PERFORMANCE OF VC-BACKED IPOs COMPARED TO NON-VC-BACKED IPOs

A COMPARATIVE STUDY OF VENTURE CAPITAL INFLUENCE ON IPO PERFORMANCE IN THE US

SAVYA GUPTA

KRISTIANA ROKO

Bachelor Thesis

Stockholm School of Economics

2024

A COMPARATIVE STUDY OF VENTURE CAPITAL INFLUENCE ON IPO PERFORMANCE IN THE US

Abstract:

In this paper, we compare the performance of venture capital-backed IPOs with the performance of non-venture capital-backed IPOs in the US from 1980 to 2020 using a variety of performance metrics such as Underpricing, Buy and Hold Abnormal Returns (BHAR), Property, Plant, and Equipment (PPE) as a measure of Investments, Return on Assets (ROA) and Sales Growth. We provide evidence that VC-backed IPOs portray strong long-term performance owing to high growth ambitions and strategic investments but often compromise profitability. One of the key focus areas of our study is the 2008 financial crisis. We find that during the crisis, VC-backed IPOs showed more resilience compared to their non-VC-backed counterparts. By controlling for industry and year-fixed effects, this study aims to provide evidence for the value-added and the dynamic role played by venture capitals in helping firms achieve strong IPO performance.

Keywords:

IPOs, Venture Capital, Underpricing, Returns, Investment, Return on Assets, Sales Growth, Crisis, Performance

Authors:

Savya Gupta (25549)
Kristiana Roko (25852)

Tutors:

Mustafa Bulut, Postdoctoral Fellow, Department of Finance

Examiner:

Ramin Baghai, Associate Professor, Department of Finance

Bachelor Thesis

Bachelor's Program in Business and Economics
Stockholm School of Economics

The dynamics of venture capital-backed IPOs (Initial Public Offerings) have been a recurring academic research topic in recent years, largely due to venture capital's integral role in high-potential companies' growth and public entry. Since the 1980s, the US IPO landscape has evolved with increased venture capital activity. Over 35% of the total IPOs are annually backed by venture capital (Dutta et al., 2015), transforming industries by enabling companies to scale and ultimately exit by going public. By the end of the decade, venture capital funds had experienced an increase from $100-200 million to over $4 billion. A reason for that is the contribution of pension funds that were allowed to invest up to 10% of their capital in the venture capital industry (Gompers, 1994). In this paper, we examine the performance of VC-backed IPOs in the U.S. from 1980 to 2020, offering a comparative analysis against non-VC-backed IPOs during the same period based on the following five performance metrics: Underpricing, Buy-and-Hold Abnormal Returns (BHAR), Investments (Property, Plant, and Equipment or PPE as a percentage of assets), Return on Assets (ROA) and Sales Growth. Through these performance metrics, we aim to target a variety of aspects associated with performance. For example, Property, Plant, and Equipment indicate how much the firm invests in its assets. While underpricing is more associated with the first day of IPO, by analyzing Return on Assets, we seek to gain an understanding of the operating profitability of the companies a few years post-IPO. Hence, while these performance metrics are very specific, there are underlying aspects that we seek to achieve by analyzing them.

To see how much the difference between the performance of VC-backed IPOs and non-VC-backed IPOs is, we considered it important to also analyze their performance during times of economic distress. Thus, we take the 2008 financial crisis as an example and perform regressions to see how these two groups of firms performed during that time. In general, we believe that VC-backed firms may be more resilient to economic downturns and thus more stable during financial distress as compared to non-VC-backed firms. This is largely because these companies are in a better position to access more funding when financial markets are under severe pressure. This is mainly due to two reasons. First, venture capitalists tend to have strong ties with the banking industry and can leverage this relationship to access greater funding during times of economic distress (Ivashina & Kovner, 2011). Another reason why this might be the case is that venture capital funds are drawn down and invested over multiple years and thus may have "deep pockets" during economic downturns (Ivashina & Kovner, 2011). These capital commitments may encourage them to invest further in their firms when accessing new sources is challenging.

The relationship between venture capital backing and IPO performance has been explored in several studies, highlighting that venture capital involvement tends to improve the financial health and growth trajectory of IPO-bound companies. Gompers (1996) and others have claimed that VC-backed firms often use underpricing as a strategic tool to build a strong reputation amongst investors by signaling high growth potential, potentially making them sustainable in the

long run (Brav & Gompers, 1997). Moreover, Barry et al. (1990) and Lee & Wahal (2004) identified that VC-backed IPOs generally experience higher underpricing, as these venture capitals tend to cater to high-growth industries that attract substantial initial market interest. This tendency aligns with the findings by von Drathen (2007), who observed that PE-backed IPOs in Germany outperformed non-PE-backed IPOs, with the most significant abnormal returns occurring in the years soon after the IPO. While this trend was observed in Germany and the study analyzed PE-backing, it still gives us an insight into the general nature of VC-backed IPOs. However, this does not necessarily have to be the case. As emphasized by Megginson and Weiss (1991), venture capitalists provide certification that reduces information asymmetry between the IPO firm and potential investors, attracting high-quality underwriters and improving long-term outcomes for IPOs. Thus, they may not necessarily need to have high underpricing. This debate in literature allows us to use the data and analyze our results to see whether VC-backed IPOs have high or low underpricing.

Moreover, sticking to the short term (one year post IPO), studies including the work by Chan et al. (2008), have found that VC-backed IPOs may struggle to sustain high initial returns due to the pressures associated with rapid expansion and the potential volatility that comes with scaling and growing the firms they are associated with (Chen & Liang, 2016). Our study also incorporates ROA and sales growth as long-term performance indicators to gauge whether poor short-term post-IPO performance of VC-backed IPOs results in sustained profitability. Evidence suggests that VC-backed firms may focus less on capital-intensive assets, making them flexible but potentially more vulnerable to market volatility due to having fewer investments in their assets (Ahtiainen, 2022).

Thus, our paper seeks to examine the following question:

How have venture capital-backed IPOs in the U.S. performed from 1980 to 2020 compared to non-venture capital-backed IPOs?

By addressing this question, this study aims to provide insights into venture capital involvement in IPOs and provide broader implications of the dynamics that shape the long-term success of both VC-backed IPOs as well as non-VC-backed IPOs in the US market.

Our paper connects several strands of literature in finance. First, our paper contributes to the literature by focusing on performance metrics across both the short and long term, while also incorporating the impact during times of economic distress, particularly during the 2008 financial crisis. Current literature reflects mixed results regarding long-term PE-backed and VC-backed IPO performance (Ahtiainen, 2022; Von Drathen, 2007). We hypothesize that VC-backed IPOs may perform better initially due to intensive capital support and growth-oriented strategies but may not sustain this advantage in the long term due to higher

growth pressures and strategic volatility of the markets. In contrast, non-VC-backed IPOs may show more stable but gradual growth post-IPO.

Seeing the disparity in the performance of VC-backed IPOs and non-VC-backed IPOs during economic distress, especially the 2008 financial crisis, offers additional insights into the nature of VC-backed firms. For instance, our paper also complements recent work by Bernstein et al. (2017), who demonstrated that PE-backed IPOs exhibited higher investment rates and growth in assets during the crisis, largely due to having greater access to capital, even during bad economic conditions. This shows how private equity or venture capital backing might help firms be more resilient to financial downturns as compared to non-VC-backed firms. Moreover, we add to the literature by clarifying whether VC-backed IPOs demonstrate an advantage in volatile markets due to strategic capital access and high-growth focus, or if their initial growth advantages disappear, making them achieve the long-term stability seen in non-VC-backed IPOs. This comparative analysis enhances our understanding of venture capital's impact on firm resilience and contributes to strategies that VC-backed firms and IPO candidates might adopt to maximize value in both growth and downturn phases. We provide evidence that VC-backed IPOs tend to focus less on profitability and returns and more on growth and expansion in the form of establishing a greater market reputation through higher underpricing as well as striving to achieve higher sales compared to non-VC-backed firms.

Finally, our paper contributes to the literature by providing a multi-faceted view of VC-backed versus non-VC-backed IPO performance in the US, spanning four decades, and incorporating the effects of the 2008 financial crisis. Our analysis covers diverse performance metrics—underpricing, BHAR, PPE, ROA, and sales growth—which are rarely studied together in IPO research. Prior studies have often examined IPO performance in the short-term or long-term independently. Our study provides an integrated approach that considers both short-term and long-term indicators, offering insights into how venture capital involvement shapes IPO outcomes across economic cycles and irrespective of the period considered.

