on corporate investment and policies. However, the human and economic cost of the ongoing COVID-19 pandemic is unprecedented, at least since the 1918 influenza pandemic. The US government is spending twice as much to lessen the impact of the COVID-19 pandemic as they spent in stimulus packages following the GFC, Uren (2020). Hence, examining how financial flexibility affects corporate investment during the COVID-19 pandemic is very important in understanding the value of financial flexibility during this unprecedented time.

Despite the negative impact of COVID-19, firms with accumulated cash are better positioned to maintain investment or acquisition programs during the pandemic. Prior researchers show that borrowing capacity depends on a firm's operational cash flows (Tirolea (1997). Lian and Ma (2018) reveals that 80% of US non-financial firms' corporate debt is based on the going-concern value of cash flows from firm's operations. The authors find that a standard borrowing constraint restricts total debt as a function of cash flows measured using operating earnings. The authors further reveal that creditors focus on EBITDA (earnings before interest, taxes, depreciation and amortization) as a key metric in issuing debt. Hence, the demand shock of COVID-19 is likely to reduce operating earnings which restricts a firm's ability to take on debt to finance investment. However, firms with accumulated cash holdings can forego debt financing and continue investing.

In addition, firms with accumulated cash do not need to increase their cash for precautionary reasons and such firms do not also need to cut back on their non-cash assets or investments as compared to firms with less cash. Hence, we expect firms with more cash to keep investing during the ongoing pandemic. However, firms with less cash during this ongoing COVID-19 crisis might forgo profitable investment opportunities and cut back on their investments. Though COVID-19 is not a financial crisis, the unanticipated disruption in business activities could put pressure on operating earnings leaving many firms with increased borrowing constraints thereby restricting their ability to borrow to finance investment programs.

Hence we test the two hypotheses;

Hypothesis 1. *COVID-19 leads to a decline in corporate investment.*

Hypothesis 2. *Cash holdings moderate the impact of COVID-19 on corporate investment.*

3.3 Data and Variable Construction

We construct our sample using the Compustat fundamental quarterly database to obtain the firm–quarterly-level US data and other accounting variables from January 2018 to June 2020. Following Opler, Pinkowitz, Stulz, and Williamson (1999), we exclude firms in the financial, insurance and utility industry. Firms have different fiscal year start and end dates. To harmonize the data set, we use calendar quarters. The calendar quarters are as follows Quarter one: January - March, Quarter two: April - June, Quarter three: July - September and Quarter four: October - December. For a firm to be classified under any of the calendar quarters, it must have accounting data for at least two calendar months that falls within our calendar quarters. For example, a firm that has a fiscal year end in January will have its first fiscal quarter from February-April but will be classified as Quarter 1 under our calendar quarters as it has at least two calendar months in January-March.

3.3.1 Dependent Variables

Capital Expenditure is measured as the sum of capital expenditure expressed as a percentage of total assets over a quarter. *Acquisition* is measured as the sum of total acquisition expenditure expressed as a percentage of total assets over a quarter.

3.3.2 Explanatory Variables of Interest

Variable of Interest

The variables of interest are *Covid(0/1)* and the interaction between *Cash* and *Covid(0/1)*. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. Following Tawiah and Keefe (2022), we define *Cash* as cash and marketable securities scaled by total assets. In our test, we lag *Cash* by one quarter in order to examine how cash at the beginning of the quarter affects corporate investment.[2]

Other Variables

In our regressions, we control for *FirmSize*, *EBITDA*, *MarketToBook*, *BDR1*, *Tangibility*, *Investments*, *Research and Development* and *Dividend*. *FirmSize* is the natural logarithm of total assets. Gala and Julio (2016) provide evidence of the impact of firm size on corporate investments. The authors also find that *MarketToBook* (Tobin's Q) and earnings are both economically and statistically significant in explaining variation in corporate investments. Hence we control for *EBITDA* and *MarketToBook*. *EBITDA* is the ratio of the firm's operating income before depreciation to total assets. *MarketToBook* is the ratio of total assets less the book value of common equity plus the total market value of equity all divided by the total book assets. *BDR1* is total debt divided by total debt plus common shareholder's equity. Previous studies report a negative relationship between debt and investment (Vo (2019), Aivazian, Ge, and Qiu (2005)). *Tangibility* is calculated as the ratio of fixed assets to total assets. Almeida and Campello (2005)

[2]For example, we are interested in understanding how the cash levels at the end of 2019 Q4 affects investments in 2020 Q1

suggest that firm's asset tangibility could promote firm's borrowing ability by providing more collateral to financial intermediaries, reduce financial restriction, and thus allow further corporate investment. *Research and Development* is the ratio of Research and Development scaled by total assets. *Research and Development* is set equal to zero if missing. Canace, Jackson, and Ma (2018) find that future R& D has a positive effect on corporate investments. *Dividend* is an indicator variable: one if a firm pays dividend in a quarter and zero otherwise. Rozeff (1982) finds that there is an inverse relationship between investment and dividend payout. All variables are expressed over a quarter. We winsorize the variables at the 1% and the 99% level to restrict the impact of outliers. Our data set includes 41,263 observations where there are no missing observations. We rank firms into terciles based on their *MarketToBook* values. Firms in the highest tercile are referred to *High MarketToBook Firms* which proxy's for firms with the highest growth opportunities.

Financially Constrained Firms are firms with the lowest *Interest Coverage Ratio* values. *Interest Coverage Ratio* measures the ratio of earnings before interest, tax, depreciation, amortization (EBITDA) to interest expense. We rank firms into terciles based on their *Interest Coverage Ratio* values. Firms with the lowest *Interest Coverage Ratio* represent firms with borrowing constraints and are referred to as *Financially Constrained Firms* in our study. EBITDA is a widely used indicator of a firm's economic performance. It captures firm profits that come directly from its regular operations and is readily available for scrutiny by lenders as part of standard financial reporting. Lian and Ma (2018) reveals that 80% of US non-financial firms' corporate debt is based on the going-concern value of cash flows from firm's operations. A decline in operating earnings increases borrowing constraints of firms which restricts their ability to raise debt.

3.3.3 Univariate Statistics

Table 3.1 provides summary statistics of key variables used in this study. We report the mean, standard deviation, 25th percentile, median, and 75th percentile. Panel A reports the full sample period (January 2018 - June 2020). Panel B reports the period before COVID-19 (January 2018 - December 2019). Panel C reports the period after COVID-19. With the full sample period in Panel A, *Acquisition* has a mean of 0.963% while *Capital Expenditure* has a mean of 2.572%. On average, firms hold 24.7% of assets in cash. *Covid(0/1)* has a mean of 0.2, thus 20% of our observation is in the year 2020.[3] Panel B reports the summary statistics of our dependent variables by cash quartiles.

