ERASMUS UNIVERSITY ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS
Bachelor Thesis Economics & Business

The Role of present-day Venture Capital in the long-run performance of IPOs in the United States

Author: Noël Bax
Student number: 535881
Thesis supervisor: Dr. Ruben de Bliek
Second reader: Dr. Adriana Breaban
Finish date: 07-08-2023

ABSTRACT

For this thesis, I have studied whether venture capital-backed (VC) initial public offerings (IPOs) conducted in the United States after 2010 have superior long-run post-IPO performance compared to non-VC-backed IPOs. Using a large sample of 1419 US firms that went public after 2010, I apply a regression analysis on the effects of VC on the long-term performance, measured by the three-year buy-and-hold abnormal return (BHAR) of an IPO. The findings show that the value-weighted BHAR is approximately 16% higher for VC-backed US IPOs than for the non-VC-backed group. These findings also hold for both the BHR and the equal-weighted BHAR. This implies that US VC-backed IPOs outperformed the non-VC-backed ones in terms of long-run returns for the time period following 2010. However, these implications should be taken with caution as the research has several limitations.

Keywords: Venture Capital, Initial Public Offerings, Long-run post-IPO performance

JEL codes: G24, G30

TABLE OF CONTENTS

CHAPTER 1 Introduction

Initial Public Offerings, or IPOs, have been discussed throughout the years. One of the biggest topics still up for debate is the long-run stock performance after the IPO. Previous studies have shown clear evidence of long-run underperformance of companies that went public through an IPO (Ritter, 1991). Ritter found that the phenomenon of underpricing, where the first day closing price is substantially higher than the offering price, does not last in the long run. Many papers that followed have studied the determinants for this occurrence (Brav et al., 2000; Dong et al., 2011). However, only few of them look at the involvement of venture capital (VC). VC refers to a specific form of private equity (PE) where the fund invests in start-up companies with what they believe to be potential for large growth. Besides owning a smaller stake in the shares of these companies than regular PE firms, they also actively provide managerial support. Studies have shown that VC firms do add value to the performance of their portfolio companies due to their services (Fernhaber & McDougall-Covin, 2009). On the other hand, earlier research has shown that VC firms' age tends to affect the IPO timing of their portfolio companies. It is stated that this happens because of reputational reasons, called 'grandstanding' (Gompers, 1996). This is logical, as younger venture capitalists have yet to prove themselves. Moreover, the fund managers often receive fees based on the size of the VC fund's assets. Since VC funds are more likely to obtain new capital after an IPO, they have selfish reasons to 'prematurely' have their portfolio companies go public. It should be clear that these two findings should have adverse effects on the post-IPO stock performance. Hence, I wondered whether VC involvement would have a positive effect on IPO stocks and their returns in the long run.

Although it is a small proportion of the studies that are about long-term underperformance of IPOs, this relationship has been studied quite extensively in the past by researchers in the field of financial economics. An article by Bessler & Seim (2012) studied the difference in both underpricing and long-run performance of European VC-backed IPOs compared to European IPOs that did not have venture capitalists as financial sponsors. They looked at the buy-and-hold abnormal returns (BHAR) for at least 750 trading days (approximately three calendar years) as a measure of long-run performance. The results showed a significant difference in the BHAR of IPOs of approximately 7.27% after 750 trading days. Another paper by Que and Zhang (2019) studied the relationship between pre-IPO growth and long-run performance while controlling for the effect of VC-backing. They found that for the Chinese A-share market, there is a positive correlation between pre-IPO growth and long-term stock performance. However, this correlation is attenuated by controlling for VC-backing. Newer research done by Matanova et al. (2022) looked at US IPOs from 1997 up to 2010 and studied the effects of both VC and PE involvement on the long-run performance, again measured by the three-year BHAR. They further investigated these effects for a subsample of newly public acquirers, defined as the IPO firms that were part of merger and acquisition (M&A) deals. Their results show that both PE and VC-backed IPOs tend to outperform non-backed IPOs. The latter result

for the VC-backed IPOs is similar to findings of earlier research (Brav & Gompers,1997; Yip et al., 2009). Moreover, Matanova et al. (2022) find that being VC-backed positively impacts the long-run performance of IPO firms that partook in an M&A deal within the first year of going public.

The various previous studies all seem to indicate that long-run post-IPO performance is positively influenced by being VC-backed. However, most of the research was carried out in different areas than the US, like the studies by Que and Zhang (2019). According to studies by Schwienbacher (2005), there are substantial differences between the US and European VC markets. Data provided by Dealroom.co makes it even more clear how the VC market differs substantially in both size and growth from both China and Europe. There are also significant differences in the IPO markets for these countries and how these are alternating throughout the past decades. Where the US used to be the global leader in IPOs, it is Mainland China that, as of 2022, has the both the most IPOs and the best IPO returns according to the global IPO watch by PriceWaterhouseCoopers (PWC). It is therefore not unthinkable that the results of the research done in different areas would vary from studying US VC-backed IPOs. The studies that did look at the US used past data, with the paper by Matanova et al. (2022) using the most recent sample of IPOs ranging from 1997 to 2010. However, while previous research by Cumming (2012) indicated that the VC market was in a crisis before 2010, studies by Lerner and Nanda (2020) showed that the VC market had actually flourished during the 2010s. This is backed up by data from PitchBook which showed that the VC annual investment had gone up from 32 billion USD in 2010 to almost 333 billion USD in 2021. The number of VC deals had also roughly tripled in size over the same period. On the other hand, IPO data from the University of Florida by Jay R. Ritter shows that the average three-year BHAR for 2011 to 2021 is -14.5%, while the period of 2002-2010 had a positive average of 2.2%. It is therefore still unclear how these different circumstances will affect the results of previous literature regarding VC-backed IPOs. Hence, for my thesis, the research question I will aim to answer is: how does VC-backing affect the long-run post-IPO performance of firms that went public in the United States after 2010?

I will obtain the list of IPOs from the University of Florida. Their website contains data for all US IPOs after 1980. This data is collected by Jay R. Ritter, the author of many studies on the topic of long-run underperformance of IPOs. For my sample, I will look at firms that went public through an IPO in the US from 2011 to year-end 2019. I will split my sample into two groups: one with IPOs that had VC backing at the time of going public and one that did not have a VC fund as a financial sponsor. Although it can be said that the years following 2019 have been a major turning point for financial markets due to the COVID pandemic, I will not look at IPOs after 2019 as they do not have the data that are necessary to analyse long-run returns. To measure the long-run performance, I will calculate the BHAR for a firm for 36 months following their IPO date, as described by Ritter & Welch (2002). The Center for Research in Security Prices (CRSP) index will be used as a benchmark to adjust for market returns. I will merge the samples from Ritter's list with data from the CRSP database using their company codes. I will then do a quantitative analysis on the difference in long-run performance

between these two samples by running a multivariate regression where I aim to control for external factors, such as the quality of the underwriter.

Previous literature seems to indicate that VC-backing does have a positive effect on post-IPO performance. However, as both VC and IPO markets have changed drastically in the US, it is difficult to hypothesize whether the negative or positive influence of VC backing will take the overhand. Nonetheless, I believe that the increasing competition in the VC market will have driven venture capitalists to seek even better performance of their portfolio companies. Moreover, the competition will have driven out VC funds that are underperforming, leaving only the efficient and successful ones. Hence, my expectations are that after controlling for variables that could influence post-IPO performance, the effect of VC will still be significantly positive.

The remainder of this thesis is structured as follows. Section 2 discusses previous and relevant studies, creating an overview of the literary landscape of this topic. Section 3 reviews the data that has been obtained for my sample. It also introduces both the dependent and control variables that will be used for the regression analysis. Section 4 focuses on analysing and discussing the results of this regression. Section 5 contains my conclusion from these results. This section also looks at some constraints that my research might have had and provides some suggestions for future research.