This study is organized as follows. In section I, we provide a critical evaluation of our data sources as well as the variables we use. The methodology and results are discussed in section II. In Section III, we introduce our analysis of the crisis period, where we focus specifically on the 2008 financial crisis. Here, we also discuss our results for the crisis period. Section IV discusses the limitations of our approach and the results. Section V concludes the study.

I. Data and Variables

A. Main Data Sources

Our sample of IPOs comes from data provided by Jay Ritter. The data includes numerous variables such as the names of the 15,447 IPOs in the US from January 1975 to December 2022, the offer date for each of these IPOs, various IPO unique identifying keys such as CUSIP number, ticker symbol, and CRSP PERMNOs, and the founding date for each company. We are also using Venture Capital as a dummy variable for identifying whether the IPO is backed by venture capital or not. There is a group of IPOs in the database that are backed by what Jay Ritter terms Growth Capital (a subset of venture capital). Since they are subsets of venture capital, we are still interested in them. Hence, we include them under the venture capital dummy variable in our data. There are some firms where it is not clear if they were backed by venture capital or not and thus we exclude them from the data.

We supplement this IPO database with information from the CRSP Compustat database where we collect information on the five metrics we are analyzing. We also use the FRED database to collect data for the Consumer Price Index (CPI) in the US, thereby allowing us to calculate inflation and adjust the sales growth for real prices over the three-year average that we are looking at. To get the offer price data for the IPOs in the concerned period, we collect information from the Securities Data Company's (SDC) Global New Issues Database.

B. Sample Construction

For the calculation of each metric, we follow a systematic process that involves data cleaning, merging, and filtering before conducting the final regression analysis. We standardize variables across the datasets to ensure compatibility with Jay Ritter's IPO data set. To run the OLS regressions, we merge Jay Ritter's IPO dataset with the calculated metrics at the firm level by using PERMNO, the unique identifier for each IPO. This creates a master table containing firm-specific information and the corresponding calculated metrics for each PERMNO. Additionally, we incorporate the SIC code from the CRSP Compustat database as a means to have a certain industry classification.

To ensure data integrity, missing values are carefully addressed throughout the analysis. Missing PERMNOs as well as missing offer dates for the respective PERMNOs are filtered out. However, if some PERMNOs in Jay Ritter's IPO database have missing values for some of the metrics, we do not filter out these PERMNOs and instead mark the missing values as NA for the respective metrics. To get a better understanding of our dataset, let us now look at the distribution of VC-backed IPOs and non-VC-backed IPOs in the US during our sample period.

Table I
Number of IPOs over Time

Table I reports the breakdown of the number of VC-backed IPOs compared to those that are non-VC-backed from 1980 - 2020. The total IPOs here are the sum of the VC-backed and non-VC-backed IPOs.

IPO Statistics			
Year	**Total IPOs**	**VC-Backed IPOs**	**Non-VC-Backed IPOs**
1980	77	26	51
1981	192	53	139
1982	84	22	62
1983	653	119	534
1984	316	48	268
1985	328	40	288
1986	671	85	586
1987	511	69	442
1988	276	42	234
1989	235	45	190
1990	204	47	157
1991	404	129	275
1992	599	154	445
1993	802	188	614
1994	616	154	462
1995	571	198	373
1996	828	285	543
1997	603	142	461
1998	382	80	302
1999	561	280	281
2000	430	252	178
2001	130	34	96
2002	159	24	135
2003	131	27	104
2004	295	91	204
2005	267	57	210
2006	246	61	185
2007	314	91	223
2008	47	9	38
2009	79	14	65
2010	189	68	121
2011	164	58	106
2012	175	52	123
2013	254	90	164
2014	305	152	153
2015	183	87	96
2016	113	55	58
2017	200	78	122
2018	242	111	131
2019	227	94	133
2020	449	135	314

As depicted by Table I, our sample consists of both VC-backed as well as non-VC-backed IPOs from 1980 to 2020. A key insight here is that the number of total IPOs done each year varies to a great extent largely due to differences in economic and market conditions. For example, the number of IPOs that happened during 2008 was 47. The main reason for this might be the financial crisis that took place that year due to the collapse of the Lehman Brothers, a situation that we will analyze towards the end of our paper. Another period that stands out is the years 1999 and 2000. In 1999, the number of VC-backed IPOs was nearly the same as the number of non-VC-backed IPOs, while in 2000, VC-backed IPOs were more than non-VC-backed IPOs. This trend reflects the increased activity of VC during the dot-com era, which was a period characterized by investments in technology.

Table II below compares the number of VC-backed IPOs with the number of non-VC-backed IPOs across different industries.

Table II
Number of IPOs across Industries

Table II reports the breakdown of the number of IPOs that are VC-backed and non-VC-backed for every industry in our sample. To find these industries, we grouped the industries by the first two digits of their SIC code to obtain a balance between capturing important variations in the industry level and avoiding overfitting due to an excessive number of SIC codes. This gives us an insight into how certain industries may have a greater number of IPOs in total compared to some other industries. This also helps us understand which industries venture capitalists target and thus have a greater number of IPOs in.

Industry Division Summary

Industry	Number of IPOs	VC-Backed IPOs	Non-VC-Backed IPOs
Agriculture, Forestry, and Fishing	43	10	33
Mining	320	47	273
Construction	120	14	106
Manufacturing	4319	1779	2540
Transportation, Communications, Electric, Gas, and Sanitary Services	910	196	714
Wholesale Trade	376	53	323
Retail Trade	817	181	636
Finance, Insurance, and Real Estate	2677	161	2516
Services	2991	1313	1678
Public Administration	401	41	360

As Table II shows, certain industries such as Manufacturing, have a larger number of IPOs compared to other industries such as Agriculture, Forestry, and Fishing. The industry differences show that these external factors can have a huge impact on the performance of VC-backed as

well as non-VC-backed IPOs. Thus, it is important to control for such factors to make our analysis more standardized.

To analyze how venture capital-backed firms perform post-IPO compared to non-venture capital-backed IPOs, we run regressions on each metric, controlling for certain factors. The SIC code incorporated in the datasets is controlled in our regressions to account for the industry-level effects. We also control for year-fixed effects in our regressions to eliminate any discrepancies arising from unobservable factors that change over time but impact all the firms. As mentioned before, we use venture capital as a dummy variable to see if a firm is backed by venture capital or not. We handle outliers in our results by winsorizing the results at the 1% and 99% confidence intervals. The winsorization is applied on each performance metric separately and grouped by venture capital status (whether the IPO is backed by venture capital or not).

As motivated by our introduction, we have decided to vary our approach to take both a short-term as well as long-run perspective. While underpricing and BHAR give us a short-term (up to one-year post-IPO) indication of performance, we focus on the longer term by looking at how the investments made by companies have changed in the three years post-IPO. We also take this longer-term perspective to look at the return on assets and sales growth over three years. This allows us to capture the company's performance from the initial offering to a more mature post-IPO stage.

C. Variables

Underpricing

As mentioned previously, one of the metrics we measure is underpricing. We analyze how different the underpricing is for firms depending on whether they are backed by venture capital or not. We calculate underpricing as the change in offer price to the first-day closing price.

$$Underpricing_i = \frac{(ClosingPrice_i - OfferPrice_i)}{OfferPrice_i} \times 100$$

By analyzing underpricing, we get a better understanding of the impact of venture capital involvement on the market's reception of IPOs.