3.4 Testing

To test the relationship, we estimate;

$$\begin{aligned} Investment_{i,q} &= \alpha_i + \beta_1 Cash_{q-1} + \beta_2 Covid(0/1)_{iq} + \gamma X_{i,q-1} \\ &+ \beta_3 Cash_{i,}q - 1 * Covid(0/1)_q + \delta_q + \epsilon_{i,q} \end{aligned} \tag{3.1}$$

where $Investment_{i,q}$ is the dependent variable. Our measures of $Investment_{i,q}$ are *Capital Expenditure* and *Acquisition*. $X_{i,q-1}$ is a matrix of lagged control variables defined in Section (3.3.2), δ_q represents quarter dummies. Due to collinearity issues, $\delta_q = 1$ of the regression is dropped. We use firm fixed effects to control for time invariant firm heterogeneity which implicitly controls for industry. $Cash_{q-1} * Covid(0/1)_{iq}$ is the variable of interest.

3.5 Results

Table 3.2 shows estimation results of Eq.(1). Due to the impact of COVID-19 pandemic we expect that $\beta_2 < 0$. Our results show that the relationship between *Covid(0/1)* and our measures of investments is negative and statistically significant at less than 1% level. This results is consistent with hypothesis 1. Specifically, the coefficients are -0.951 and

[3] 2020 has 2 quarters, expressed over 10 quarters from 2018-2020. To keep the homogeneity of firms for equitable comparisons, we only include firms with 10 consecutive quarterly data, thus firms with data from January 2018 to June 2020.

-0.683 using *Capital Expenditure* and *Acquisition* respectively. This translates to a 37% and 71% decline in *Capital Expenditure* and *Acquisition* respectively from their sample mean. We control for *Cash*, however, we don't predict the direction of β_1. Cash does not explain investments in normal period as our β_1 is statistically not significant. Hence, cash fulfills the role of an insurance policy that is used when the unexpected happens. Due to the insurance attribute of cash, we expect $\beta_3 > 0$. Our results show that the interaction between *Cash* and *Covid(0/1)* is positive and statistically significant at 1% which is consistent with hypothesis 2.

Lian and Ma (2018) reveals that 80% of US non-financial firms' corporate debt is based on the going-concern value of cash flows from firm's operations. A decline in operating earnings increases borrowing constraints of firms which restricts their ability to raise debt to finance investments. In Table 3.3, we test the relationship between *Covid(0/1)* and operating earnings as measured by EBITDA (Earnings before interest, depreciation and amortisation) scaled by asset total over a quarter. We find that the coefficient associated with *Covid(0/1)* on *EBITDA* is statistically significant at less than the 1% level and equals -0.017, which translates to 14% decline in operating earnings from the sample mean. This decline in operating earnings increases borrowing constraints and restricts the ability of firms to raise debt to finance investments. This could explain the decline in *Capital Expenditure* and *Acquisition* during the COVID-19 pandemic.

However, firms with accumulated cash holdings can easily forego debt and carry on investing at pre-COVID-19 levels. Moreover, firms with accumulated cash holdings might not cut back on investment activities but might keep up with their investment programs which will give them a competitive advantage in the long-term. This could explain why $\beta_3 > 0$.

As a next step, we solve for the cash level where a company maintains investment at pre-COVID 19 levels as follows:

$$E[Investment_i|Covid(0/1) = 1] = \alpha_i + \beta_1 Cash_{q-1} + \beta_2 + \beta_3 Cash_{q-1} + \gamma X_{i,q-1} + \delta_q + \epsilon_{i,q} \tag{3.2}$$

$$E[Investment_i|Covid(0/1) = 0] = \alpha_i + \beta_1 Cash_{q-1} + \gamma X_{i,q-1} + \delta_q + \epsilon_{i,q} \tag{3.3}$$

The change in investment is equal to Eq. (3.2) minus Eq. (3.3) or

$$\Delta[Investment] = \beta_2 + \beta_3 Cash_{q-1} \tag{3.4}$$

Using Eq. (3.4) and the coefficients in Column (1), we solve for the cash level where a company maintains *Capital Expenditure* at pre-COVID-19 levels as follows;

$$\Delta Capital\ Expenditure = -0.951 + 1.818 Cash_{q-1} > 0 \tag{3.5}$$

$$1.818 Cash_{q-1} > 0.951$$

$$Cash_{q-1} > 0.52$$

Thus, firms maintain *Capital Expenditure* at pre-COVID-19 levels when *Cash* is greater than 0.52. This value occurs at the 81st percentile of cash holdings of the empirical distribution, which implies that cash overcomes the negative influence of *Covid(0/1)* on *Capital Expenditure* only at very high levels.

Using Eq.(3.4) and the coefficients in Column (2), we solve for the cash level where a company maintains *Acquisition* at pre-COVID-19 levels as follows;

$$\Delta Acquisition = -0.683 + 1.315 Cash_{q-1} > 0 \tag{3.6}$$

$$1.315 Cash_{q-1} > 0.683$$

$$Cash_{t-1} > 0.52$$

Thus, firms maintain *Acquisition* at pre-COVID-19 levels when *Cash* is greater than 0.52. This value occurs at the 81st percentile of cash holdings of the empirical distribution, which implies that cash overcomes the negative influence of *Covid(0/1)* on *Acquisition* only at very high levels.

3.6 Robustness Tests

3.6.1 Industry Level Analysis

We acknowledge that there may exist fundamental differences among industries. Hence we re-estimate our baseline regression for different using the Fama and French 5 industry classifications. In Table 3.4 and Table 3.5, we find qualitatively similar results for all industries except the consumer industry where the interaction between cash and COVID-19 is positive but not statistically significant. On average, firms hold 24.7% of their assets in cash, however firms in the Consumer, Wholesale and Retail industry hold 11% of assets in cash which is lower relative to other industries. This suggests that firms in the Consumer, Wholesale and Retail industry may not hold sufficient cash to impact investment during COVID-19. The impact of COVID-19 on *Capital Expenditure* is severe in industry 2 - "Manufacturing, Energy, and Utilities Industry" and industry 4 represents "Healthcare Industry". The coefficient of *Covid(0/1)* on *Capital Expenditure* in industry 2 and industry 4 are -1.197 and -0.522 respectively and are statistically significant at the 1% significance level. Compared to the unreported industry-level summary statistics, the coefficients of *Covid(0/1)* on *Capital Expenditure* translates to 34% and 47% decline in *Capital Expenditure* in industry 2 and industry 4 respectively. Also, the impact of *Covid(0/1)* on *Acquisition* is severe in Industry 3 - "Business Equipment, Telephone, Transmission Industry". The coefficient of *Covid(0/1)* on *Acquisition* in industry 3 is -1.629 and this is statistically significant at the 1% significance level. Compared to the unreported industry-level summary statistics, the coefficient of *Covid(0/1)* on *Acquisition* translates to 95% reduction in industry 3 - "Business Equipment, Telephone, Transmission Industry".