CHAPTER 2 Theoretical Framework

2.1 Long-term post-IPO performance

We first need to look at the past literature before we can discuss how VC and post-IPO performance are related. Although underpricing was already a well-known phenomenon at the time, the seminal studies of Ritter (1991) added the anomaly of long-term IPO underperformance to the literary landscape. The author argued that this was a vital topic to study for both investors and companies that were exploring the option of going public. For investors, the existence of underperformance could lead to differing strategies and opportunities. On the other hand, for firms seeking to go public this underperformance would suggest lower cost of external equity financing. The author also studied how the volume of IPOs differed over time and how underperformance was related to this variation. Many papers on this topic that followed have been based on his work. To define the timespan that can be seen as 'long term', he looked at the returns of stocks over three years following the IPO. Studies from Ritter and Welch (2002) described a measurement form that would later become the standard for measuring stock performance over a longer time period. They looked at both the three-year buy-and hold returns (BHR) and the three-year buy-and-hold abnormal returns (BHAR). The BHR can be defined as the return on an investment in the acquiring firm without making any adjustments or trades over the time period. The BHAR adjusts these returns for the market by benchmarking the returns to those of a market index. It also typically includes distributions, such as dividends, as these are realized during the holding period. Ritter and Welch used the value-weighted NASDAQ, American Stock Exchange (AMEX) and New York Stock Exchange (NYSE) indices to benchmark their data against. A value-weighted market index applies varying weights to the stocks of that index based on the market capitalization of the corresponding firms. Later research has used both value-weighted and equal-weighted market indices (Dong et al, 2011; Que & Zhang, 2019). Ritter and Welch also introduced the style-adjusted BHR where the returns are adjusted to those of a similar firm that has been listed on one of the aforementioned exchanges for at least five years. To match these similar firms, they looked at both market capitalization and book-to-market ratios. Although the BHAR could be seen as the standard for measuring stock performance, many other ways have been introduced to this field of research. The cumulative abnormal returns (CAR), CAPM alpha and the Fama-French alpha are all other performance indicators that have been used quite frequently in the existing literature.

Following the work of Ritter (1991), many papers tried to come up with an explanation for the clear evidence of long-run underperformance of IPOs. Ritter and Welch (2002) argue that the people who actually invest in an IPO tend to be the most optimistic about its future returns. As time goes by, these optimistic returns are not realized, decreasing the optimism towards the mean view on the firm. This leads to the stock price falling over time. The initial overvaluation of the firm goes away, and the stock underperforms relative to the market. Another theory introduced by Schultz (2001) states that

large volumes of IPOs follow periods of successful IPOs. Since the expectation for these later IPOs is quite high due to the previous successes of their predecessors, they will almost always underperform relative to these predecessors. As each IPO is weighted equally, the large volume of underperforming IPOs will outweigh the successful ones that came before them, resulting in a negative average. This is called the Pseudo Market Timing theory and offers a rational explanation for the anomaly of underperforming IPOs. The limitation to this theory is that it looks at event-time periods instead of calendar time periods. It does not offer an explanation to the underperformance when all time periods are equally weighted as is done in the works of Baker and Wurgler (2002). A third well-known theory discussed by Ritter and Welch (2002) states that the informational asymmetric market theory of Akerlof, Stiglitz and Spence could also be implemented for IPOs. As the insiders of a firm have information that the public does not, they are able to time their IPO when they believe their stocks to be overvalued in order to collect more money. When all information becomes public, investors find out that the company was overvalued and the stock price drops. Later studies by Jog et al. (2019) find that companies that go public through a two-stage IPO exhibit less information asymmetry and in turn have better long-term performance than their counterparts that did regular IPOs. This suggests that information asymmetry could indeed partly explain the underperforming IPOs.

Many other studies do not try to give full explanations but rather come up with predictors that should be included in the analysis of long-term underperforming IPOs. For example, studies by Dong et al. (2011) find that a better quality of the underwriter diminishes the long-run underperformance. Another paper by Brav et al. (2000) examines the effects of firm size on long-term performance of equity issuers. They find that the underperformance was mostly concentrated in smaller firms with lower book-to-market ratios. Yet another paper by Brav and Gompers (1997) studies how VC-backed IPOs perform in the long run compared to their peers that did not have VC financing.

2.2 Venture Capital and IPOs

This brings us to the topic of the importance of the VC industry. VC is a form of investment institutions that support early-stage companies through funding and strategy consulting. VC is often confused with PE, as both have the main strategy to invest in firms that are not publicly listed via equity financing. They aim to obtain positive returns when they exit these firms, making a profit in the process. However, VC funds differ from other forms of PE in three ways. Unlike PE firms, VC funds get actively involved with strategic and managerial concerns of their portfolio companies. Second, VC funds invest in more early-stage companies compared to PE firms. They believe these younger firms have a lot of growth potential and will generate high returns in the future. Finally, venture capitalists often have less than half of the equity share of their portfolio companies, whereas PE investors generally take full ownership of their firms.

Extensive research from the last decades has shown that venture capitalists add significant value to their portfolio companies and to the economic growth of their countries (Florida & Kenney,

1988; Sahlman, 1990; Keuschnigg, 2004). One of the earlier papers to discuss this is the one by Florida and Kenney (1988), who argue that their investment has accelerated technological innovation and, in turn, business formation. The paper by Sahlman (1990) focuses on the performance of the firms that venture capitalists invest in. The author argues that the superior performance of these companies is attained through the active involvement of venture capitalists with strategic issues. The studies done by Keuschnigg (2004) looks at a more macro-economic perspective, where the author argues that the accelerated innovation due to VC financing has been a major factor for economic growth. Later research by Fernhaber and McDougall-Covin (2009) finds that besides their knowledge, their reputation also seems to be advantageous for their companies as it leads to more venture internationalization. To rephrase, these companies have a higher likelihood of expanding globally. A paper by Kaplan and Lerner (2010) reviews how VC investment and its effects had changed throughout the past. The reason for this paper was to make projections about the future of the VC industry, as it was experiencing a rough period at the time of publishment. This development will also be discussed later in this section. The authors argued that the US VC model had been extremely successful and had led to high economic growth for the country. They pled that this success had led to the model being copied around the world. The authors also showed that an extensive amount of IPOs had received VC financing in the past. For many years, this was the case for more than half of the IPOs.

Since most portfolio firms of a VC fund do not yield positive earnings, the exits are quite important as it is their main way of realizing a positive return for their investors. The most common forms of exiting are going public through an IPO, selling their stakes via an acquisition and the managerial buyout (MBO). Although VC is now part of financial markets in most of the world, it was the US where the industry first took off. A paper by Black and Gilson (1999) argues that the VC industry is positively related with the ability to exit through an IPO, which in turn needs active and unrestricted stock markets. As the US stock markets have been considered the most developed and free of all stock markets globally, it is no coincidence that the VC industry has seen the highest growth in this country. This is backed up by another paper from Schwienbacher (2005), who also adds that there are some extensive contrasts between European and US VC markets. Besides the findings that European stock markets are less active he also argues that the financial markets for investing in VC firms are more rigid. The use of convertible securities was also found to be way more common for US VC's than for European ones. These contrasts have likely led to the large difference between the volume of VC investment in the US and in Europe. However, the US IPO market is no longer the biggest in the world. According to the 2022 Global IPO Watch by PWC, the Chinese IPO market overtook the US in both size and returns. This raises the question whether the VC industry can still flourish with this changing IPO market.

It was argued by Cumming (2012) that the VC industry was in a crisis around 2010. Following the financial crisis of 2008, the author found that the volume of VC investment showed a

steady decline. Moreover, he showed that the number of IPO exits that were backed by VC had been declining since the dotcom bubble had burst too. He argued that not all of these downturns could be attributed to the financial crisis of 2008 and that other forms of investment, like the buyout fund portfolios, had become increasingly popular. However, a more recent paper by Lerner and Nanda (2020) showed that the aforementioned trends had not carried through during the 2010s. Both the amount of early-stage companies receiving first round investment from VC and the actual investment volume rose showed an exceptional increase after the financial crisis. Moreover, the number of VC firms raising funds was significantly higher in 2019 compared to 2007. These positive developments can be attributed to lower cost of capital due to the decline in the federal funds rate, as well as to an abundance of new investment opportunities like the Software-as-a-Service (SaaS) companies. The authors showed that the VC industry did not suffer under the changing IPO markets during the period after 2010.