Returns (Buy and Hold Abnormal Returns)

We use Buy and Hold Abnormal Returns (BHAR) to measure how much extra return an investor earns by holding the stock of a company over a certain period. In this paper, we define the period as one year after the IPO offering date. This gives a balanced approach between a relatively

short-term and long-term perspective on the post-IPO performance of a firm. BHAR gives us the difference between compounded stock returns of individual firms and compounded benchmark market returns over one year. We use the S&P 500's returns to benchmark for the performance of the market. The BHAR formula is as follows:

$$\mathrm{BHAR}_{i,T} = \prod_{t=1}^{T}(1 + R_{i,t}) - \prod_{t=1}^{T}(1 + R_{m,t})$$

Investment

We use Property, Plant, and Equipment (PPE) as a measure of a company's operational capacity (investments). This indicates how much a company has been investing in its assets and how venture capital might potentially impact a firm's investing activity post-IPO. Thus, in this paper, whenever we refer to PPE, we mean investments. We account for firm size in this metric by dividing PPE by the total assets of each firm (as seen in the equation below), as it gives a better picture by comparing firms irrespective of their size. We use this metric to target the long-term horizon by taking the three-year average ratio of PPE/Total Assets, thereby assessing the efficiency in utilizing fixed assets.

$$\frac{PPE_i}{TotalAssets_i}$$

Return on Assets

Return on Assets (ROA) is a measure of a company's operating profitability. This metric helps us understand if venture capital impacts the operating profitability of companies post-IPO. Instead of directly extracting the return on assets from the CRSP Compustat database, we found it more useful and reliable to calculate it ourselves by dividing the EBIT (Earnings Before Interests and Taxes) for each firm by their respective Total Assets. We choose EBIT instead of EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) because EBIT provides a better insight into the company's operating profitability and includes depreciation, which accounts for the wear and tear of its assets. The use of total assets helps us also account for firm size, thus indirectly eliminating the effects that might occur due to varying firm sizes. We took an average ROA over three years post-IPO to see how it might have developed in the years following the IPO.

$$ROA_i = \frac{EBIT_i}{TotalAssets_i}$$

Sales Growth

We measure sales growth as average annual growth three years post-IPO date. We take the two-year average if no data was available for three years. Consequently, the value of n in the formula adjusts based on data availability for the years post-IPO, with n = 3 when 3 years of data are available and n = 2, otherwise. We base our original year (year 0) as one year after the IPO instead of the IPO year due to a lack of data for the IPO year. So if the IPO year is 2015, our base year is 2016. We calculate the nominal sales growth (r) using the following formula:

$$r_i = \left(\frac{\text{Sales at year n}}{\text{Sales at year 0}} \right)^{\frac{1}{n}} - 1$$

We later adjust for inflation using the US Consumer Price Index for the years concerned to compare the growth. Thus, the growth we see is accounted for by inflationary pressures irrespective of the period considered. We calculate inflation using the base year's CPI and the year corresponding to the nominal sales growth.

C.1 Dummy Variables

C.1.1 Venture Capital (VC)

To compare the performance of Venture Capital-backed IPOs with non-Venture Capital-backed IPOs, we use VC as a dummy variable with “1” for VC-backed IPOs and “0” for non-VC-backed IPOs. This is done to distinguish between the two categories and make it easier to compare their respective performances.

Jay Ritter defines Growth Capital as a subset of Venture Capital in his IPO database represented by the number “2” under the VC variable. We include these into the category of VC-backed IPOs and therefore assign number “1” to all the Growth Capital-backed IPOs.

Table III below reports the summary statistics for all the variables we will be using in our analysis.

Table III

Summary Statistics for all the Firms that went Public between 1980 - 2020

Summary statistics for the performance metrics being analyzed across a large sample of firms. Each performance metric (Underpricing, BHAR, PPE, ROA, or Sales Growth) has a different number of IPOs being analyzed based on data availability. Starting from the left, Table III reports the number of IPOs per metric, the mean for each metric, the standard deviation for each metric, and the minimum and maximum values for each metric. The values for underpricing are expressed as percentages, while the values for the BHAR, PPE, ROA, and sales growth are expressed as percentage points.

Summary Statistics

Metrics	N	Mean	SD	Min	Max
Underpricing	3963	11.935	22.478	-20.082	190.476
BHAR	13142	-0.078	0.579	-1.063	3.353
PPE	10717	0.215	0.218	0.000	0.904
ROA	10798	-0.096	0.322	-1.982	0.340
Sales Growth	8222	0.170	0.356	-0.948	2.636

The summary statistics in this table highlight the characteristics of IPOs based on the performance metrics being analyzed. The data indicates that, on average, IPOs are underpriced by 11.935%. This means that, on average, the initial offering price is 11.935% lower than the first-day closing price which can be an indication of how much the investors value the firm. However, the high standard deviation highlights significant variation in underpricing, ranging from substantial undervaluation to overvaluation. This disparity suggests that market sentiment and information asymmetry are crucial in determining IPO pricing.

The negative average BHAR (-7.8 percentage points) suggests that IPOs underperform the market on average when it comes to returns one-year post-IPO. However, the significant standard deviation implies that individual IPOs can exhibit both substantial outperformance and underperformance. The average investment of 0.215 indicates that firms going public have an average 21.5 percentage point allocation of their total assets to fixed assets.

The negative average ROA (-9.6 percentage points) suggests that, on average, IPOs tend to not be immediately profitable. This finding might be attributed to factors such as high initial investment costs, intense competition, and the challenges of scaling operations. However, the significant standard deviation indicates that some IPOs achieve substantial profitability, while others incur significant losses. The positive sales growth (17 percentage points) suggests that, on average, IPOs experience high growth in sales.

Since we have now gotten an understanding of most of our variables, let us dive into the results.

II. Results

The methodology used to obtain the main results of our analysis is performing numerous OLS regressions on our metrics of interest. These regressions utilize the VC dummy variable to capture the impact that VC involvement has on an IPO's performance. The regression models include industry and year-fixed effects to ensure that these external factors do not impact our analysis in any way. These are explained in greater detail below. Through the regressions, we are seeking an understanding of how much more of an impact venture capital has on IPO performance compared to non-VC-backed IPOs.

A. Control Variables

A.*1 Industry*

Each industry is associated with a specific SIC (Standard Industry Classification) code in the data. There tends to be some variation in IPO performance depending on the industry. For example, certain industries like the technology industry are more volatile to economic shocks. Since the US has numerous industries and there are many uncertainties associated with each industry, we have chosen to control for the industry effects so that our analysis focuses on only the performances of IPOs rather than being influenced by external factors and potentially giving a wrong indication of the outcome. This is mainly done to control for the unobservable factors related to each industry that remain constant over time.

The difference in the growth potential, sensitivity to economic cycles, and the difference in capital intensity across industries are factors that can greatly impact the performance of companies post-IPO. Controlling for the industry helps us remain focused on the performance of IPO market factors rather than the industry-specific sentiment of investors. As a result, by controlling for industry, we separate the performance of IPOs from the broader economic market dynamics.

A.2 Year-Fixed Effects

Since we are interested in looking at the trend over the given period (1980 - 2020), we control for year-fixed effects in our regressions to eliminate any discrepancies arising from unobservable factors that change over time but impact all the firms.

Before exploring our results from the regressions, we compare the summary statistics for the two groups (VC-backed and non-VC-backed) of IPOs separately and see how different they are from each other. We also perform t-tests to evaluate if the differences in means between the two groups are statistically significant, with p-values providing a measure of significance.

Table IV

Grouped Summary Statistics for VC-backed and non-VC-backed Firms

Table IV reports the grouped summary statistics for IPOs categorized by VC-backed and non-VC-backed status during the period 1980 - 2020. The table includes our performance metrics of interest. For each metric, the number of observations, mean and median are reported. The three columns on the right report the difference in means across the two groups for each metric and the t-statistics and p-values for each difference in mean value. The values for underpricing are shown as percentages, while the values for the BHAR, PPE, ROA, and Sales growth are expressed as percentage points.

Grouped Summary Statistics: VC-Backed and Non-VC Backed IPOs

	VC			Non-VC					
Metrics	**N**	**Mean**	**Median**	**N**	**Mean**	**Median**	**Mean Difference**	**t-statistic**	**p-value**
Underpricing	1277	18.238	7.812	2861	9.000	2.083	9.238	10.236	0.000
BHAR	3961	-0.062	-0.212	9860	-0.081	-0.139	0.019	1.485	0.138
PPE	3685	0.156	0.103	7624	0.247	0.164	-0.091	-24.371	0.000
ROA	3690	-0.185	-0.083	7726	-0.048	0.042	-0.137	-20.881	0.000
Sales Growth	2794	0.210	0.152	5919	0.148	0.087	0.062	6.824	0.000

Note: p-value < 0.05 indicates a statistically significant difference in means between VC-backed and Non-VC-backed IPOs.