3.6.2 Firm Level Analysis Based on Investment Growth Opportunities

In our baseline regression, we show that the corporate investment by firms has declined during COVID-19, however, we find that accumulated cash holdings reduces the impact. However, a key point that is missed is that corporate investment (both *Capital Expenditure* and *Acquisition*) are undertaken primarily for growth purposes. Growth opportunities during COVID-19 pandemic have reduced as economic activity has reduced. Hence, one could argue that the level of corporate investment could be a result of growth or investment opportunities. Hence, availability of investment opportunities seems to be an omitted variable in the study. To establish that the decline in corporate investment is not as a result of lesser investment opportunities, we group firms into terciles based on their *MarketToBook* values. Firms in the highest tercile represents high MarkettoBook firms and firms in the lowest terciles represents low MarkettoBook firms. Focusing on these two subsample firms, we show the effect of COVID-19 on investments and how cash reduces the impact among among firms with high and low investment growth opportunities. Our results in Table 3.6 are qualitatively similar to our baseline regression. We find that across our subsamples, COVID-19 leads to a decline in corporate investments but cash reduces the impact. This shows that investment is not driven exclusively by high MarkettoBook firms.

3.6.3 Borrowing Constraints

In Table 3.3, we show that COVID-19 leads to lower EBITDA which leads to higher borrowing constraints for firms. While this is true at the aggregate level, it may not apply to all firms as EBITDA has to fall below certain threshold levels before the borrowing constraints manifest. Some firms have raised more debt during COVID-19 crisis and this creates doubt on whether there are significant borrowing constraints for all firms. Even though EBITDA goes down in aggregate, it may still be high enough for a significant number of firms to not have effective borrowing constraints. To identify constraint firms during the pandemic, we group firms into terciles based on their interest coverage ratio (EBITDA/Interest Expense). Banks (and by extension, debt-providers) use interest coverage ratio as a proxy for ability to repay debt. We define firms in the lowest tercile as financially constrained firms as such firms have higher probability of facing borrowing constraints during the COVID-19 crisis.

As a next step, we examine the impact of COVID-19 on corporate investment among financially constrained firms with high growth opportunities (high *MarketToBook* ratios) in Table 3.7. With this analysis, we are able to examine whether accumulated cash holdings reduces the impact of COVID-19 for financially constrained firms with high growth opportunities. Such firms have lower probability of accessing external debt. Hence, we expect the impact of COVID-19 pandemic on investment to be severe. Nonetheless we expect such financially constrained firms might fund the high growth investment opportunities with accumulated cash. Consistent with our expectation, in Table 3.7, we find that the coefficient of *Covid(0/1)* on *Capital Expenditure* is -1.029. This translates to a 40% decline in *Capital Expenditure*. The magnitude of decline is higher than that of the baseline regression for *Capital Expenditure*. Given that the sample consists of financially constrained firms with growth opportunities, the relatively higher decline in *Capital Expenditure* is expected as such firms face huge borrowing constraints and cannot readily access external funds to secure investment opportunities. Yet, we find that financially constrained firms with accumulated cash are able to invest at pre COVID-19 levels as reported in Table 3.7 and is consistent with the baseline regression. However, we do not find any effect of cash holdings on acquisition for constrained firms with investment opportunities. This finding is consistent with Williamson and Yang (2016) who show that financially constrained firms are more likely to use stock to fund acquisitions than firms that are less financially constrained. Since financially constrained firms are unable to raise external debt to raise the cash necessary for acquisitions, such firms are more likely to use shares to make acquisition, even undervalued shares.

3.6.4 State-level COVID-19 outbreak and Corporate Investment

So far, our results show that the decline in corporate investment is due to the COVID-19 pandemic. To further establish a causal connection, we use state-level data to evaluate the connection between the COVID-19 pandemic and corporate investment. The COVID-19 outbreak varied significantly across different states with some states being hit harder compared to other states. For example, the outbreak was more severe in states like New York, New Jersey, California, and Florida during the first six months of the pandemic. One will expect the decline in corporate investment to be more pronounced among firms operating in states which were hard hit by the pandemic.

We measure the state-level COVID-19 outbreak in two ways. The first measure (*COVID cases*) is the quarterly number of positive cases per state population. The second measure (*COVID deaths*) is the quarterly number of COVID-19 related deaths per state population.[4] Following prior studies (Pham, Adrian, Garg, Phang, and Truong (2021), Pirinsky and Wang (2006) and Coval and Moskowitz (1999)), we use the state in which a firm has its headquarter as the firm's operational location. We control for state-level personal income growth and gross domestic product (GDP) growth based on data collected from the U.S. Bureau of Economic Analysis.

We test the following model;

[4]Deaths come from the Center for Systems Science and Engineering (CSSE), Johns Hopkins University (https://systems.jhu.edu/). State population comes from the World Population Review (https://worldpopulationreview.com/states/).

$$
\begin{aligned}
Investment_{i,q} = \alpha_i + \beta_1 Cash_{q-1} + \beta_2 State\ COVID\ Intensity_{iq} + \gamma X_{i,q-1} \\
+ \beta_3 Cash_{q-1} * State\ COVID\ Intensity_{iq} + \delta_q + \epsilon_{i,q}
\end{aligned} \tag{3.7}
$$

where $Investment_{i,q}$ is the dependent variable. Our measures of $Investment_{i,q}$ are *Capital Expenditure* and *Acquisition*. $X_{i,q-1}$ is a matrix of lagged control variables defined in Section (3.3.2) which includes state-level personal income growth and gross domestic product (GDP) growth, δ_q represents quarter dummies. Due to collinearity issues, $\delta_q = 1$ of the regression is dropped. We use firm fixed effects to control for time invariant firm heterogeneity which implicitly controls for industry. Our measures of *State COVID Intensity* are *COVID cases* and *COVID deaths*. The first measure (*COVID cases*) is the quarterly number of COVID-19 positive cases per state population. The second measure (*COVID deaths*) is the quarterly number of COVID-19 related deaths per state population. *Cash* is defined as cash and marketable securities scaled by beginning total book assets over a quarter. $Cash_{q-1} * State\ COVID\ Intensity_{iq}$ is the variable of interest which is an interaction of *Cash* and *State COVID Intensity*.

We report the results in Table 3.8. Our results show that the number of COVID-19 state reported cases and COVID-19 related deaths are negatively related to corporate investments. However, we still find that cash holdings reduces the impact of COVID-19 on corporate investment. This analysis helps to better understand the causal connection between COVID-19 and corporate investment.