2.3 Venture Capital and post-IPO performance

When analysing the post-IPO performance, the research usually follows the work of Ritter (1991) and looks at the performance in the long run. The performance in the long run is commonly measured by the three-year BHR or the three-year BHAR as described by Ritter and Welch (2002).

2.3.1 Long-run IPO performance

The paper by Ritter (1991) sparked many researchers to try to find out the cause of the long-run underperformance of IPOs or to find predictors for its severity. Brav and Gompers (1997) were the first to report that VC-backed firms that went public showed less underperformance than the IPOs of firms that did not have VC-backing. The authors also found that using value-weighted market indices significantly lowered the difference in underperformance. Their initial findings were later supported by Yip et al. (2009), who added that the quality of the underwriter also seemed to attenuate the underperformance of the IPOs. Since the US IPO and VC markets were quite different from those of other areas, Bessler and Seim (2012) decided to study the same relationship for Europe. They too found evidence showing a positive correlation between VC-backing and long-run IPO performance. Que and Zhang (2019) did similar research for the Chinese markets, where they studied the effects of pre-IPO growth on long-term performance and the influence of VC-backing on that relationship. They showed that the positive relationship between pre-IPO growth and long-run performance was significantly attenuated by being VC-backed. These findings again suggest that for IPOs conducted in China the involvement of VC leads to better stock performance. The latest studies on this topic by Matanova et al. (2022) looked at US IPOs up until 2010, both VC-backed and non-VC-backed, to study M&A activity within the first few years after going public. Besides the better stock performance of VC-backed IPOs they also showed that the VC-backed group achieved better results for M&A

deals. The extensive research shows continuing evidence for VC-backed IPOs outperforming their counterparts that did not have VC involvement.

On the other hand, there have also been critics that claim VC firms act purely out of selfish reasons. Some studies, like the paper by Lerner (1994) finds that VC firms are highly skilled when it comes to timing their exit. He showed that venture-backed firms often seek to go public when equity valuations are high during market peaks. Gompers (1996) was the first to introduce the topic of 'grandstanding', where younger VC firms tend to take their companies public quicker than older VCs. He argued that they do this for two main reasons. First, the younger VC firm wants to quickly earn a reputation in order to compete with their older peers. A higher volume of firms that went public under their supervision would likely lead to a better reputation. Second, the younger VC fund wants to quickly obtain new rounds of financing for their next investments. Going public leads to large returns and therefore is a very positive signal to possible investors. Hence, they time their IPOs to synchronize with the follow-up rounds of financing. Later research further added to this theory by showing that during periods of technological change, VC firms that take their portfolio firms public quicker obtain larger subsequent rounds of financing (Hsu, 2013). The incubation period, defined as the time between the first VC investment and the date of the IPO, was shown to be significantly shorter during these times of technological change. This provides additional evidence that venture capitalists conduct IPOs due to their desire for larger volumes of future capital. The author also showed that this did have negative effects on the post-IPO performance of these companies. Not only did the companies earn lower stock returns, but they also had lower chances of survival and obtained less patents after going public.

The IPO market is constantly changing, which is one of the reasons why researchers keep investigating the anomaly of post-IPO underperformance. The theory of 'IPO waves' has been widely accepted and documented throughout the past literature (Ibbotson & Jaffe, 1975; Ritter, 1984). This theory states that IPOs are issued in waves, with periods of large volumes and periods of small volumes. The perfect example for a large volume wave would be the dotcom bubble era of 1999 to 2001, where there was a surge in the number of IPOs. Another paper by Boeh and Dunbar (2014) provides evidence for factors that significantly affect the volume of IPO issuances. The authors also state that these IPO waves are likely to affect post-IPO performance as well. It is therefore not surprising that there is a lot of data on how this performance has altered throughout the past. Jay R. Ritter has collected a lot of data on this topic for US IPOs from 1980 up until 2021. His set of data, which can be found in Appendix A Table 1, shows the number of IPOs, the average first-day and one-year returns as well as the three-year BHR and BHAR. Moreover, it also shows these figures for certain subperiods of time. It can be seen that both the number of IPOs and their performance are substantially between the periods of 2001 to 2010 and 2011 to 2021. It should be noted here that Ritter also collected data on the comparison of VC-backed IPOs and non-VC-backed IPOs. This data, which can be found in Appendix A Table 2, shows this comparison for the entire timespan of 1980 to 2021

(Panel A) as well as for certain subperiods of time (Panel B-E). This data does provide evidence that VC-backed IPOs outperform the non-VC-backed ones for the entire period of time. However, there is no such data and evidence for the IPOs after 2010 specifically. This further adds to the question of what the VC effects will look like after 2010.

Although the previous research does seem to indicate that VC-backed IPOs outperform non-backed ones, both the US IPO and VC markets have drastically changed over the past decades. The papers by Cumming (2012) and Nanda and Lerner (2020) are the perfect example of showing how the VC market is constantly changing and adapting to the economic circumstances. The 2010s showed a steady increase in both VC funds and financing. Moreover, from 2010 up until 2019 there have been few extreme crashes or crises, unlike the 2000s during which both the dotcom bubble and the financial crisis of 2008 had occurred. Besides these varying financial landscapes, there is also research done that indicates that VC financing might deteriorate the long-run performance, such as the paper by Hsu (2013). Hence, the question remains whether the previous evidence for VC-backed US IPOs better performance will also hold when we look at US IPOs after 2010. This introduces my hypothesis:

H1: VC-backed IPOs conducted in the United States and after 2010 have superior long-run post-IPO performance compared to non-VC-backed IPOs.

CHAPTER 3 Data & Methodology

3.1 Sample

To obtain my list of IPOs that were conducted in the US after 2010 I will consult the data provided by the University of Florida. The data is collected by Jay R. Ritter, the man behind many influential papers on IPOs, some of which have been previously discussed. This database has substantial data on all topics of IPOs in the United States, from the number of offerings to underwriter reputation. The database also provides an extensive list of all US IPOs from around 1975 up until 2022. This list, which is called the IPO-age list and can be found under the list of VC-backed IPOs on the website, shows for each IPO whether or not it was VC-backed, if the issuance had dual shares and the primary offer date. Ritter also provides a subgroup of VC-backed IPOs which he calls 'Growth Capital-backed' IPOs. In another paper by Ritter (2015), it is explained that this subgroup differs from pure VC as they invest in tangible assets and make acquisitions as part of their business model. The dataset also shows certain company codes such as the CUSIP and the Ticker. These codes identify the companies and will later be used to merge the IPOs with the respective stock data. Finally, the list also provides the industry that the firm is active in by giving the US Standard Industry Classification (SIC) code. The first two digits of this code represent the major industry sector that the business operates in. For my baseline sample, I will only select IPOs that meet the following requirements. In the first place, the IPO must have taken place after 2010 and before 2019. These years are chosen since I am trying to study the VC effects after 2010. However, as the three-year BHAR is going to be the measure of long-run post-IPO performance and the monthly stock data is available up to year-end 2022, I will only look at IPOs with an offer date up to year-end 2019. Second, the IPO must be defined as being VC-backed by the Ritter data. Since the Growth Capital companies are just a subgroup of VC who still actively invest in their portfolio firms, they can reasonably still be seen as VC. I will therefore include these Growth Capital-backed IPOs in my baseline sample. Leaving out the observations for which there was no indication whether or not the IPO was VC-backed I end up with 1663 US IPOs.