From Table IV above, we notice that VC-backed IPOs are significantly more underpriced than non-VC-backed IPOs, with an average underpricing of 18.238% compared to 9.0%. This suggests that VC-backed companies are perceived to have higher growth potential and are thus valued more favorably by investors. Venture capitalists also generally tend to price the IPO lower than normal to attract investors and gain a strong reputation which they believe will help the firm grow in the future (Gompers, 1996). The higher standard deviation in underpricing for VC-backed IPOs indicates greater variability in their valuations, potentially reflecting the higher risk and uncertainty associated with these companies. The difference in means of 9.238

percentage points, with a t-statistic value of 10.236 and a p-value<0.05 and more specifically 0, provides evidence that there is a statistically significant difference in underpricing between the two groups.

While both VC-backed and non-VC-backed IPOs tend to underperform the market in the longer run as the negative average BHAR indicates, VC-backed IPOs exhibit slightly better longer-term performance. The average BHAR for VC-backed IPOs is -6.2 percentage points, while for non-VC-backed IPOs it is -8.1 percentage points. However, the significant standard deviation in BHAR for both groups highlights the challenges of predicting future performance, even for VC-backed companies. Although the mean difference in BHAR is 1.9 percentage points, the t-statistic value of 1.485 and the p-value of 0.138 suggest that the difference in means is not statistically significant.

VC-backed IPOs tend to have lower investments than non-VC-backed IPOs, as evidenced by their lower PPE/Total Assets ratio. The average PPE/AT for VC-backed IPOs is 15.6 percentage points, while for non-VC-backed IPOs it is 24.7 percentage points. This potentially reflects VC-backed firms' greater focus on intangible assets and technology-driven business models, compared to non-VC-backed firms' emphasis on tangible assets and traditional business models, as these are usually low-risk firms with a moderate growth rate. Regarding the PPE to total assets ratio, the difference in means is -9.1 percentage points with a t-statistic value of -24.371 and a p-value of 0 highlighting that the difference in means between the groups is statistically significant.

Both VC-backed and non-VC-backed IPOs exhibit negative average ROA, indicating that, on average, they are not profitable. The average ROA for VC-backed IPOs is negative 18.5 percentage points, while for non-VC-backed IPOs it is negative 4.8 percentage points. This finding highlights the challenges of generating sustainable profits in the early stages of a company's life cycle, even for high-growth firms generally backed by venture capital. With the statistically significant t-statistic of -20.881 and p-value of 0, the difference in means is -13.7 percentage points for ROA between the groups.

VC-backed IPOs exhibit higher sales growth than non-VC-backed IPOs, aligning with the venture capital model of investing in high-growth potential companies. The average sales growth for VC-backed IPOs is 21.0 percentage points, while for non-VC-backed IPOs it is 14.8 percentage points. This finding underscores the role of venture capital in fostering innovation and driving economic growth. This is also consistent with the idea that venture capitalists focus more on growth than profitability and thus try to gain as much market share as possible, especially at the initial stage of IPOs. The mean difference of 6.2 percentage points for the sales growth between the means for the two groups is statistically significant with a t-statistic of 6.824 and a p-value of 0.

As we saw, in general, there seems to be a significant difference in the means of the two groups of firms and thus we can expect notable results in our regressions. The statistical significance of the results, with most p-values < 0.05, strongly supports the differences between the VC-backed IPOs and non-VC-backed IPOs.

Table V
OLS Regressions Output

Table V presents the results of the OLS regressions analyzing the impact VC-backing has on IPO performance. The table reports the estimated coefficients for the VC dummy variable, the intercept, adjusted R-squared, F statistics, and the number of observations for each regression model. In parentheses below the coefficients, we find the standard errors for each coefficient. Significance levels are denoted by * p<0.1, ** p<0.05 and *** p <0.01. The values for Underpricing are shown as percentages, while the values for the BHAR, PPE, ROA, and Sales Growth are expressed as percentage points. Specifically, the table reports the following equation:

$$Y_{i,t} = \alpha_i + \beta \cdot VC_i + \gamma_i + \delta_t + \epsilon_{i,t}$$

Where $Y_{i,t}$ captures each of our performance metrics (the dependent variables), γ_i captures the SIC code as a means to control for industry, δ_t exhibits fixed effects of offer year and $\epsilon_{i,t}$ is the error term. The subscript "i" refers to each specific firm and "t" refers to the year.

Regression Results

Metric	Underpricing	BHAR	PPE	ROA	Sales Growth
VC	4.460 ***	0.020	-0.042 ***	-0.030 ***	0.062 ***
	(0.829)	(0.013)	(0.004)	(0.007)	(0.009)
(Intercept)	3.461	-0.016	0.411 ***	-0.046	0.123
	(23.259)	(0.129)	(0.037)	(0.067)	(0.085)
Adjusted R-squared	0.164	0.043	0.459	0.193	0.051
F-statistic	7.870	6.059	82.339	24.090	4.924
Num. obs.	3867	12620	10717	10798	8222
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes

Note: * p<0.1; ** p<0.05; *** p<0.01. Numbers in parentheses are standard errors.

The regression results reveal a statistically significant positive relationship between VC-backing and underpricing. The coefficient of 4.460, with a p-value of less than 0.01, indicates that, on average, VC-backed IPOs are underpriced by approximately 4.460% more than non-VC-backed IPOs. This suggests that VC-backed companies are perceived to have higher growth potential and are thus valued more favorably by investors.

An interesting insight here is that VC-backed IPOs having higher or lower underpricing compared to non-VC-backed IPOs largely depends on the type of venture capital that is backing the concerned firm. For example, Gompers' (1996) grandstanding hypothesis states that younger venture capital firms are dedicated to bringing companies to market earlier, utilizing higher underpricing as a strategic cost. This is done to help VC-backed firms establish a reputation and attract investors, which according to Ritter (Ritter & Welch, 2002) has its roots in the signaling model. However, this was not the case for older and more established venture capitalists. More specifically, Gompers claims that VC-backed IPOs supported by younger venture capitals had an average underpricing of 13.6% compared to 7.3% on those IPOs that were backed by older venture capitals from 1978 to 1987 (Gompers, 1996). Further context is provided by (Barry et al, 1990) who highlighted that venture capitalists who actively monitor IPO firms can also influence their characteristics. Lower underpricing was obtained on the firms backed by higher-quality venture capitals, and significant equity positions were maintained on the IPO firms, reassuring continued monitoring. This is translated to the fact that the market can recognize these quality venture capital firms, resulting in lower underpricing for such firms (Barry et al., 1990).

The results support other studies that were conducted after Gompers (1996). A study by Lee and Wahal (2004) on IPOs between 1980 and 2000 concluded that VC-backed IPOs experienced significantly higher underpricing or first-day returns than non-VC-backed ones. More specifically, the difference in return ranged from 5.01 to 10.32 percentage points, being especially significant during the 1999-2000 time period, mostly due to an increase in market activity in combination with increased competition among the VCs. This is further supported by the fact that in 2000, there were 252 VC-backed IPOs in the US as compared to 178 non-VC-backed IPOs as seen in Table I above. This period was also characterized by having a large number of IPOs compared to many other years with 561 IPOs in total in 1999 and 430 IPOs in 2000, as depicted in Table I above. Underpricing in VC-backed IPOs can be utilized as a signal to the market and more specifically by the younger VC firms to build upon their reputation which can be used to attract future funding (Gompers, 1996; Lee & Wahal, 2004).

As for the slightly longer term, the regression suggests a slight positive relationship between VC backing and BHAR. The coefficient of 0.020, being statistically insignificant, indicates a relatively small impact. This suggests that, on average, VC-backed IPOs outperform non-VC-backed IPOs by 2.0 percentage points in terms of BHAR, after controlling for other factors. However, this effect's magnitude is relatively modest. Thus, we cannot be fully certain of our argument in this case due to statistical insignificance.

Chan et al. (2008) found similar results where VC-backed IPOs generally perform better in the long run than non-VC-backed ones. That was found to be the case especially for larger IPOs, suggesting that the potential effect that VC backing has on IPO in the long run should not be discounted. A similar notion is supported by Dutta et al., (2015) who found that VC-backed IPOs from 1980 to 2013 performed better in a longer period of a three-year BHAR (both market- and style-adjusted) than non-VC-backed IPOs. Our results could be insignificant due to the one-year time period we chose to analyze instead of the three years Dutta chose to explore.

The regression results confirm that VC-backed IPOs invest less in tangible assets compared to non-VC-backed IPOs. The negative coefficient of -0.042, with a statistically significant p-value of less than 0.01, indicates that on average, VC-backed IPOs have an investment ratio that is 4.2 percentage points lower than non-VC-backed IPOs, after controlling for other factors. This aligns with the notion that VC-backed companies often operate in technology-intensive industries with lower capital requirements as a way to pursue their strategy of investment in high-growth companies (Gompers, 1994).