3.6.5 External Financing

Firms with cash can be seen as safe borrowers and as such can build up their cash balances by increasing their use of external finance during the pandemic. Barbalau, Huson, and Roth (2022) examine the relation between cash holdings and access to external finance through bank loans. The authors document a negative relationship between cash holdings and spreads on loans. Hence, one could argue that the subsequent capital raised by cash-rich firms influences their investment activities and not the accumulated cash. Hence, we examine whether firms raise new capital during the pandemic.

We test the following model;

$$\Delta ExternalFinance_{i,q} = \alpha_i + \beta_1 Cash_{q-1} + \beta_2 Covid(0/1)_{iq} + \gamma X_{i,q-1} + \beta_3 Cash_{q-1} * Covid(0/1)_{iq} + \delta_q + \epsilon_{i,q} \quad (3.8)$$

where $\Delta ExternalFinance_{i,q}$ is the change in our dependent variables. Our measures of $ExternalFinance_{i,q}$ are *Debt Issuance* and *Equity Issuance*. Following Boasiako and Keefe (2021) and Dierker, Lee, and Seo (2019), we measure external finance in two ways (1) *Equity Issuance*, measured as the ratio of the difference between the sale of common and preferred stocks (SSTKY) and the purchase of common and preferred stocks (PRSTKCY) to total assets. *Debt Issuance* is measured as the ratio of long-term debt issuance (DLTISY) minus long-term debt reduction (DLTRY) to total assets. All data are quarterly data. $X_{i,q-1}$ is a matrix of lagged control variables defined in Section (3.3.2), δ_q represents quarter dummies. Due to collinearity issues, $\delta_q = 1$ of the regression is dropped. We use firm fixed effects to control for time invariant firm heterogeneity which implicitly controls for industry. $Cash_{q-1} * Covid(0/1)_{iq}$ is the variable of interest. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by beginning total book assets over a quarter. We cluster standard errors by firm.

Columns (1) and Columns (2) of Table 3.9 show that COVID-19 leads to an increase in external finance. There is a significant positive relationship between *Covid(0/1)* and our measures of external finance. Specifically, the coefficients of *Covid(0/1)* on *Debt Issuance* and *Equity Issuance* are 0.017 and 0.030, respectively. Thus, we interpret *Covid(0/1)* as causing 24.2% (0.017/0.070) and 20.2% (0.030/0.148) standard deviation increases in *Debt Issuance* and *Equity Issuance*, respectively.

Our results are consistent with studies that show that firms raised more finance externally during the pandemic (Halling, Yu, and Zechner (2020), Halling, Yu, and Zechner (2020)). Li, Strahan, and Zhang (2020) find that firms drew funds from pre-existing lines of credit at an unprecedented scale during the pandemic. Halling, Yu, and Zechner (2020) show that at the onset of the pandemic, corporate bond issues increased substantially. Halling, Yu, and Zechner (2020) also show that equity markets decreased significantly in the first 4-weeks of the COVID 19 crisis and in May 2020, it recovered and exceeded levels during normal times quite substantially. Refinitiv reports that in May 2020, total proceeds from global issuance (follow on offerings) increased significantly to $129.54 billion with total proceeds more than doubling from the $59.45 billion in May 2019.[5]

While the *Covid(0/1)* variable is positively significant, the interaction term with cash holdings is significantly negative for *Debt Issuance* and *Equity Issuance*. This suggest that investment activities of cash-rich firms are not necessarily influenced by external financing during the COVID-19 pandemic. Firms with cash reduce their debt and equity issuance which suggests that cash holdings overcomes liquidity constraints during a pandemic.

3.6.6 Short-Term Financing - Trade Credit

During crisis, alternative sources of finance become important. Trade credit is one of the most important sources of short-term financing (Rajan and Zingales (1995), Seifert, Seifert, and Protopappa-Sieke (2013)). Prior studies have analysed the impact of a crisis on trade credit. Prior research shows that during the financial crisis, firms that increased their trade credit were less creditworthy, small and financially weak (Casey and O'Toole (2014), Bastos and Pindado (2013a), Bastos and Pindado (2013b), Carbo-Valverde, Rodriguez-Fernandez, and Udell (2016), McGuinness and Hogan (2016), Love, Preve, and Sarria-Allende (2007)). Love, Preve, and Sarria-Allende (2007) also show that

[5]Cited from the article: Equity capital raising during COVID-19: practical tips

trade credit increased during the financial crisis but more liquid firms accepted less credit from their suppliers. In this section, we investigate whether firms obtain alternative finance from suppliers. In particular, we ask whether firms with cash disproportionately obtain higher trade credit (short-term finance) from suppliers during the COVID-19 pandemic which could potentially explain why firms with cash invest more in the pandemic.

We test the following model;

$$\begin{aligned} \Delta TradeCredit_{i,q} = \alpha_i &+ \beta_1 Cash_{q-1} + \beta_2 Covid(0/1)_{iq} + \gamma X_{i,q-1} \\ &+ \beta_3 Cash_{q-1} * Covid(0/1)_{iq} + \delta_q + \epsilon_{i,q} \end{aligned} \tag{3.9}$$

where $\Delta TradeCredit_{i,q}$ is the change in trade credit. Following Love, Preve, and Sarria-Allende (2007), we measure trade credit as accounts payable scaled by cost of goods sold. Quarterly data is used. $X_{i,q-1}$ is a matrix of lagged control variables defined in Section (3.3.2), δ_q represents quarter dummies. Due to collinearity issues, $\delta_q = 1$ of the regression is dropped. We use firm fixed effects to control for time invariant firm heterogeneity which implicitly controls for industry. $Cash_{q-1} * Covid(0/1)_{iq}$ is the variable of interest. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by beginning total book assets over a quarter. We cluster standard errors by firm.

Table 3.10 shows that COVID-19 leads to an increase in the use of trade credit. There is a significant positive relationship between *Covid(0/1)* and trade credit. Specifically, the coefficient of *Covid(0/1)* on Δ*Trade Credit* is 0.132. Thus, we interpret *Covid(0/1)* as causing 17.2% (0.132/0.767) standard deviation increase in trade credit. While the *Covid(0/1)* variable is positive and statistically significant, the interaction term with cash holdings is insignificant.

3.6.7 Policy Intervention – The CARES ACT

The COVID-19 pandemic triggered a $2 trillion policy response through the passing of the Coronavirus Aid, Relief, and Economic Security (CARES) Act. The Federal Reserve (Fed) announced a quantitative easing (QE) plan on March 15, 2020, and Congress passed the CARES Act on March 27, 2020. The CARES Act supported firms running low on cash and provided firms immediate liquidity in response to the COVID-19 pandemic. Hence, we examine how stabilization policies such as the CARES Act affect corporate investment during the pandemic.