3.1.1 Long-run Performance

In order to compare the difference in returns between these two subsamples, we need to obtain the stock data of the firms. Although using daily returns would give an even more precise result for the BHAR, I will stick to the monthly data as I am examining the returns for multiple years, reaching up to more than a decade for some of the earliest IPOs. The monthly stock data can be found via the Wharton Research Data Services database of the University of Pennsylvania. They are a well-established research platform for capital markets, partnering with vendors from all over the world to host the broadest collection of data. The Centre for Research in Security Prices (CRSP), one of these partners, is the main provider for the security data of the NYSE, NYSE MKT (previously known as the AMEX) and NASDAQ stock exchanges. Their monthly stock file will be my source of data for the

stock returns. CRSP gives the option to provide a certain list of company codes in order to find the security data for the firms that you seek to study. I opted for the Ticker symbol, which is a four-letter identification code that is unique per public US company, as these symbols are included in the list of IPOs by Ritter. After implementing the list of firm Ticker symbols, the monthly stock data from the issue date of the IPO up until year-end 2022 is obtained. However, some of the identifiers from the Ritter data have been slightly altered in the CRSP database since the former data had been published. Using a match function, it also appeared that some of the Tickers were not found in the CRSP list of data. It appeared that some Tickers had either been incorrectly reported by Ritter or had been changed since the time of publication. Approximately twenty Tickers were adjusted to their current status as is shown on the NASDAQ, NYSE MKT or NYSE exchanges. A list of the adapted Tickers was again put into the CRSP database to obtain the stock files for these companies as well. Examining the updated dataset, it was found that only seven firms of Ritter's IPO list were not matched to the CRSP data. Since the updated Tickers for the firms did not seem to be included in the CRSP database, the respective companies were removed from the list of data.

To properly calculate the market-adjusted returns I also need the benchmark returns for these years. CRSP provides this as well in their Stock Market Indexes data. Another option to obtain market index return can be found in the monthly stock file by selecting the variable called 'Value-Weighted Return (including distributions). This variable gives the market-adjusted return using the value-weighted CRSP market index while including dividends. The index is value-weighted using the market capitalization as a measure of size. The database also provides the same market index without applying such weight which they call the equal-weighted CRSP market index. All stocks are given equal weights when calculating this index. Both indices consist of all firms listed on the following exchanges: the NYSE, NYSE MKT, NASDAQ and NYSE Arca exchanges. Having obtained the desired three-year returns for both the IPOs and the market benchmarks, the BHAR can be calculated using the following formula:

$$BHAR_i = \sum_{t=1}^{36}(1 + R_{i,t}) - \sum_{t=1}^{36}(1 + Rm_t)$$

Where BHAR is the three-year buy-and-hold abnormal return for firm *i* after going public, (1+Ri,t) is the raw return for firm *i* for month *t* after the IPO and (1+Rm,t) is the market index return for month *t*. It is vital to use the market index returns for the same months as the stock returns to obtain the correct BHAR. For the market benchmarks, I opted to look at both the value-weighted CRSP index and the equal-weighted CRSP index in order to compare the results for different measures of the market. As I am aiming to also test the results for robustness, the BHR is also required. This measure can easily be obtained by adjusting the previous formula:

$$BHR_i = \sum_{t=1}^{36} (1 + R_{i,t})$$

Where BHR is the three-year buy-and-hold return for firm *i* after going public. Here, the market index is left out in order to assess the performance of raw returns of an IPO. Although controlling for the market and its trends gives a more valid view, it could be interesting to see if the results differ when these are disregarded.

As I am looking at the long-run performance, we need to consider that there are also IPOs of which the stocks have been publicly traded for less than three years. These firms are noted as 'delisted', which means as much as that their stocks are no longer publicly available on the exchange. The delisting of companies can have various reasons. For example, firms getting acquired shortly after going public happens quite frequently. Firms could also have merged with other firms, continuing under a new name with new stocks. Finally, firms filing for bankruptcy are also delisted. Since these delisted stocks do not have long term returns, they need to be taken out of the analysis. To do this I create an extra list of data that only shows the three-year BHAR if the Ticker for the data three years later is the same as the Ticker at the current date. This way, the file will only show the BHAR of an IPO if there is data for that specific company for at least 36 months after going public. IPOs that do not meet this requirement show a value of zero for the BHAR and are omitted for my analysis. This leaves me with 1419 US IPOs, which will be my final full sample.

3.2 Control Variables

To further analyze the long-run post-IPO performance, I add certain control variables to the multivariate setting. First of all, the underwriter is expected to play a role in the long-run performance of the IPOs following the results found by Yip et al. (2009) and by Dong et al. (2011). Hence, the quality of the underwriter is added to the regression. The website of IPOscoop.com has data for US IPOs from early 2000 up to 2020, sorted by year and including Ticker symbols. It contains data for the initial performance but also shows all leading managers (underwriters). For quite a few IPOs this meant that there were multiple underwriters leading the process of going public, which is called 'joint-lead management'. For simplicity, the first of the leading investment banks that is mentioned will be used to identify underwriter quality. This is done by splitting the values for the underwriter cells into different columns. As the underwriters that work together often have similar reputations and skills, it can logically be assumed that it would not matter which investment bank is chosen as a measure of quality. Next, the underwriter reputation needs to be matched to the respective underwriters. The list of rankings can also be found on the website of the University of Florida under 'IPO underwriter reputation rankings (1980-2022)'. The scores used in this list are based on the papers by Carter and Manaster (1990) and Carter et al. (1998), who wrote about underwriter reputations and the effects on IPOs and their initial returns. They base the prestige of an investment bank on tombstone

announcements, which can be seen as an announcement of a public listing. Based on the relative position of the investment banks in these announcements they obtain a prestige ranking ranging from nine, the best, to zero, the worst. Their methodology has become the standard for measuring underwriter quality, which is why the list by Ritter is also composed using this approach. This list is now updated every few years and currently contains the prestige rankings for underwriters from 1980 up until 2021. The data also provides a separate list that contains the rankings for the year 2014. It needs to be noted that for some underwriters the scores are not always updated and therefore have missing values for some periods. As I am examining IPOs from 2011 to 2019, I only look at the rankings from Ritter's updates that are within this period. This left me with four lists of rankings that belong to the following time periods: 2010-2011, 2012-2017, 2018-2020 and a separate one from 2014. The last one is implemented as it contains scores for some underwriters that were not mentioned in any of the other lists. Since the IPOscoop data contains an extensive amount of underwriters it is desirable to obtain as many scores as possible. After merging the lists of rankings with the IPOscoop data, it was cleaned with respect to differences in company names for some of the investment banks.

The rankings were matched to the respective underwriters in the following way. First, an average of is obtained from the rankings that belong to the three updated periods. Should there be a missing value for one of these periods, it is left out of the calculation as otherwise it would be taken as a zero. This would falsely drive the average downwards. It would not make sense to match the year of the IPO to the period of the ranking as there are quite a few missing values for the different updates. This would lead to underwriters returning a missing value and therefore a zero, even though there is a ranking available. Therefore, the average ranking is in my view the most unbiased measure of reputation. Next, the score of the 2014 list is matched to the same underwriter. Should there be no score available in any of the three time periods, this ranking is implemented as the final ranking. Otherwise, the calculated average of the three periods will count as the final prestige score. If there was no ranking in any of these lists, the underwriter was handed a rank of zero. This was done as the data by Ritter includes all major investment banks, which means that not being mentioned in any of his lists is likely to indicate that the underwriter had a low reputation. Finally, these final rankings were matched to the list of IPOs using the Ticker symbols. The IPOscoop list apparently did not have information on all IPOs, as some Tickers returned missing values. After controlling for differences or adaptations in the Tickers symbols, there were still a few missing values. Fortunately, the amount was not severely high.

Quite a few papers state that younger VC firms take their portfolio firms public earlier than older, more established VC firms, like the one by Gompers (1996). The author argues that this is done in order to boost their funds through refinancing while disregarding whether the IPO is premature. It is therefore not unreasonable to think that these firms, that have less time between their founding date and their date of going public, underperform relative to the firms that do not rush into the IPO. Recent studies by Basnet et al. (2022) show that these premature listings obtain lower post-IPO returns.

Moreover, it could be argued that the age of a company brings knowledge and experience with it, which could have a positive effect on long-term performance. Therefore, I will control for the age of a firm when going public in my analysis. The list of data by Ritter contains the offer date and the year that the firm was established, which gives me the opportunity to add the number of years before going public to the regression. Unfortunately, the exact date of establishment was not provided by either CRSP or Ritter's list which is why the number of months could not be calculated. It should also be acknowledged that the list of data did not have the founding years for all corporations. These firms report missing values for the number of years leading up to the IPO.