As for ROA, the regression results indicate that VC-backed IPOs tend to have lower profitability than non-VC-backed IPOs. The negative coefficient of -0.030, with a statistically significant p-value of less than 0.01, suggests that on average, VC-backed IPOs have a 3.0 percentage point lower ROA than non-VC-backed IPOs, after controlling for other factors. This may be due to higher investment in growth initiatives and a focus on long-term value creation, which can negatively impact profitability.

Although the monitoring role of venture capitalists could be a factor in high post-IPO performance, there might still be other factors such as conflict of interest and pressure to go public early which may instead lead to inefficient asset utilization (Wang et al., 2003). They claim that venture capitalists may prioritize bringing the firms to the public market rather than securing asset efficiency which would boost ROA. This is also supported by Gompers's (1996) study, suggesting that it is important to build a reputation for venture capitals, and more specifically for younger venture capitals, leading to a potential trade-off between entering the market earlier and compromising on efficient asset utilization.

The regression results confirm that VC-backed IPOs exhibit higher sales growth than non-VC-backed IPOs. The positive coefficient of 0.062, with a statistically significant p-value of less than 0.01, indicates that, on average, VC-backed IPOs have a sales growth rate of 6.2 percentage points higher than non-VC-backed IPOs, after controlling for other factors. This resonates with the venture capital model of investing in high-growth potential companies. These results can be aligned with the findings suggesting that VC-backed firms' net sales benefit from the active monitoring and the involvement of venture capitalists, which strengthen the performance of the firm post-IPO (Raghupathy & Thillairajan, 2015).

The regression analysis provides strong empirical evidence for the distinct characteristics of VC-backed IPOs. While they offer higher growth potential and initial market excitement, they also come with higher risk and uncertainty, as shown by their lower profitability. One of the most important takeaways from our analysis is that VC-backing instills greater underpricing and sales growth, implying that VC-backed IPOs tend to have higher growth potential, one of the main reasons for attracting investors. However, we also notice poor profitability (ROA) as VC-backed IPOs tend to focus more on growth and expansion. This trade-off reflects the inherent nature of venture capital where they focus on strong growth, even if it means compromising on operating profitability. These findings are synonymous with the findings in literature like Gompers' grandstanding hypothesis, indicating that younger venture capital firms use underpricing to build a reputation in the market. In contrast, the active monitoring by venture capitalists contributes to higher sales growth after the firms go public.

While this analysis focused on the generic trend of VC-backed and non-VC-backed IPO performance over 40 years, it does not give the complete picture of whether one group of firms performs better than the other or not. To fully understand this argument, we will now dive deeper into analyzing the performance of these two groups of firms during the 2008 financial crisis, which helps us focus on how these two groups of firms adapt when economic conditions are not normal.

III. Crisis

As mentioned earlier, to get a better understanding of whether venture capital influences IPO performance in the US or not, it is important to also focus on the differences in their performance during times of economic distress. This is where we get a more informed understanding of the nature of both VC-backed IPOs as well as non-VC-backed IPOs. One of the main differences we notice between these two groups of firms during a crisis is that VC-backed IPOs might also play a vital role in keeping the confidence of investors in check during economic crises. This is largely due to certain systemic risks being a major concern, which Arner (2009) identifies. The collapse of the Lehan Brothers that triggered the 2008 financial crisis led to a loss of confidence across financial systems (Arner, 2009). Thus, in such a situation, VC-backed IPOs may be better off in keeping investors' confidence intact (Arner, 2009). This is further reinforced by Tammi (2024), who claims that venture capital plays a huge role in mitigating risks associated with investor sentiment by certifying IPO quality merely through backing their respective firms.

A. Data and Variables

A.1 Main Data Sources

We are once again using the IPOs listed in Jay Ritter's IPO database as our main dataset. However this time we limit our data to firms going public from 2004 to 2007. We complement

this dataset with the financial data for these firms during the fiscal years 2004 - 2011. The financial data is collected from the CRSP Compustat database and the data we collect is EBIT, PPE, Sales, and Total Assets, which we use to calculate ROA and PPE to total assets ratio.

A.2 Sample Construction

As mentioned, the period we are focusing on for our analysis of the crisis is 2004 - 2011. However, we specifically focus on firms that went public between 2004 and 2007. This allows us to analyze how VC-backing affected the firms' performance post-2008 (the period during and after the crisis). If we include firms that went public after 2008, we risk our results being biased as firms that are listed during the crisis may naturally exhibit weaker financial performance due to the economic conditions. Therefore, we are exclusively interested in all IPOs conducted between 2004 and 2007.

Even in this analysis, we follow a similar process that merges Jay Ritter's IPO database with the CRSP Compustat dataset by using PERMNO, the unique identifier for each IPO, to create a master table with the firm information and the financial data for each PERMNO. Additionally, we incorporate the SIC code from the CRSP Compustat database as a means to have a certain industry classification.

The final table is a panel dataset that contains financial information for firms going public from 2004 to 2007. The dataset includes financial data from 2004 to 2011, with yearly data depending on each firm's year of public offering.

A.3 Variables

ROA

As mentioned before, Return on Assets (ROA) is a measure of a company's operating profitability. Here as well, we calculate ROA ourselves by dividing the EBIT (Earnings Before Interests and Taxes) for each firm by their respective Total Assets. The use of total assets helps us also account for firm size, thus indirectly eliminating the effects that might occur due to varying firm sizes. We took a yearly ROA for each fiscal year during the period to see how it might have developed in the years following the IPO.

$$ROA_i = \frac{EBIT_i}{TotalAssets_i}$$

Investment

As mentioned before, we use Property, Plant, and Equipment (PPE) as a measure of a company's operational capacity (investments). We account for firm size in this metric by dividing PPE by

the total assets of each firm (as seen in the equation below), as it gives a better picture by comparing firms irrespective of their size. We measure the yearly PPE for each fiscal year during the period to see how it might have developed in the years following the IPO, thereby assessing the efficiency in utilizing fixed assets.

$$\frac{PPE_i}{TotalAssets_i}$$

Sales

We collect the data for the net sales of all companies in our sample period. This variable represents gross sales, the amount of actual billings to customers for regular sales completed during the period, reduced by cash discounts, trade discounts returned sales, and allowances for which credit is given to customers. This variable is scaled in millions.

To gain a better understanding of the variables we are using in this analysis, we construct summary statistics of all the variables.

Table VI

Summary Statistics - Crisis Period (2004-2011)

Table VI reports the summary statistics for three performance metrics ROA, PPE, and Sales of the firms that went public from 2004 to 2007. The data points span the post-IPO performance over the period from 2004 to 2011. Each performance metric has a different number of IPOs being analyzed based on data availability. Additionally, mean, standard deviation, minimum, and maximum values are presented for each metric. The values for ROA and PPE are shown as percentage points, while the values for Sales are expressed as million USD.

Summary Statistics

Metrics	N	Mean	SD	Min	Max
ROA	890	-0.027	0.218	-1.234	0.363
PPE	865	0.210	0.263	0.000	0.941
Sales	893	568.319	1225.618	0.000	10018.200

Table VI depicts the summary statistics for the variables we are using to analyze the performance of the two groups of firms during the crisis period. The negative average ROA (-2.7 percentage points) suggests that, on average, IPOs are not profitable. This might be due to factors such as high initial investment costs and intense competition. However, the standard deviation of 21.8 percentage points seems to be high and thus reveals a wide variation in profitability across firms. This can range from a huge loss of 123.4 percentage points to a strong profit of 36.3 percentage points. This illustrates the idea that while IPOs tend to struggle with profitability, some firms may manage to achieve huge success in the very short term after going public.

The average investment of 0.210 indicates that IPOs have an average 21.0 percentage points allocation of their total assets to fixed assets. The large standard deviation of 26.3 percentage points highlights the great variety in investment strategies among firms, with some having no investments in fixed assets to others having significant investments in fixed assets (94.1 percentage points). This variability is largely due to differences in industries, access to capital during crises as well as the business models of specific firms.

The average sales (568.319 million USD) suggest a strong notion that IPOs contribute significantly to improved sales levels. However, as before, the large standard deviation of 1,225.618 million USD hints at a diverse sales performance across firms in our sample, with some having no sales at all while others having sales of up to 10,018.2 million USD.