To test the relationship, we estimate;

$$\begin{aligned} Investment_{i,q} &= \alpha_i + \beta_1 Cash_{q-1} + \beta_2 PostCARES(0/1)_{iq} + \gamma X_{i,q-1} \\ &+ \beta_3 Cash_{q-1} * PostCARES(0/1)_{iq} + \delta_q + \epsilon_{i,q} \end{aligned} \tag{3.10}$$

where $Investment_{i,q}$ is the dependent variable. Our measures of $Investment_{i,q}$ are *Capital Expenditure* and *Acquisition*. $X_{i,q-1}$ is a matrix of lagged control variables defined in Section (3.3.2), δ_q represents quarter dummies. Due to collinearity issues, $\delta_q = 1$ of the regression is dropped. We use firm fixed effects to control for time invariant firm heterogeneity which implicitly controls for industry. *PostCARES(0/1)* is a dummy variable, which equals to one after the U.S. Congress passes the CARES ACT (March, 2020). *Cash* is defined as cash and marketable securities scaled by beginning total book assets over a quarter. $Cash_{q-1} * PostCARES(0/1)_{iq}$ is the variable of interest which is an interaction of *Cash* and *PostCARES(0/1)*.

Table 3.11 shows the estimation results of Eq.2. The results showed that after the passage of the CARES Act, the effect of corporate investment is still negative and statistically significant. Specifically, the coefficients are -0.939 and -0.678 using *Capital Expenditure* and *Acquisition* respectively. This translates to a 36% and 70% decline in *Capital Ex-*

penditure and *Acquisition* respectively from their sample mean. We still find that cash holdings reduce the impact of the COVID-19 pandemic on corporate investments.

3.7 Conclusion

The COVID-19 pandemic serves as an exogenous shock which helps in understanding the importance of cash holdings on firm policies and behavior. We examine the impact of cash holdings on corporate investment during COVID-19. During the great financial crisis, there was a shock in the external supply of funds which led to a decline in external finance for investment. However, the ongoing COVID-19 pandemic has also led to depletion of operational cashflows resulting in increased borrowing constraints and reduction in external finance for investment. We find that Capital Expenditure and M&A levels decrease by 37% and 71% respectively during the COVID 19 pandemic. However, the impact of COVID-19 on investment is less for firms with accumulated cash. Firms at the 81st percentile of cash holdings maintain capital expenditure and acquisition at pre-COVID-19 levels. The study also shows that policy intervention, such as the Coronavirus Aid, Relief, and Economic Security (CARES) Act did not economically improve corporate investments and does not matter for our findings. In addition, we find that, COVID-19 leads to an increase in external finance; measured by Debt and Equity Issuance, however, we find that cash-rich firms reduce their use of external finance. This suggests that investment activities of cash-rich firms are not necessarily influenced by external financing during the COVID-19 pandemic. Finally, our results show that the number of COVID-19 state reported cases and COVID-19 related deaths are negatively related to corporate investments. However, we still find that cash holdings reduces the impact of COVID-19 on corporate investment. This analysis helps to better understand the causal connection between COVID-19 and corporate investment. Overall, our evidence shows that the COVID-19 pandemic has had an adverse effect on corporate investment activities, but accumulated cash holdings reduces the impact.

3.8 Credit Authorship Statement

Bernard Tawiah: Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft. Michael O'Connor Keefe: Conceptualization, Methodology, Writing – review & editing, Supervision.

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Table 3.1: Summary Statistics over a quarter

This table presents summary statistics of the variables used in this study from January 2018 to June 2020. Panel A reports the full sample period. Panel B reports the summary statistics of our dependent varibles by cash quartiles. All the variables are winsorized at 1% level in both tails of the distribution before the summary statistics are calculated. The table reports the number of observations, mean, 25th percentile, median, 75th percentile and standard deviation. Variable definitions are provided in Section (3.3.2)

Variable		Observation	mean	p25	p50	p75	sd
Panel A : Full Sample Period							
Acquisition		41,263	0.963	0	0	0	3.661
Capital Expenditure		41,263	2.572	0.217	1.027	2.910	4.325
$Cash_{q-1} * Covid(0/1)$		41,263	0.050	0	0	0	0.161
Covid(0/1)		41,263	0.200	0	0	0	0.400
Cash		41,263	0.247	0.034	0.113	0.372	0.287
FirmSize		41,263	5.300	3.327	5.602	7.556	3.101
EBITDA		41,263	-0.125	-0.069	0.001	0.020	0.512
MarketToBook		41,263	9.105	1.119	1.680	3.311	41.472
BDR1		41,263	0.302	0.003	0.260	0.544	0.777
Tangibility		41,263	0.289	0.050	0.164	0.474	0.296
Research and Development		41,263	0.024	0	0	0.017	0.063
Dividend		41,263	0.281	0	0	1	0.450
Debt Issuance		34,908	0.003	-0.004	0	0.001	0.070
Equity Issuance		33,723	0.005	-0.001	0	0.002	0.148
Δ *Trade Credit*		30,505	0.040	-0.074	0	0.074	0.767
Personal Income Growth		23,740	0.055	0.020	0.033	0.083	0.043
GDP Growth		23,740	0.056	0.019	0.032	0.092	0.046
COVID cases		36,410	0.001	0	0	0	0.002
COVID deaths		36,410	0.000	0	0	0	0.000
PostCARES(0/1)		36,410	0.093	0	0	0	0.290
Panel B : Summary Statistics by Cash Quartiles							
Acquisition	Quartile 1	11,048	1.093	0.294	1.274	3.541	3.932
Acquisition	Quartile 2	10,202	1.261	0	0	0.033	4.116
Acquisition	Quartile 3	10,008	1.008	0	0	0	3.726
Acquisition	Quartile 4	10,005	0.405	0	0	0	2.410
Capital Expenditure	Quartile 1	11,048	3.004	0.294	1.274	3.541	4.746
Capital Expenditure	Quartile 2	10,202	2.981	0.513	1.497	3.633	4.321
Capital Expenditure	Quartile 3	10,008	2.865	0.355	1.224	3.224	4.574
Capital Expenditure	Quartile 4	10,005	1.398	0.003	0.310	1.251	3.392

Table 3.2: Cash Holdings and Corporate Investment during COVID-19

This table reports estimation results of Equation (3.1), which estimates the effect of cash holdings and corporate investment. The dependent variables are *Capital Expenditure* and *Acquisition* in columns (1) and (2) respectively. *Capital Expenditure* is measured as the sum of capital expenditure expressed as a percentage of total assets over a quarter. *Acquisition* is measured as the sum of total acquisition expenditure expressed as a percentage of total assets over a quarter. $Cash_{q-1} * Covid(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1)*. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by total assets. Section (3.3.2)defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)
VARIABLES	*Capital Expenditure*	*Acquisition*
$Cash_{q-1}$	0.299	0.176
	(0.208)	(0.244)
Covid(0/1)	-0.951***	-0.683***
	(0.054)	(0.066)
$Cash_{q-1} * Covid(0/1)$	1.818***	1.315***
	(0.121)	(0.108)
FirmSize	-0.010	0.087
	(0.087)	(0.067)
EBITDA	0.062	0.003
	(0.067)	(0.042)
MarketToBook	-0.001	-0.001
	(0.002)	(0.001)
BDR1	-0.046	-0.012
	(0.043)	(0.021)
Tangibility	0.406	-0.486**
	(0.441)	(0.237)
Research and Development	-0.610	0.240
	(0.445)	(0.317)
Dividend	-0.164	0.068
	(0.129)	(0.148)
Constant	1.567***	0.326
	(0.501)	(0.347)
Quarterly Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	41,263	41,263
R-squared	0.115	0.019
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 3.3: The Effect of COVID-19 on *EBITDA*