Finally, the size of a firm when going public could be an indication of how well the firm was performing before, which in turn could lead to better results for the long-term performance. This correlation between firm size and long-run performance was also documented in earlier research (Brav et al., 2000). Hence, I control for firm size by adding the market capitalization at the time of going public to the regression. The CRSP database also contains monthly market capitalization data. Using the same method as before, this firm size data is matched to the corresponding IPOs. Unfortunately, the market capitalization is only available after the first month of trading of an IPO. However, assuming a company's size does not alter that much in a month, it is still a decent indicator for the size of the IPO firm. I opted to use the natural logarithm for this variable in order to linearize the relationship. Table 3 below shows the descriptive statistics for the full sample.

Table 3: Summary statistics for the full sample. *vwBHAR* and *ewBHAR* are the buy-and-hold abnormal returns using the value-weighted and equal-weighted CRSP indices respectively to adjust for market returns. BHR is the buy-and-hold raw return without market adjustment. Their values are in percentiles. *VC* is a dummy variable with values of zero, one and two. It indicates whether the IPO had VC-backing, growth capital-backing or no backing. *Ranking* shows the score of the underwriter with values ranging from zero to nine. *Ln (Size)* is the natural logarithm of the market capitalization which was measured in USD. *AgeatIPO* is the age of a firm when going public in number of years.

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
vwBHAR	1,419	-.035215	1.069649	-3.88446	7.213968
ewBHAR	1,419	.05277	1.066745	-3.787835	7.345341
BHR	1,419	0.3247331	1.076688	-3.612465	7.472362
VC	1,419	.5031712	.5894798	0	2
Ranking	1,223	7.902701	2.069796	0	9.001
Ln (Size)	1,419	12.94965	1.3072	9.293581	18.03488
AgeatIPO	1,343	16.38347	23.91293	0	172

It can be seen that there are fewer observations with respect to the underwriter quality or the age. This is due to the missing values in the data for some of the IPOs in the sample. It should also be noted that the 'VC' variable can also has observations that hold the value two. This will later be changed in order to have only two groups: VC-backed and non-backed IPOs. For now, it could be interesting to see how the statistics vary over the different groups. Table 4, for which the full version can be found in Appendix B, shows these differences. These statistics show that the mean for the three-year BHAR is higher for the VC-backed group than for the non-backed group. It is also interesting to see that the mean of the firm's age when going public is substantially lower for the VC-backed groups than for the non-backed group. This is in line with the findings of Gompers (1996) that venture capitalists take their portfolio companies public sooner.

Table 4: Summary statistics categorized by being VC-backed. *vwBHAR* is the buy-and-hold abnormal return using the value-weighted CRSP index to adjust for market returns. Its values are in percentiles. *AgeatIPO* is the age of a firm when going public in number of years.

	Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
VC = 0	*vwBHAR*	774	-.1351569	.8555812	-3.638576	5.317327
	AgeatIPO	698	22.45129	31.29603	0	172
VC = 1	*vwBHAR*	576	.1261524	1.301308	-3.88446	7.213968
	AgeatIPO	576	9.201389	5.016605	1	32
VC = 2	*vwBHAR*	69	-.2611945	.9122741	-3.752479	1.918523
	AgeatIPO	69	14.95652	14.70338	2	67

3.3 Regression analysis

For my analysis I run a multivariate ordinary least squares (OLS) regression. The three-year BHAR is used as the measure of long-term post-IPO performance. The following regression shows the base model of my analysis:

$$vwBHAR_i = \beta_0 + \beta_1 * VC_i + \beta_2 * Ln(Size)_i + \beta_3 * AgeatIPO_i + \beta_4 * Ranking_i + \varepsilon_i$$

Where '*vwBHAR*' is the three-year buy-and-hold abnormal return of the IPO, benchmarked against the value-weighted CRSP index. '*VC*' is a dummy variable which equals one if the IPO was VC-backed, two if the IPO was growth capital-backed and zero otherwise. In order to get rid of the Growth Capital-backed group, all values of two are replaced with one. This leaves only two groups: VC-backed and non-VC-backed IPOs. The '*Ln (Size)*' variable indicates the size of a firm, measured by the market capitalization in thousands of USD at the time of going public. I control for the number of

years leading up to the IPO with the continuous '*AgeatIPO*' variable that measures the number of years between the founding date and the IPO date. '*Ranking*' is the control variable that shows the rank of the underwriter of the IPO with values ranging from zero to nine. Both industry and the year of going public could have large effects on the outcome. Some years had better economic circumstances than others, while some industries have been doing better over the past decade. Therefore, I use a robust, multi-clustered regression. The results are clustered by the '*industry*' variable, which shows the first two digits of the US SIC code (major industry sector). The regression is simultaneously clustered by the '*offeryear*' variable, which indicates the year that the respective firm went public.

As I am looking to check the robustness of this analysis, the regression is also run for the BHR as well as the equal-weighted three-year BHAR. These additional measurements of long-term performance follow the works of Ritter and Welch (2002) and Que and Zhang (2019). The following regression shows the model for the BHR:

$$BHR_i = \beta_0 + \beta_1 * VC_i + \beta_2 * Ln(Size)_i + \beta_3 * AgeatIPO_i + \beta_4 * Ranking_i + \varepsilon_i$$

Where '*BHR*' is the three-year buy-and-hold return of the IPO. The only difference from the BHAR is that the returns are not adjusted for the market. Rather, the raw returns of the IPO are assessed for long-term performance. This method gives an idea as to how the various IPOs perform when disregarding market trends. Next, the regression below shows the model for the equal-weighted BHAR:

$$ewBHAR_i = \beta_0 + \beta_1 * VC_i + \beta_2 * Ln(Size)_i + \beta_3 * AgeatIPO_i + \beta_4 * Ranking_i + \varepsilon_i$$

Where '*ewBHAR*' is the equal-weighted three-year buy-and-hold abnormal return of the IPO. The only difference in calculating this variable with the value-weighted BHAR is the market index that is used. For the equal-weighted BHAR, the equal-weighted CRSP index is implemented to adjust for the market. This index gives the same weight to all stocks in its portfolio and gives no regard to their size. The results of both of these regressions are again simultaneously clustered by both the industry and the year of initial offering.

CHAPTER 4 Results & Discussion

4.1 Results of the base model

To assess the effect of VC-backing, I run my OLS regression for the base model in the statistical software of Stata. I will give a quick explanation of the interpretations of the various coefficients as most of these are rather straightforward. The coefficient for the '*Ln (Size)*' variable can be interpreted as a percentage increase in the BHAR for every one percent increase in the size of the IPO. The '*ranking*' coefficient shows the difference in the BHAR for one additional point in the quality score. The '*ageatIPO*' coefficient shows this difference for every year increase in the age of a firm when going public. Finally, the coefficient of the '*VC*' dummy variable indicates the change in the BHAR when an IPO was VC-backed relative to an IPO that did not have VC involvement. In the following sections, I will discuss these results. As there are some variables that have missing values, I apply a step-by-step analysis of the regression where these variables are gradually added to a baseline model. The variables are added in order of which one has the least missing values. Table 5 shows the results of the different regressions.

Table 5: Regression results of the base model. *vwBHAR* is in percentiles. *Ln (Size)* is the natural logarithm of the market capitalization which was measured in USD. *AgeatIPO* is the age of a firm when going public in number of years. *Ranking* is the score of the underwriter and has values ranging from zero to nine.

	vwBHAR		
	(1)	*(2)*	*(3)*
VC	0.2169977**	0.2260238***	0.1611897**
	(0.0712905)	(0.0661538)	(0.0606464)
Ln (Size)	0.0235996	0.018983	-0.0038317
	(0.0257607)	(0.0303936)	(0.0420688)
AgeatIPO		0.0012145	0.0005116
		(0.0013054)	(0.0016327)
Ranking			0.0438403
			(0.029158)
Constant	-0.4394573	-0.4003158	-0.3867115
	(0.3044626)	(0.3428522)	(0.3363566)
Observations	1,419	1,343	1,183
R^2	0.0113	0.0109	0.0128
Adjusted R^2	0.0099	0.0087	0.0094

*Note: *p<0.1; **p<0.05; ***p<0.01*

The first column of Table 5 shows the outcome of my baseline regression, where I leave the variables that have a substantial amount of missing values out. In this case those are the ranking and age variables. The R-squared for the baseline model is 0.0113, meaning that this model explains about one percent of the outcome. A lot of other factors that influence the BHAR still need to be taken into account. The coefficient for the '*VC*' variable shows that, on average, VC-backed IPOs had a value-weighted three-year BHAR that was 0.217 higher than the non-backed IPOs. The coefficient is statistically significant at the 5% level, but not at the 1% level. The natural logarithm of size does not appear to have a significant effect on the BHAR in my sample.