B. Results

As aforementioned, our analysis explores the impact of venture capital backing on the performance metrics of our interest during the 2004 - 2011 period, with a specific focus on firms that went public between 2004 and 2007, following the methodology of Bernstein et al. (2017). The panel data we chose to construct is symmetric in the year 2008, similar to what Bernstein uses. We also use the idea of 2007 being the base year to see the difference in IPO performance before and after the crisis.

The panel data regression models use both firm-fixed effects and year-fixed effects. With this approach, we aim to assess the relationship between venture capital involvement and IPO performance while controlling for unobservable firm-specific and time-varying factors.

B.1 Control Variables

We use several control variables in the regressions to limit the influence of various external factors.

B.1.1 Firm-Fixed Effects

In our analysis, we incorporate firm-fixed effects, controlling for the unique firm identifier, PERMNO. This is done to account for unobservable, time-invariant characteristics specific to each IPO firm. By controlling firm-specific variations over time, we focus on other factors that might contribute to performance, such as venture capital backing, rather than the unobservable internal factors.

B.1.2 Year-Fixed Effects

Since we are interested in looking at the trend over the given period (2004 - 2011), we control for year-fixed effects in our regressions to eliminate any discrepancies arising from unobservable factors that change over time but impact all the firms.

B.1.3 Assets

We include the firms' total assets in 2007 as an additional control variable. This is included to account for differences in firm size that could impact IPO performance. The usage of 2007 as the baseline year allows us to standardize the impact of firm size Bernstein et al. (2017). This ensures that differences in performance are not driven by differences in the firms' sizes.

B.2 Dummy Variables

B.2.1 Crisis

In addition to the VC dummy variable used before, we also use Crisis as an additional dummy variable to separate the years in our sample between the pre-crisis and post-crisis periods. For the crisis and post-crisis period, we assign variable 1, which is defined by the period from 2008 to 2011. The period from 2004 to 2007 is defined as the pre-crisis period. Introducing this dummy variable allows us to compare firm performance across these two periods.

Before exploring our results from the panel model regressions, let us compare the summary statistics for the two groups of IPOs separately and see how different they are from each other.

Table VII

Grouped Summary Statistics - Crisis Period (2004-2011)

The Grouped Summary Statistics for the crisis period report the mean and median values. Once this is done, the difference in the mean of VC-backed IPOs and non-VC-backed IPOs for each metric is calculated. The t-statistic and p-value are then calculated to show how significant the

difference between the means of the two groups of firms is. The values for ROA and PPE are expressed as percentage points and the values for Sales are expressed as million USD.

Grouped Summary Statistics: VC-Backed and Non-VC Backed IPOs

	VC			Non-VC					
Metrics	**N**	**Mean**	**Median**	**N**	**Mean**	**Median**	**Mean Difference**	**t-statistic**	**p-value**
ROA	284	-0.151	-0.032	743	0.031	0.051	-0.182	-9.850	0.000
PPE	284	0.101	0.061	743	0.263	0.115	-0.162	-11.358	0.000
Sales	284	200.174	89.568	743	739.999	261.201	-539.825	-8.602	0.000

Note: p-value < 0.05 indicates a statistically significant difference in means between VC-backed and Non-VC-backed IPOs.

Tabe VII depicts notable differences between VC-backed IPOs and non-VC-backed IPOs. VC-backed IPOs indicate a mean of -15.1 percentage points for ROA compared to 3.1 percentage points observed for non-VC-backed IPOs. This gives an insight into the potential challenges VC-backed firms face in generating profits during the early stages post-IPO compared to non-VC-backed IPOs. The difference in mean of -18.2 percentage points is statistically significant, highlighted by a p-value of 0 and a t-statistic of -9.850. This reveals a huge distinction in profitability between the two groups of firms, possibly due to VC-backed firms being more growth-oriented compared to non-VC-backed firms.

In terms of investments, VC-backed IPOs allocate a smaller percentage of their total assets, with an average PPE ratio of 10.1 percentage points compared to 26.3 percentage points for non-VC-backed IPOs. The difference in mean of -16.2 percentage points is also statistically significant, as highlighted by a p-value of 0 and a t-statistic of -11.358. This hints at the fact that VC-backed firms tend to focus more on intangible assets and technology-centric business models whereas non-VC-backed firms focus more on capital-intensive business models as well as tangible assets.

VC-backed IPOs, on average, have significantly lower sales of 200.174 million USD compared to 739.999 million USD for non-VC-backed IPOs. The difference in mean of -539.825 million USD is statistically significant with a t-statistic of -8.602 and a p-value of 0. VC-backed firms showing lower sales than non-VC-backed firms indicate that VC-backed firms are generally in their early stages of growth and are focused on expanding their reputation in the market rather than increasing their revenue. The median sales values are also lower for VC-backed firms, 89.568 million USD compared to non-VC-backed firms (261.201 million USD), which strengthens the previous argument.

Overall, we see large differences in the two groups of firms with VC-backed firms targeting growth prospects at the cost of profitability as opposed to non-VC-backed firms. The statistically significant differences in ROA, PPE, and Sales across the two groups, supported by p-values <

0.05, underscore the diverse financial and operational nature of VC-backed IPOs compared to non-VC-backed IPOs.

Table VIII

Fixed Effects Panel Regressions Output (2004 - 2011)

Table VIII reports the estimates of the interaction between the VC dummy variable and the crisis dummy variable. Models 1, 3, and 5 contain the coefficient of our interaction term (VC * Crisis) of interest while employing year and firm fixed effects. The regressions run with these fixed effects are our baseline model. To get another perspective, Models 2, 4, and 6 expand on our baseline regression and account for the asset size in 2007 of each firm. These assets interact with the post-crisis dummy variable. The output from columns 1 and 2 reflect ROA, columns 3 and 4 reflect PPE scaled on total assets and columns 5 and 6 illustrate the outputs for sales. Significance levels are denoted by *<0.1, ** p<0.05 and *** p <0.01. The values for ROA and PPE are expressed as percentage points while the values for Sales are expressed in million USD. Specifically, the table reports the following equation:

$$Y_{i,t} = \alpha_i + \beta \cdot (VC_i \cdot Crisis_t) + \theta_t + \lambda_i + \epsilon_{i,t}$$

Where Y_i captures each of our performance metrics (the dependent variables), $VC_i \cdot Crisis_t$ is the interaction term we are analyzing, θ_t captures the fiscal year as a means to control for year-fixed effects, λ_i exhibits firm fixed effects and $\epsilon_{i,t}$ is the error term. The subscript "$_i$" refers to each specific firm and "$_t$" refers to the year.

Regression Results

	Dependent variable:					
	ROA		PPE		Sales	
	(1)	(2)	(3)	(4)	(5)	(6)
VC * Crisis	-0.002	-0.003	0.021***	0.023***	316.283***	328.808***
	(0.008)	(0.008)	(0.004)	(0.004)	(23.673)	(24.502)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Assets Control	No	Yes	No	Yes	No	Yes
Observations	4,556	4,388	4,445	4,296	4,594	4,424
Adjusted R^2	-0.198	-0.180	-0.196	-0.178	-0.110	-0.093
Note:						*p<0.1; **p<0.05; ***p<0.01

We see clear disparities between VC-backed IPOs and non-VC-backed IPOs with varied significance levels. The interaction term VC * Crisis measures the treatment effect of how differently the two groups of firms performed during the crisis. We will now look at how these two groups of firms performed measured by our performance metrics.

The coefficient of the interaction term VC * Crisis in the models regressed on ROA (1 and 2) are -0.002 and -0.003, respectively. Both of these are statistically insignificant with p-values >0.1, indicating that during the crisis, VC-backed IPOs did not outperform non-VC-backed IPOs in terms of ROA (profitability). On average, VC-backed IPOs performed 0.2 percentage points and 0.3 percentage points (when controlling for assets) lower compared to non-VC-backed IPOs. This suggests that while venture capital support may support growth and expansion through the addition of capital, it does not necessarily mean that the improvements in profitability are immediate.