This table reports the effect of *Covid(0/1)* on *EBITDA*. The dependent variable is *EBITDA*. *EBITDA* is measured as EBITDA scaled by beginning asset total over a quarter. *Covid(0/1)* is the variable of interest and is a dummy variable equal to one if year is 2020 and zero if otherwise. Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)
VARIABLES	*EBITDA*
Covid(0/1)	-0.017***
	(0.002)
FirmSize	0.134***
	(0.019)
Cash	0.097**
	(0.042)
MarketToBook	-0.003***
	(0.001)
BDR1	0.010**
	(0.004)
Tangibility	-0.040
	(0.041)
Research and Development	-0.631***
	(0.194)
Dividend	-0.001
	(0.004)
Constant	-0.838***
	(0.116)
Quarterly Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	33,154
R-squared	0.182
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 3.4: Cash Holdings and *Capital Expenditure* during COVID-19

This table reports estimation results of Equation (3.1), which estimates the effect of cash holdings and *Capital Expenditure* across Fama-French 5 Industry classification. *Capital Expenditure* is measured as the sum of capital expenditure expressed as a percentage of total assets over a quarter. $Cash_{q-1} * Covid(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1)*. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by total assets. Ind 1 represents "Consumer, Wholesale and Retail Industry", Ind 2 represents Manufacturing, Energy, and Utilities Industry" Ind 3 represents "Business Equipment, Telephone, Transmission Industry" Ind 4 represents "Healthcare Industry" and Ind 5 represents "Other Industries" Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Ind 1	Ind 2	Ind 3	Ind 4	Ind 5
$Cash_{q-1}$	-0.283	0.266	-0.060	0.114	-4.749
	(0.884)	(1.393)	(0.721)	(0.360)	(4.147)
Covid(0/1)	-0.198***	-1.197***	-0.565***	-0.522***	-0.511***
	(0.072)	(0.245)	(0.162)	(0.152)	(0.149)
$Cash_{q-1} * Covid(0/1)$	0.928	4.203***	0.877***	0.813***	0.824***
	(0.613)	(0.915)	(0.323)	(0.206)	(0.217)
Control Variables	Yes	Yes	Yes	Yes	Yes
Constant	4.692**	14.036**	-1.696	1.542**	-3.005
	(0.501)	(6.183)	(1.681)	(0.698)	(13.460)
Quarterly Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	4,146	6,223	6,055	6,109	7,657
R-squared	0.163	0.107	0.056	0.092	0.024
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Table 3.5: Cash Holdings and *Acquisition* during COVID-19

This table reports estimation results of Equation (3.1), which estimates the effect of cash holdings and *Acquisition* across Fama-French 5 Industry classification. *Acquisition* is measured as the sum of total acquisition expenditure expressed as a percentage of total assets over a quarter. $Cash_{q-1} * Covid(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1). Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by total assets. Ind 1 represents "Consumer, Wholesale and Retail Industry", Ind 2 represents Manufacturing, Energy, and Utilities Industry" Ind 3 represents "Business Equipment, Telephone, Transmission Industry" Ind 4 represents "Healthcare Industry" and Ind 5 represents "Other Industries" Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Ind 1	Ind 2	Ind 3	Ind 4	Ind 5
$Cash_{q-1}$	1.835	-0.508	1.005	0.236	0.139
	(1.441)	(2.143)	(0.721)	(0.758)	(0.501)
Covid(0/1)	-0.777**	-0.641***	-1.629***	-1.204***	-0.407***
	(0.343)	(0.201)	(0.392)	(0.319)	(0.106)
$Cash_{q-1} * Covid(0/1)$	0.452	2.889***	3.588***	0.813***	1.085***
	(3.567)	(0.764)	(0.926)	(0.206)	(0.217)
Control Variables	Yes	Yes	Yes	Yes	Yes
Constant	-6.244	-2.402	-4.350	0.388	1.028
	(4.054)	(3.291)	(2.666)	(0.698)	(0.632)
Quarterly Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	4,146	6,223	6,055	6,109	7,657
R-squared	0.164	0.018	0.021	0.010	0.014
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Table 3.6: Cash Holdings and Corporate Investment during COVID-19 - High Marketto-Books Firms and Low MarkettoBook Firms

This table reports estimation results of Equation (3.1) based on the MarkettoBook values of firms. We group firms into terciles based on their *MarketToBook* values. Firms in the highest tercile represents High MarkettoBook firms and firms in the lowest terciles represents low MarkettoBook firms. The dependent variables are *Capital Expenditure* and *Acquisition* in columns (1) and (2) respectively. *Capital Expenditure* is measured as the sum of capital expenditure expressed as a percentage of total assets over a quarter. *Acquisition* is measured as the sum of total acquisition expenditure expressed as a percentage of total assets over a quarter. $Cash_{q-1} * Covid(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1)*. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by total assets. Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	High Market To Book Firms		Low Market To Book Firms	
	Capital Expenditure	*Acquisition*	*Capital Expenditure*	*Acquisition*
VARIABLES	*Capital Expenditure*	*Acquisition*	*Capital Expenditure*	*Acquisition*
$Cash_{q-1}$	-0.147	-0.020	2.546***	0.732
	(0.248)	(0.189)	(0.803)	(0.782)
Covid(0/1)	-0.768***	-0.401***	-0.756***	-0.706***
	(0.153)	(0.135)	(0.084)	(0.102)
$Cash_{q-1} * Covid(0/1)$	1.000***	0.716***	2.418***	1.759***
	(0.248)	(0.189)	(0.279)	(0.276)
FirmSize	0.153	0.136**	0.139	-0.713**
	(0.140)	(0.063)	(0.229)	(0.343)
EBITDA	-0.043	-0.005	1.107**	0.672**
	(0.091)	(0.027)	(0.455)	(0.328)
MarketToBook	-0.002	-0.000	0.029	0.002
	(0.002)	(0.000)	(0.024)	(0.022)
BDR1	-0.009	0.002	-1.221***	-0.885**
	(0.053)	(0.014)	(0.403)	(0.370)
Tangibility	1.709*	-0.130	-1.225	-0.461
	(0.930)	(0.291)	(0.811)	(0.817)
Research and Development	-0.492	0.516	1.338	-0.946
	(0.506)	(0.407)	(1.158)	(0.929)
Dividend	-0.180	-0.526	-0.197	0.133
	(0.205)	(0.577)	(0.181)	(0.223)
Constant	0.597	0.080	1.470	5.324**
	(0.641)	(0.288)	(1.449)	(0.288)
Quarterly Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	13,540	13,540	13,540	13,540
R-squared	0.078	0.014	0.190	0.030
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 3.7: Cash Holdings and Corporate Investment during COVID-19 - Financially Constrained Firms with High MarketToBook Values