The second column of Table 5 shows the results of the second step in my analysis where I control for the age of the firm when going public. Although adding this variable to the regression does lower the p-value of the natural logarithm of size, its coefficient is still statistically insignificant. The indicator for age also does not have a statistically significant effect. The coefficient for the VC-backing variable is now also significant at the 1% level. For this regression, the VC-backed group had on average 22.6% higher abnormal returns in the long run than their counterpart. The adjusted R-squared has dropped to 0.0087 compared to a value of 0.0099 for the previous model. Hence, this model has less explanatory power than the first one. However, the alteration in the VC-backing coefficient does seem to indicate that the age of a firm when going public has a role in predicting long-run performance. The age variable is therefore kept as it could be relevant for the results.

Next, I add the final control variable which indicates the quality of the leading underwriter. The results for this final analysis can be found in column three of Table 5. This final regression has an R-squared of 0.0128. While the statistical fit has improved, it is still indisputably low. This likely means that there are still many other variables that could have been taken into account for the regression. Neither of the effects for age and size show statistical significance at any percentage level. The quality of the underwriter does not appear to have a significant effect on the long-term performance of the IPOs in my sample either. The '*VC*' variable still has positive coefficient of 0.161 and is significant at the 5% level. This indicates that on average, the VC-backed IPOs had a 16.1% higher BHAR than the non-VC-backed group.

4.2 Results of the robustness test

In order to test the robustness of the previous analysis, the regression is replicated using different indicators of long-run post-IPO performance. Both the BHR and the equal-weighted BHAR are analysed. For the latter, the value-weighted CRSP is now implemented as the benchmark. This section focuses on the similarities and differences between the results of the base model and this one, rather than going over the interpretation of every coefficient. Table 6 shows the results of the various models for the robustness test. The full version, where the step-by-step expansion of the regressions is added, can be found in Appendix C.

Table 6: Regression results of the robustness test models. *BHR* and *ewBHAR* are the buy-and-hold return and the equal-weighted buy-and-hold abnormal return respectively. Their values are in percentiles. *Ln (Size)* is the natural logarithm of the market capitalization which was measured in USD. *AgeatIPO* is the age of a firm when going public in number of years. *Ranking* is the score of the underwriter and has values ranging from zero to nine.

	BHR	*ewBHAR*
	(1)	*(2)*
VC	0.1683069**	0.1587633**
	(0.0631871)	(0.0572442)
Ln (Size)	-0.001505	-0.0055022
	(0.0422356)	(0.0418451)
AgeatIPO	0.0004174	0.0006451
	(0.0016452)	(0.0016008)
Ranking	0.0422065	0.0446825
	(0.0300298)	(0.02855)
Constant	-0.0503254	-0.2852809
	(0.3039411)	(0.3481939)
Observations	1,183	1,183
R^2	0.0127	0.0128
Adjusted R^2	0.0094	0.0094

*Note: *p<0.1; **p<0.05; ***p<0.01*

Results for the full regression of the BHR model can be found in the first column. Similar to the full regression of the base model, the *'VC'* variable has a positive coefficient that is statistically significant at the 5% level. The coefficient is now slightly higher and indicates a superior three-year BHAR of approximately 16.8% for the VC-backed IPOs. This coefficient stays at least significant at the 5% level for all versions of the expanding regression, as can be seen in Appendix C. This is similar to the analysis of the value-weighted BHAR. None of any of the control variables show any sign of statistical significance. The constant is substantially higher for this model, which follows expectations as there is no adjustment for market returns.

The results for full regression of the equal-weighted BHAR model can be found in the second column. The *'VC'* variable now has a coefficient that is lower compared to the value-weighted model. his time, the VC-backed IPOs had on average a long-term abnormal return that was approximately 15.9% higher than the non-VC-backed group. However, '*VC*' is still the only significant coefficient and has a p-value of 0.024. Overall, the results do not differ significantly between the three models with respect to the sign, magnitude and significance of the coefficient for the VC effect.

4.3 Discussion

Throughout the different regressions for the base model, the p-value for the VC-backing coefficient stays below 0.05. This suggests that the effect of VC-backing stays significant at the 5% level even while adding the various control variables. This does not change when looking at either the equal-weighted BHAR or the BHR as measures of long-term performance. Furthermore, for all models the coefficient stays positive, indicating a positive effect of VC on long-term returns. Hence, I am unable to reject my initial hypothesis, which stated that VC-backed IPOs conducted after 2010 had superior performance in the long run than non-VC-backed IPOs. This is in line with the expectations, as most previous research that studied this relationship either in the US (Brav & Gompers, 1997; Matanova et al., 2022) or in a different area of the world (Yip et al., 2009; Bessler & Seim, 2012) showed similar evidence. The evidence that was reported in this research suggests that the trend that was reported in the US by Matanova et al. (2022) for the 21st century is continuing after 2010. This implies that VC-backed IPOs in the US still have better long-run returns than those without VC involvement, even when adjusting for the market. This would make them more interesting to prospective investors. However, the models that were used for my analysis appear to lack other explanatory variables if we look at the R-squared. Moreover, there are several other limitations to my research that need to be kept in mind when interpreting the results of this research. These limitations will be discussed in the following section.

CHAPTER 5 Conclusion

For my studies, I tried to examine the post-IPO long-run performance of VC-backed US in comparison with the performance of those that did not have VC funding. Although almost all previous research showed evidence of VC-backed IPOs having less underperformance in their long-term returns, this had not yet been shown for companies that went public after 2010. This is odd, as the VC market in the US had shown a significant comeback during the 2010s after the financial crisis of 2008. This alteration could clearly have an impact on the performance of VC firms and their portfolio companies' returns. Studies that did conduct research on this topic after 2010 did not look at data from the US, despite the fact that the US markets for both VC and IPOs are substantially different than those of other areas around the world. Moreover, the trends that these markets have undergone in the US have not been the same globally. For example, the Chinese IPO market has been showing lots of improvement both financially and in terms of volume, whereas US IPOs stagnated on these matters. Hence, the question arose whether US VC-backed IPOs conducted after 2010 also outperformed non-VC-backed IPOs in the long run.

In order to analyze this research question, I consulted the database of the University of Florida by Jay R. Ritter from which I obtained a sample of 1663 US IPOs that went public between 2010 and 2019. After controlling for firms that were delisted within three years and would therefore not be suitable to study long-term performance effects, I ended up with a sample of 1419 US IPOs. As there are many factors that come into play when it comes to the returns of a firm, I obtained data concerning the size and age of the firm behind the IPO, as well as the quality of their leading underwriter. After examining the baseline model, these control variables were gradually added to the regression in order to apply a step-by-step analysis. All models showed evidence that VC-backed firms displayed better long-term post-IPO performance than non-VC-backed firms for US IPOs after 2010. Next, these results were tested on robustness by comparing them to models where the long-term performance was measured by the BHR and the equal-weighted BHAR. All models of this test showed similar results, further adding to the validity of the evidence.

To conclude on my research, VC-backed US IPOs conducted after 2010 do exhibit superior long-run post-IPO performance compared to those that did not have VC-backing. This is in line with the research that showed similar results for all previous periods. It would suggest that VC firms are still capable of adding value to their portfolio companies, be it via their experience or via their active involvement. For non-researchers, my findings imply that investing in VC-backed IPOs would yield higher returns in the long run than the non-VC-backed ones. However, my findings also show that both groups displayed on average a negative long-term return regardless of whether it was market-adjusted, which means that the anomaly of underperformance can unfortunately still be seen in VC-backed IPOs after 2010. This is vital to keep in mind when determining in which firms to invest.