The statistically significant and positive interaction term VC * Crisis for Investments (PPE), with coefficients of 0.021 for model 3 and 0.023 for model 4, suggests that VC-backed IPOs invested more post-crisis than non-VC-backed IPOs. On average, VC-backed firms invested 2.1 percentage points more than non-VC-backed IPOs post-crisis and 2.3 percentage points when controlling for assets. These results imply that venture capital in general supported their portfolio companies under challenging economic conditions, helping them maintain or enhance their investments (Bernstein et al, 2017). This proactive approach to investment highlights how venture capital backing helps firms gain certain competitive advantages during times of economic distress (Bernstein et al, 2017).

In the models (5 and 6) for sales, the interaction term VC * Crisis is both statistically significant and positive, with coefficients of 316.283 in model 5 and 328.808 in model 6 (both with p-values <0.01). These results indicate that VC-backed IPOs exhibited superior performance, 316.283 million USD higher sales compared to non-VC-backed IPOs during the crisis period. Even after controlling for firm assets pre-crisis, the results remain positive and statistically significant, with VC-backed IPOs, on average, having 328.808 million USD higher sales.

These regression results exhibit some important insights. We notice that while venture capital backing may not help with profitability, it still enables firms to have strong investments and sales owing to the growth prospects and stability venture capital brings to their firms. This is not only due to venture capitalists helping with financing, but also helping their firms with strategic advice and networks that enable their firms to have a higher resilience during economically tough times.

Table IX

Time-Varying Fixed Effects Model

Table IX reports the coefficients from a time-varying fixed effects model. All the models employ year and firm fixed effects. The estimates exhibited are the main parameters of our analysis between the VC dummy variable and the dummy variables for each year from 2004 to 2011. Models 1, 3, and 5 contain the coefficient of our interaction terms of interest while employing year and firm fixed effects. The results for models 1, 3, and 5 are based on our baseline formula. On the other hand, models 2, 4, and 6 expand on our baseline regression and account for the assets' size of each firm measured in 2007. These assets interact with the post-crisis dummy. In columns 1 and 2 the outcome is ROA, in columns 3 and 4 the outcome is PPE scaled on total assets and in columns 5 and 6 the outcome is sales. Significance levels are denoted by *<0.1, ** p<0.05 and *** p <0.01. The values for ROA and PPE are expressed as percentage points and the values for sales are expressed as million USD. Specifically, the table reports the following equation:

$$Y_{i,t} = \alpha_i + \beta_1 \cdot (VC_i \cdot \theta_{2004}) + \beta_2 \cdot (VC_i \cdot \theta_{2005}) + \beta_3 \cdot (VC_i \cdot \theta_{2006}) + \beta_4 \cdot (VC_i \cdot \theta_{2008}) +$$

$$\beta_5 \cdot (VC_i \cdot \theta_{2009}) + \beta_6 \cdot (VC_i \cdot \theta_{2010}) + \beta_7 \cdot (VC_i \cdot \theta_{2011}) + \theta_t + \lambda_i + \epsilon_{i,t}$$

Where Y_i captures each of our performance metrics (the dependent variables), $VC_i \cdot \theta_t$ is the interaction term between the VC dummy variables and the dummy variable for each year from 2004 to 2011 that we are analyzing, θ_t captures the fiscal year as a means to control for year-fixed effects, λ_i exhibits firm fixed effects and $\epsilon_{i,t}$ is the error term. The subscript "i" refers to each specific firm and "t" refers to the year.

Regression Results

	Dependent variable:					
	ROA		PPE		Sales	
	(1)	(2)	(3)	(4)	(5)	(6)
VC * year2004	0.021	0.023*	-0.003	-0.005	-328.835***	-344.898***
	(0.013)	(0.014)	(0.007)	(0.008)	(40.498)	(43.487)
VC * year2005	0.027***	0.030***	-0.007	-0.008	-187.915***	-190.715***
	(0.010)	(0.010)	(0.005)	(0.006)	(30.248)	(31.447)
VC * year2006	0.019**	0.018**	-0.009**	-0.009*	-114.688***	-114.253***
	(0.008)	(0.009)	(0.005)	(0.005)	(25.824)	(26.409)
VC * year2008	-0.023***	-0.024***	0.023***	0.025***	117.124***	128.078***
	(0.008)	(0.008)	(0.004)	(0.004)	(24.196)	(24.924)
VC * year2009	-0.036***	-0.037***	0.027***	0.028***	5.931	16.877
	(0.008)	(0.008)	(0.004)	(0.005)	(25.189)	(25.955)
VC * year2010	-0.022***	-0.023***	0.024***	0.025***	159.435***	171.524***
	(0.008)	(0.008)	(0.005)	(0.005)	(25.786)	(26.580)
VC * year2011	-0.013	-0.014	0.022***	0.024***	322.323***	335.291***
	(0.009)	(0.009)	(0.005)	(0.005)	(26.646)	(27.434)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Assets Control	No	Yes	No	Yes	No	Yes
Observations	4,556	4,388	4,445	4,296	4,594	4,424
Adjusted R^2	-0.181	-0.164	-0.196	-0.179	-0.100	-0.083
Note:						*p<0.1; **p<0.05; ***p<0.01

Table IX illustrates how the effect of VC-backing on the performance metrics has evolved from 2004 to 2011 for each performance metric. The analysis incorporates an interaction term between the assets of the 2007 dummy and the crisis dummy as shown in columns 2, 4, and 6. The interaction term allows the models to capture the differential effect of firm size during the pre-crisis period on performance outcomes during the crisis years. This provides insights into how the involvement of venture capital interacts with the pre-existing firm capacities to shape post-IPO performance during the financial crisis and our defined crisis period (2008 - 2011).

The coefficients for the pre-crisis period and especially for years 2005 (0.027 in model 1 and 0.030 in model 2) and 2006 (0.019 in model 1 and 0.018 in model 2) are positive and statistically significant. These suggest that compared to non-VC-backed firms, VC-backed firms experienced higher profitability before the crisis with 2007 as the base year.

Looking at the period after the crisis, we notice that the coefficients exhibited are negative and statistically significant. More specifically, in 2008 the coefficient experienced a decline (-0.023

in model 1 and -0.024 in model 2). When controlling for assets, VC-backed IPOs performed 2.4 percentage points worse than non-VC-backed IPOs. A similar pattern is seen for 2009 where the coefficients are negative and statistically significant (-0.036 in model 1 and -0.037 in model 2). These results suggest that VC-backed firms faced a relative decline in profitability post-crisis compared to non-VC-backed firms.

Going back to our results on VC * Crisis from the previous table (Table VIII), we see that while the coefficients of the interaction term were negative and insignificant, something that these two results have in common is that post-crisis there is a decline in ROA compared to non-VC-backed IPOs and thus profitability for VC-backed IPOs. This trend highlights how venture capital's focus on long-term strategies instead of short-term financial returns could lead to profitability being impacted in times of crisis.

The coefficient for the pre-crisis period that is statistically significant is for 2006 with coefficients of -0.009 for both models 3 and 4, suggesting that VC-backing led to lower investments. However, in the years 2004 and 2005, we see that while the coefficients are negative, they are not statistically significant and thus we cannot be fully certain of this relationship.

However, when looking at the years post-crisis from 2008 to 2011, we see statistically significant positive results. For example, in 2008, we noticed a 2.3 percentage point increase in investments for VC-backed IPOs compared to non-VC-backed IPOs when assets were not controlled and a 2.5 percentage point increase when assets were controlled. This illustrates how the backing of venture capital provides the much-needed resilience to firms that firms usually do not get.

Going back to our results on VC * Crisis from the previous table (Table VIII), we see that the positive and statistically significant coefficients for investments are also present there. This shows how the influence of venture capital is helping firms sustain their operational capacity even during times of economic uncertainty.

For sales, in the period before the crisis, we see negative and statistically significant coefficients for the VC-backed IPOs. However, during and after the crisis, we see positive and statistically significant coefficients. For example, in 2008, the coefficients were 117.124 in model 5 and 128.078 in model 6, later rising to 322.323 in model 5 and 335.291 in model 6 respectively by 2011. These positive and statistically significant results show that despite controlling for the firm size pre-crisis in model 6, venture capitalists had a strong influence on the sales of their firms post the crisis, supporting the claim that they focus more on sustainable growth rather than short-term financial performance.

Going back to our results on VC * Crisis from the previous table (Table VIII), we see that the positive and statistically significant coefficients for investments are also present there. The results are significant and supporting, even after controlling for assets.