This table reports estimation results of Equation (3.1), which estimates the effect of cash holdings and corporate investment. Our sample consists of financially constrained firms with high *MarketToBook* values. To identify constrained firms during the pandemic, we group firms into terciles based on their interest coverage ratio (EBITDA/Interest Expense). We define firms in the lowest tercile as financially constrained firms as such firms have higher probability of facing borrowing constraints during the COVID-19 crisis. The dependent variables are *Capital Expenditure* and *Acquisition* in columns (1) and (2) respectively. *Capital Expenditure* is measured as the sum of capital expenditure expressed as a percentage of total assets over a quarter. *Acquisition* is measured as the sum of total acquisition expenditure expressed as a percentage of total assets over a quarter. $Cash_{q-1} * Covid(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1)*. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by total assets. Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)
VARIABLES	*Capital Expenditure*	*Acquisition*
$Cash_{q-1}$	0.010	-0.155
	(0.414)	(0.371)
Covid(0/1)	-1.029***	-0.227
	(0.345)	(0.212)
$Cash_{q-1} * Covid(0/1)$	1.307***	0.060
	(0.502)	(0.310)
FirmSize	0.065	0.245
	(0.173)	(0.149)
EBITDA	-0.069	-0.002
	(0.120)	(0.048)
MarketToBook	-0.002	0.001
	(0.003)	(0.001)
BDR1	-0.031	-0.002
	(0.073)	(0.013)
Tangibility	2.885*	-0.150
	(1.478)	(0.327)
Research and Development	-1.946**	0.512
	(0.831)	(0.341)
Dividend	0.295	-0.868
	(0.413)	(0.935)
Constant	0.897	-0.349
	(0.734)	(0.378)
Quarterly Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	3,356	3,356
R-squared	0.078	0.014
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 3.8: State-level COVID-19 outbreak and Corporate Investment

This table reports estimation results of Equation (3.7), which estimates the effect of state-level COVID-19 outbreak and Corporate Investment. The dependent variables are *Capital Expenditure* and *Acquisition* in columns (1) and (2) respectively. *Capital Expenditure* is measured as the sum of capital expenditure expressed as a percentage of total assets over a quarter. *Acquisition* is measured as the sum of total acquisition expenditure expressed as a percentage of total assets over a quarter. $Cash_{q-1} * State\ COVID\ Intensity_{iq}$ is the variable of interest and is an interaction between *Cash* and *State COVID Intensity*. Our measures of *State COVID Intensity* are *COVID cases* and *COVID deaths*. The first measure (*COVID cases*) is the quarterly number of COVID-19 positive cases per state population. The second measure (*COVID deaths*) is the quarterly number of COVID-19 related deaths per state population. *Cash* is defined as cash and marketable securities scaled by total assets. Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)
VARIABLES	*Capital Expenditure*	*Acquisition*	*Capital Expenditure*	*Acquisition*
COVID cases	-0.545***	-0.865***		
	(0.064)	(0.125)		
COVID deaths			-4.484***	-8.941***
			(0.928)	(1.779)
$Cash_{q-1} * COVID\ cases$	1.082***	1.650***		
	(0.146)	(0.222)		
$Cash_{q-1} * COVID\ deaths$			8.771***	18.085***
			(1.872)	(3.070)
$Cash_{q-1}$	0.072	0.058	0.344	0.318
	(0.351)	(0.351)	(0.572)	(0.572)
FirmSize	-0.252**	-0.267**	0.221	0.199
	(0.118)	(0.067)	(0.151)	(0.150)
EBITDA	0.232	0.243	-0.120	-0.104
	(0.198)	(0.198)	(0.097)	(0.097)
MarketToBook	-0.002	-0.002	-0.002*	-0.001
	(0.003)	(0.003)	(0.001)	(0.001)
BDR1	0.083	0.079	0.022	0.016
	(0.051)	(0.051)	(0.028)	(0.028)
Tangibility	0.269	0.151	-1.468**	-1.633***
	(0.772)	(0.772)	(0.622)	(0.624)
Research and Development	-0.610	0.240	-0.610	0.240
	(0.445)	(0.317)	(0.445)	(0.317)
Dividend	-0.569**	-0.562**	0.058	0.069
	(0.251)	(0.251)	(0.332)	(0.333)
State Controls				
GDP Growth	-3.837***	-4.046***	-0.007	-0.332
	(0.804)	(0.812)	(1.015)	(1.011)
Personal Income Growth	2.839***	2.920***	-0.520	-0.553
	(1.003)	(1.032)	(1.459)	(1.493)
Constant	0.088***	0.096***	0.025	0.047
	(0.026)	(0.028)	(0.044)	(0.049)
Quarterly Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	18,491	18,491	18,491	18,491
R-squared	0.158	0.156	0.026	0.024

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.9: Cash Holdings and External Finance during COVID-19

This table reports estimation results of Equation (3.8), which estimates the effect of cash holdings and *External Finance*. The dependent variables are *Debt Issuance* and *Equity Issuance* in columns (1) and (2) respectively. *Debt Issuance* is the ratio of long-term debt issuance (DLTISY) minus long-term debt reduction (DLTRY) to total assets. *Equity Issuance* is the ratio of the difference between the sale of common and preferred stocks (SSTKY) and the purchase of common and preferred stocks (PRSTKCY) to total assets. $Cash_{q-1} * Covid(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1)*. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by total assets. Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)
VARIABLES	*Debt Issuance*	*Equity Issuance*
$Cash_{q-1}$	-0.034	-0.220***
	(0.027)	(0.060)
Covid(0/1)	0.017***	0.030***
	(0.003)	(0.004)
$Cash_{q-1} * Covid(0/1)$	-0.044***	-0.108***
	(0.016)	(0.022)
FirmSize	-0.041***	-0.055***
	(0.013)	(0.018)
EBITDA	0.004	0.003
	(0.039)	(0.062)
MarketToBook	-0.000*	-0.003*
	(0.000)	(0.002)
BDR1	-0.008	-0.001
	(0.005)	(0.012)
Tangibility	0.078**	0.030
	(0.037)	(0.052)
Sale	-0.005	-0.004
	(0.005)	(0.007)
Research and Development	-0.610	0.240
	(0.445)	(0.317)
Dividend	0.004	0.004
	(0.010)	(0.005)
Constant	1.567***	0.326
	(0.501)	(0.347)
Quarterly Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	23,834	23,834
R-squared	0.009	0.037
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 3.10: Cash Holdings and Trade Credit during COVID-19