5.1 Limitations

My studies are victim to several limitations, as is the case with most research. The biggest constraint is the fact that, although my evidence is indeed significant, it has quite little explanatory power. This can be seen in the relatively low R-squared and suggests that there are other factors that need to be taken into account when looking at the long-term returns of an IPO. However, most of the previous research also focused on the variables that were added to my analysis. Other control variables differ throughout the past literature, which is why it is hard to pinpoint which controls should have been added specifically. Furthermore, the data provided by Jay R. Ritter lacks observations for some of the variables. Although some of the missing values have been accounted for in my analysis, such as the differences in Ticker symbols, quite a few were still left in the final data sample. By implementing a step-by-step expansion of the regression, I tried to show how the effect of VC alters when adding variables with missing values. This did present the fact that the VC effect stays positive and significant. Nonetheless, the missing values should be kept in mind as a hindrance for my interpreting my results. A more extensive set of data would be a great way to take care of this obstacle, should this be available for future research. On a final note, my researched focused on firms that went public up until 2019, even though the COVID pandemic that started in 2020 changed the playing field entirely for global financial markets. It would be interesting to see how the findings of both this research and previous literature would differ when examining IPOs that were conducted after the start of the COVID crisis. However, a couple of years still need to pass before we can look at the long-term returns of these IPOs. Hopefully during this time more knowledge becomes available in order to study the effects of VC on IPOs and their returns even better.

REFERENCES

Baker, M. & Wurgler, J. (2002). The Equity Share in New Issues and Aggregate Stock Returns. *The Journal of Finance, 55*(5). 2219–2257. DOI: 10.1111/0022-1082.00285

Basnet, A., Blomkvist, M. & Cumming, D.J. (2022). Premature listing and post-IPO venture capital refinancing. *Economics Letters, 216*, article 110582. DOI: 10.1016/j.econlet.2022.110582

Bessler, W. & Seim, M. (2012). The performance of venture-backed IPOs in Europe. *Venture Capital, 14*(4), 215–239. DOI: 10.1080/13691066.2012.702447

Black, B.S., & Gilson, R.J. (1998). Venture capital and the structure of capital markets: banks versus stock markets. *Journal of Financial Economics, 47*(3), 243–277. DOI: 10.1016/S0304-405X(97)00045-7

Boeh, K. & Dunbar, C. (2014). IPO waves and the issuance process. *Journal of Corporate Finance, 25*, 455–473. DOI: 10.1016/j.jcorpfin.2014.02.001

Brav, A., Geczy, C. & Gompers, P.A. (2000). Is the abnormal return following equity issuances anomalous? *Journal of Financial Economics, 56*(2), 209–249. DOI: 10.1016/S0304-405X(00)00040-4

Brav, A. & Gompers, P.A. (1997). Myth or Reality? The Long-Run Performance of Initial Public Offerings: Evidence from Venture and Nonventure-Backed Companies. *The Journal of Finance, 52*(5), 1791–1821. DOI: 10.1111/j.1540-6261.1997.tb02742.x

Carter, R.B. & Manaster, S. (1990). Initial Public Offerings and Underwriter Reputation. *The Journal of Finance, 45*(4), 1045–1067. DOI: 10.1111/j.1540-6261.1990.tb02426.x

Carter, R.B., Dark, F.H. & Singh, A.K. (1998). Underwriter Reputation, Initial Returns and the Long-Run Performance of IPO Stocks. *The Journal of Finance, 53*(1), 285–311. DOI: 10.1111/0022-1082.104624

Cumming, D.J. & Johan, S.A. (2012). Is Venture Capital in Crisis? *World Financial Review, July–August*, Available at SSRN: https://ssrn.com/abstract=2082062

Dong, M., Michel, J. & Pandes, J.A. (2011). Underwriter Quality and Long-Run IPO Performance. *Financial Management, 40*(1), 219–251. DOI: 10.1111/j.1755-053X.2010.01140.x

Fernhaber, S.A. & McDougall-Covin, P.P. (2009). Venture Capitalists as Catalysts to New Venture Internationalization: The Impact of Their Knowledge and Reputation Resources. *Entrepreneurship Theory and Practice, 33*(1), 277–295. DOI: 10.1111/j.1540-6520.2008.00289.x

Florida, R.L. & Kenney, M. (1988). Venture capital-financed innovation and technological change in the USA. *Research Policy, 17*(3), 119–137. DOI: 10.1016/0048-7333(88)90038-8

Gompers, P.A. (1996). Grandstanding in the venture capital industry. *Journal of Financial Economics, 42*(1), 133–156. DOI: 10.1016/0304-405X(96)00874-4

Hsu, H.S. (2013). Technologies timing of IPOs and venture capital incubation. *Journal of Corporate Finance, 19*, 36–55. DOI: 10.1016/j.jcorpfin.2012.09.007

Ibbotson, R.G. & Jaffe, J.F. (1988). "Hot Issue" Markets. *The Journal of Finance, 30*(4), 1027–1042. DOI: 10.2307/2326721

Jog, V., Otchere, I. & Sun, C. (2019). Does the two-stage IPO process reduce underpricing and long run underperformance? Evidence from Chinese firms listed in the U.S. *Journal of International Financial Markets, Institutions and Money, 59*, 90–105. DOI: 10.1016/j.intfin.2018.11.007

Kaplan, S.N. & Lerner, J. (2010). It Ain't Broke: The Past, Present and Future of Venture Capital. *Journal of Applied Corporate Finance, 22*(2), 36–47. DOI: 10.1111/j.1745-6622.2010.00272.x

Keuschnigg, C. (2004). Venture Capital Backed Growth. *Journal of Economic Growth, 9*(2), 239–261. DOI: 10.1023/B:JOEG.0000031428.35711.fc

Lerner, J. (1994). Venture Capitalists and the decision to go public. *Journal of Financial Economics, 35*(3). 293–316. DOI: 10.1016/0304-405X(94)90035-3

Lerner, J. & Nanda, R. (2020). Venture Capital's Role in Financing Innovation: What We Know and How Much We Still Need To Learn. *Harvard Business School Entrepreneurial Management Working Paper,* 20–131. DOI: 10.2139/ssrn.3633054

Matanova, N., Steigner, T., Sutton, N. & Thompson, L. (2022). The influence of private equity and venture capital on the post-IPO performance of newly-public acquirers. *The North American Journal of Economics and Finance, 59*, article 101597. DOI: 10.1016/j.najef.2021.101597

Que, J. & Zhang, X. (2019). Pre-IPO growth, venture capital, and the long-run performance of IPOs. *Economic Modelling, 81*, 205–216. DOI: 10.1016/j.econmod.2019.04.005

Ritter, J. R. (1984). The "Hot Issue" Market of 1980. *The Journal of Business, 57*(2), 215–240. http://www.jstor.org/stable/2352736

Ritter, J.R. (1991). The Long-Run Performance of Initial Public Offerings. *The Journal of Finance, 46*(1), 3–27. DOI: 10.2307/2328687

Ritter, J.R. (2015). Growth Capital-Backed IPOs. *The Financial Review, 50*(4), 481–515. DOI: 10.1111/fire.12075

Ritter, J.R. & Welch, I. (2002). A Review of IPO Activity, Pricing and Allocations. *The Journal of Finance, 57*(4), 1795–1828. DOI: 10.1111/1540-6261.00478

Sahlman, W.A. (1990). The structure and governance of venture-capital organizations. *The Journal of Financial Economics, 27*(2), 473–521. DOI: 10.1016/0304-405X(90)90065-8

Schultz, P.H. (2001). Pseudo Market Timing and the Long-Run Underperformance of IPOs. *University of Notre Dame Working Paper*, 1–50. DOI: 10.2139/ssrn.283699

Schwienbacher, A. (2005). An Empirical Analysis of Venture Capital Exits in Europe and the United States. *EFA 2002 Berlin Meetings Discussion Paper*, 1–40. DOI: 10.2139/ssrn.302001

Yip, Y., Su, Y. & Boon Ang, J. (2009). Effects of underwriters, venture capital and industry on long-term initial public offering performance. *Managerial Finance, 35*(8), 700–715. DOI: 10.1108/03074350910967240

APPENDIX A Jay R. Ritter Data on US IPOs

Table 1: Number of IPOs, First-Day Returns, Average One-Year Returns and Long-Run Performance of US IPOs from 1980-2021. Long-run performance is measured by both the three-year returns as well as the market-adjusted returns.