Overall, the results so far suggest that companies backed by venture capital firms were more resilient during the financial crisis than a similar set of non-VC-backed firms. One hypothesis of why this might be the case is that venture capital firms help their firms to maintain high investment levels by relaxing their financial constraints, especially when the condition of the economy is bad (Bernstein et al, 2017). This can take place in two ways. As mentioned previously, venture capitalists have fund commitments that are seldom broken and thus they may be more willing to inject more funds into their companies if access to financial markets is difficult. Another way this can take place is by venture capitalists leveraging their strong ties with banks and thus finding it easier to access credit in markets that are struggling economically (Ivashina & Kovner, 2011).

Looking at the broader implications, we see that in the pre-crisis period (2004 - 2006), the positive ROA coefficient suggests that VC-backed firms exhibited higher profitability than non-VC-backed firms, with the 2007 year as the baseline. However, while their investment and sales showed a negative performance, the coefficients were small and thus we notice more of a focus from venture capitals on financial efficiency rather than growth before the crisis.

During and after the crisis (2008 - 2011), we noticed a decline in profitability, together with an increase in investments and sales, which hints at VC-backed firms prioritizing market presence and growth over profitability. This gives insight into the strategic value of venture capital in supporting firms in dealing with economic challenges. The results elaborate on the strong impact of venture capital backing on firm performance during changing economic cycles, with 2007 as the base year. Although VC-backed firms experienced declining profitability during the crisis, they were able to be resilient in their investments and sales.

IV. Discussion

Our analysis of whether VC-backed IPOs outperform or perform differently than non-VC-backed IPOs has endogeneity problems, preventing us from being 100% certain about our results and thus generalizing the trend. Generally, venture capitals target high-growth companies and the nature of these companies tends to be different from non-VC-backed firms, making their performance inherently distinct to a certain degree. A strong performance or high growth potential could attract venture capital involvement rather than venture capital causing the performance. This reverse causality makes it difficult to determine whether the observed performance differences are due to venture capital funding or inherent company qualities that attracted venture capital funding in the first place. Moreover, companies may prefer to go public at times of favorable market conditions according to their operations and financial status and thus this self-selection of the timing of IPOs may introduce some bias when comparing performance.

Additionally, while funding is one main contribution of venture capital to firms, they also provide strategic support to their firms. This level of support can vary greatly and thus while generalizing venture capital may allow us to differentiate from non-venture capitals, within the venture capital-backed firms, there may be discrepancies due to the varied support offered.

Finally, while we control for the industry and year-fixed effects, our results may still suffer slightly from the omitted variable bias as many unmeasured factors such as company management quality can influence IPO performance irrespective of venture capital backing or not.

It is important to also note certain limitations with our data sources. While Jay Ritter's IPO database is comprehensive and widely acknowledged in literature, there is subjectivity involved in the data due to being constrained with predefined categories such as Growth Capital. Moreover, excluding firms with unclear venture capital status may prevent us from generalizing our results, due to potentially omitting firms with significant results. While used in literature to a large extent, the completeness of the CRSP Compustat and FRED datasets can be questioned. As a result, comparing the data across these datasets might lead to mismatches in our results. The SDC Global New Issues Database often misses certain data points, like PERMNOs, which prevent us from being 100% accurate in matching it with the data in Jay Ritter's IPO database and the other databases. While these sources have high credibility by researchers in the field, one must be careful in generalizing the results while considering the potential limitations.

V. Conclusion

This paper provides support for VC-backed IPOs to outperform non-VC-backed IPOs in the longer term in terms of sales growth owing to their focus on growth and market expansion, thereby compromising profitability (ROA). We also notice lower investments in VC-backed IPOs, indicating a greater focus on less capital-intensive firms by venture capital. Our results show a higher underpricing by VC-backed IPOs, perhaps as a means to build an initial reputation in the market to gain stronger returns in the future. This contradicts our hypothesis that VC-backed IPOs may perform better initially compared to non-VC-backed IPOs due to intensive capital support and growth-oriented strategies but may not sustain this advantage in the longer term due to higher growth pressure and the erratic nature of markets.

During periods of economic distress, such as the 2008 financial crisis, we noticed greater resilience exhibited by VC-backed IPOs compared to non-VC-backed IPOs, primarily due to larger access to continued funding and strategic support even during economically difficult times. Moreover, VC backing helps firms sustain their investments as well as keep the level of sales even when the economic climate is bad. This finding is also consistent with the literature, especially Bernstein, who emphasizes the role of strong financial backing during economic

downturns. While the backing of venture capital seems to be promising, the results also illustrate the trade-offs faced by VC-backed IPOs where they might have a higher exposure to volatility and might be exposed to market risks due to reduced capital investments in tangible assets for instance.

By conducting a multi-faceted performance analysis, our paper highlights the strategic influence of venture capital on IPO performance and illustrates nuanced strategies for sustaining long-term success in volatile economic conditions.

Our findings contribute to the broader understanding of the IPO market and the vital role played by venture capitalists in influencing post-IPO performance. Moreover, our paper provides insightful perspectives on different measures of IPO performance as well as different periods. While this study controls for industry and year-fixed effects to reduce the influences of these additional factors, further insights could be generated by going deeper into sector-specific factors and seeing the differential impact of venture capital influence on IPO performance across industries.

References

Ahtiainen, V., 2022, Long-run post-IPO performance of private equity-backed companies. Evidence from the United Kingdom, Master's thesis, Lappeenranta-Lahti University of Technology LUT.

Barry, C. B., Muscarella, C. J., Peavy, J. W., & Vetsuypens, M. R., 1990, The role of venture capital in the creation of public companies. Journal of Financial Economics, 27, 447–471.

Bernstein, S., Lerner, J., & Mezzanotti, F., 2017, Private Equity and Financial Fragility during the Crisis, working paper, National Bureau of Economic Research.

Brav, A., & Gompers, P. A., 1997, Myth or Reality? The Long‐Run Underperformance of Initial Public Offerings: Evidence from Venture and Non-Venture Capital‐Backed Companies. The Journal of Finance, 52(5), 1791–1821.

Chan, K., Cooney, J. W., Kim, J., & Singh, A. K., 2008, The IPO Derby: Are There Consistent Losers and Winners on This Track?, Financial Management, 37(1), 45–79.

Chen, H.-K., & Liang, W., 2016, Do venture capitalists improve the operating performance of IPOs?, International Review of Economics & Finance, 44, 291–304.

Dutta, S., Ganguly, A., & Ge, L, 2015, The Role of Private Equity in Initial Public Offerings: The Case of Venture Capital Firms, Private Equity: Opportunities and Risks,12, 200–214.

Gompers, P. A., 1994, The Rise and Fall of Venture Capital, Business and Economic History, 23.

Gompers, P. A., 1996, Grandstanding in the venture capital industry. Journal of Financial Economics, 42(1), 133–156.

Ivashina, V., & Kovner, A., 2011, The Private Equity Advantage: Leveraged Buyout Firms and Relationship Banking, working paper, Harvard Business School.

Jain, B. A., & Kini, O., 1995, Venture capitalist participation and the post‐issue operating performance of IPO firms, Managerial and Decision Economics, 16(6), 593–606.

Lee, P. M., & Wahal, S., 2004, Grandstanding, certification and the underpricing of venture capital-backed IPOs. Journal of Financial Economics, 73(2), 375–407.

Megginson, W. L., & Weiss, K. A., 1991, Venture Capitalist Certification in Initial Public Offerings. The Journal of Finance, 46, 879–903.

Raghupathy, M. B., & Thillairajan, A., 2015, Financial Value Creation: A Comparative Study of VC-Backed IPOs and Non-VC-Backed IPOs in India, The Journal of Private Equity, 18(3), 55–71.

Ritter, J. R., & Welch, I., 2002, A Review of IPO Activity, Pricing, and Allocations, The Journal of Finance, 57, 1795–1828

Tammi, B., 2024, IPO Performance and Financial Crises, Master's thesis, University of Vaasa.

Von Drathen, C., 2007, The Performance of Private Equity-Backed Initial Public Offerings in Germany, working paper, London Business School.

Wang, C. K., Wang, K., & Lu, Q., 2003, Effects of venture capitalists' participation in listed companies, Journal of Banking & Finance, 27(10), 2015–2034.

VI. AI-Appendix

** Chat GPT was used to enhance the quality of writing and condense the text in certain sections of the paper. We also used Chat GPT to fix certain errors in our code in R when running the regressions. **