This table reports estimation results of Equation (3.9), which estimates the effect of cash holdings and *Trade Credit*. The dependent variable is change in *Trade Credit*. Δ*Trade Credit* is the change in accounts payable scaled by cost of goods sold. $Cash_{q-1} * Covid(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1)*. *Covid(0/1)* is a dummy variable equal to one if year is 2020 and zero if otherwise. *Cash* is defined as cash and marketable securities scaled by total assets. Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)
VARIABLES	Δ*Trade Credit*
$Cash_{q-1}$	0.780
	(0.482)
Covid(0/1)	0.132**
	(0.057)
$Cash_{q-1} * Covid(0/1)$	0.150
	(0.252)
FirmSize	-0.509***
	(0.136)
EBITDA	-0.620**
	(0.320)
MarketToBook	-0.008**
	(0.004)
Sale	0.479***
	(0.084)
Investments	-0.128
	(0.402)
Constant	1.267
	(0.863)
Quarterly Fixed Effects	Yes
Firm Fixed Effects	Yes
Observations	24,368
R-squared	0.014
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 3.11: Cash Holdings and Corporate Investment during COVID-19; Policy Intervention

This table reports estimation results of Equation (3.10), which estimates the effect of cash holdings and corporate investment after the passage of the CARES ACT. The dependent variables are *Capital Expenditure* and *Acquisition* in columns (1) and (2) respectively. *Capital Expenditure* is measured as the sum of capital expenditure expressed as a percentage of total assets over a quarter. *Acquisition* is measured as the sum of total acquisition expenditure expressed as a percentage of total assets over a quarter. $Cash_{q-1} * PostCARES(0/1)$ is the variable of interest and is an interaction between *Cash* and *Covid(0/1)*. *PostCARES(0/1)* is a dummy variable, which equals to one after the U.S. Congress passes the CARES ACT (March 2020). *Cash* is defined as cash and marketable securities scaled by total assets. Section (3.3.2) defines the variables. All control variables are lagged by a quarter. Clustered errors by firm are shown in parentheses with 1%, 5%, and 10% significance levels denoted by ***, **, and *, respectively.

	(1)	(2)
VARIABLES	*Capital Expenditure*	*Acquisition*
$Cash_{q-1}$	0.305	0.322
	(0.224)	(0.303)
PostCARES(0/1)	-0.939***	-0.678***
	(0.059)	(0.073)
$Cash_{q-1} * PostCARES(0/1)$	1.490***	1.191***
	(0.132)	(0.125)
FirmSize	-0.068	0.006
	(0.094)	(0.077)
EBITDA	-0.027	-0.020
	(0.093)	(0.047)
MarketToBook	-0.003*	-0.001
	(0.002)	(0.001)
BDR1	-0.040	0.001
	(0.051)	(0.019)
Tangibility	0.257	-0.631***
	(0.513)	(0.310)
Research and Development	-0.787*	0.169
	(0.447)	(0.357)
Dividend	-0.375**	-0.060
	(0.171)	(0.202)
Constant	1.712***	0.659
	(0.565)	(0.409)
Quarterly Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	41,263	41,263
R-squared	0.143	0.020

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusion

3.9 Conclusion

This thesis is composed of three self-contained essays. Corporate Venture Capital (CVC) investments have become increasingly important and continue to attract many public companies. Unlike Independent Venture Capitals (IVCs) that are established for purely financial returns, CVCs pursue strategic objectives. Despite the strategic importance of CVC investments, there is no research about how CVC investments affect the financial policies and dividend payout of CVC investing firms.

In Essay one, we fill this gap by investigating whether CVC investments affect debt and cash holdings of CVC investing firms. Motivated by the strategic reasons behind CVC investment, we propose that CVC investing firms maintain financial flexibility to ensure that (a) the funds needed to finance CVC driven innovations are available when needed (b) firms can expand their knowledge base through the acquisition of their portfolio companies when it is potentially useful to do so and (c) firms can exercise their growth option through a follow – on investment when uncertainty unfolds to its advantage. Consistent with our predictions, we find that CVC investing firm hold less debt and more cash. Moreover, we find that our results are more pronounced among the highest CVC investing firms. Furthermore, we find that our results are more pronounced among strategically driven CVC firms. In addition, our results show that CVC firms in industries with high dependence on external finance hold less debt while CVC firms in industries with less dependence on external finance hold more cash. Moreover, we also find that CVC firms are more likely to offer considerations with cash deals during acquisitions and this relationship is also pronounced among strategic CVC firms. We also find that our baseline results apply to different time periods before the financial crisis period ranging from 1980 to 2006, and the period after the financial crisis period ranging from 2009 to 2018. Our study provides financial guidance for firms that might begin a CVC program.

Essay 2 studies empirically shows that CVC investing firms experience an increase in dividend payout. We find that CVC investment enhances future earnings and profitability and managers of CVC firms increase dividend payment to signal future performance. Also, the study tests whether the findings are driven by financially or strategically oriented CVC firms. The results show that the relationship between CVC investment and dividend is driven by strategic CVC investors. There is no statistically significant relationship between CVC and dividend for financially oriented CVC firms. This findings contribute to the existing literature that explores the determinants of dividend payout. Also the study extends the literature on CVC investment. CVC firms can draw upon this findings in their decision-making process as they consider financial policy concerning dividend payout.

Essay 3 examines the impact of cash holdings on corporate investment during COVID-19. We find that Capital Expenditure and M&A levels decrease by 37% and 71% respectively during the COVID 19 pandemic. However, the impact of COVID-19 on investment is less for firms with accumulated cash. Firms at the 81st percentile of cash holdings maintain capital expenditure and acquisition at pre-COVID-19 levels. The study also shows that policy intervention, such as the Coronavirus Aid, Relief, and Economic Security (CARES) Act did not economically improve corporate investments and does not matter for our findings. In addition, we find that, COVID-19 leads to an increase in external finance; measured by Debt and Equity Issuance, however, we find that cash-rich firms reduce their use of external finance. This suggests that investment activities of cash-rich firms are not necessarily influenced by external financing during the COVID-19 pandemic. Finally, our results show that the number of COVID-19 state reported cases and COVID-19 related deaths are negatively related to corporate investments. However, we still find that cash holdings reduces the impact of COVID-19 on corporate investment. This analysis helps to better understand the causal connection between COVID-19 and corporate investment. Overall, our evidence shows that the COVID-19 pandemic has had an adverse effect on corporate investment activities, but accumulated cash holdings reduces the impact.