				Three-year BHAR	
Year	**Number of IPOS**	**Average First-Day Return**	**Average One-Year Return**	**IPOs**	**Market-Adjusted**
1980	71	14.3%	28.7%	89.8%	37.0%
1981	192	5.9%	-10.5%	12.3%	-27.0%
1982	77	11.0%	101.8%	37.5%	-31.5%
1983	451	9.9%	-19.2%	15.9%	-37.7%
1984	171	3.7%	20.0%	50.2%	-28.5%
1985	186	6.4%	23.6%	5.6%	-41.3%
1986	393	6.2%	9.5%	16.9%	-22.6%
1987	285	5.6%	-21.5%	-2.6%	-19.1%
1988	105	5.5%	28.7%	58.0%	9.7%
1989	116	8.0%	-5.5%	48.1%	13.2%
1990	110	10.8%	4.0%	9.7%	-35.9%
1991	286	11.9%	10.5%	31.2%	-1.8%
1992	412	10.3%	20.5%	37.4%	-0.2%
1993	510	12.7%	3.0%	44.1%	-8.7%
1994	402	9.6%	27.8%	78.0%	-5.7%
1995	462	21.4%	26.5%	28.6%	-58.0%
1996	677	17.2%	7.1%	25.2%	-56.8%
1997	474	14.0%	8.0%	58.3%	-2.0%
1998	283	21.8%	18.4%	22.9%	5.1%
1999	476	71.2%	22.1%	-47.6%	-32.5%
2000	380	56.4%	-52.9%	-60.1%	-30.9%
2001	80	14.0%	-14.3%	18.0%	14.6%
2002	66	9.1%	3.1%	68.6%	39.0%
2003	63	11.7%	25.7%	34.0%	-7.7%
2004	173	12.3%	17.8%	51.4%	6.9%
2005	159	10.3%	19.0%	14.6%	3.1%
2006	157	12.1%	21.4%	-28.8%	-11.1%
2007	159	14.0%	-28.4%	-16.5%	-0.4%
2008	21	5.7%	-34.4%	11.4%	8.1%

2009	41	9.8%	11.5%	37.0%	-5.1%
2010	91	9.4%	15.7%	36.4%	-9.6%
2011	81	13.9%	-12.2%	38.6%	-8.7%
2012	93	17.7%	35.7%	81.9%	31.8%
2013	158	20.9%	12.8%	12.1%	-14.1%
2014	206	15.5%	20.1%	17.1%	-9.7%
2015	118	19.2%	-23.8%	24.5%	-9.9%
2016	75	14.5%	23.3%	70.5%	29.5%
2017	106	12.9%	32.4%	52.8%	22.6%
2018	134	18.6%	-6.8%	79.1%	23.4%
2019	113	23.5%	33.0%	12.5%	-25.1%
2020	165	41.6%	9.7%	-47.6%	-63.8%
2021	311	32.1%	-49.2%	-56.4%	-44.3%
1980-1989	2,047	7.2%	3.4%	22.5%	-22.6%
1999-2000	856	64.6%	-11.2%	-53.1%	-31.8%
2001-2010	1,010	11.6%	6.7%	17.1%	2.2%
2011-2021	1,560	23.1%	-0.1%	10.6%	-14.5%
1980-2021	9,089	18.9%	6.0%	19.6%	-18.7%

Table 2, Panel A: IPOs from 1980-2021 categorized by VC-backing. Long-run performance is measured by both the three-year returns as well as the market-adjusted returns.

	THREE-YEAR BHAR			
VC-backed or not	**Number of IPOs**	**Average First-Day Return**	**IPOs**	**Market-Adjusted**
VC-backed	3662	27.0%	21.6%	-11.5%
Non-VC-backed	5427	13.4%	18.2%	-23.5%
All	9089	18.9%	19.6%	-18.7%

Panel B: IPOs from 1980-1989 categorized by VC-backing. Long-run performance is measured by both the three-year returns as well as the market-adjusted returns.

	THREE-YEAR BHAR			
VC-backed or not	**Number of IPOs**	**Average First-Day Return**	**IPOs**	**Market-Adjusted**
VC-backed	514	8.6%	31.9%	-13.9%
Non-VC-backed	1533	6.8%	19.3%	-25.5%
All	2047	7.2%	22.5%	-22.6%

Panel C: IPOs from 1990-1998 categorized by VC-backing. Long-run performance is measured by both the three-year returns as well as the market-adjusted returns.

			THREE-YEAR BHAR	
VC-backed or not	**Number of IPOs**	**Average First-Day Return**	**IPOs**	**Market-Adjusted**
VC-backed	1266	17.3%	60.7%	-1.1%
Non-VC-backed	2350	13.5%	28.4%	-31.8%
All	3616	14.80%	39.7%	-21.0%

Panel D: IPOs from 1999-2000 categorized by VC-backing. Long-run performance is measured by both the three-year returns as well as the market-adjusted returns.

			THREE-YEAR BHAR	
VC-backed or not	**Number of IPOs**	**Average First-Day Return**	**IPOs**	**Market-Adjusted**
VC-backed	526	80.8%	-62.3%	-40.5%
Non-VC-backed	330	38.8%	-38.5%	-17.8%
All	856	64.6%	-53.1%	-31.8%

Panel E: IPOs from 2001-2021 categorized by VC-backing. Long-run performance is measured by both the three-year returns as well as the market-adjusted returns.

			THREE-YEAR BHAR	
VC-backed or not	**Number of IPOs**	**Average First-Day Return**	**IPOs**	**Market-Adjusted**
VC-backed	1356	22.2	13.8%	-9.0%
Non-VC-backed	1214	14.6%	12.5%	-6.7%
All	2570	18.2%	13.1%	-8.0%

APPENDIX B Sample summary statistics

Table 4: Summary statistics categorized by VC-backing, full version. *vwBHAR* is the buy-and-hold abnormal return using the value-weighted CRSP index to adjust for market returns. Its values are in percentiles. *AgeatIPO* is the age of a firm when going public in number of years.

	Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
VC = 0	*vwBHAR*	774	-.1351569	.8555812	-3.638576	5.317327
	Ranking	601	7.662344	2.273988	0	9.001
	AgeatIPO	698	22.45129	31.29603	0	172
	Ln (Size)	774	12.89429	1.391614	9.354361	16.90235
VC = 1	*vwBHAR*	576	.1261524	1.301308	-3.88446	7.213968
	Ranking	556	8.111276	1.881581	0	9.001
	AgeatIPO	576	9.201389	5.016605	1	32
	Ln (Size)	576	12.94922	1.191528	9.293581	18.03488
VC = 2	*vwBHAR*	69	-.2611945	.9122741	-3.752479	1.918523
	Ranking	66	8.334318	1.217852	0	9.001
	AgeatIPO	69	14.95652	14.70338	2	67
	Ln (Size)	69	13.5743	1.087414	11.21274	16.51035

APPENDIX C Robustness test regression results

Table 6, Panel A: Results for the BHR model, full version. *BHR* is the buy-and-hold return. Its values are in percentiles. *Ln (Size)* is the natural logarithm of the market capitalization which was measured in USD. *AgeatIPO* is the age of a firm when going public in number of years. *Ranking* is the score of the underwriter and has values ranging from zero to nine. The first column shows the regression without the age and ranking variables. The second column shows the addition of *AgeatIPO*, while the third column shows the full regression with all variables.

	BHR		
	(1)	*(2)*	*(3)*
VC	0.2180148**	0.2273538***	0.1683069**
	(0.0722591)	(0.0662749)	(0.0631871)
Ln (Size)	0.021474	0.016823	-0.001505
	(0.0256972)	(0.0301352)	(0.0422356)
AgeatIPO		0.0012012	0.0004174
		(0.0013573)	(0.0016452)
Ranking			0.0422065
			(0.0300298)
Constant	-0.052446	-0.0130389	-0.0503254
	(0.2876113)	(0.3204468)	(0.3039411)
Observations	1,419	1,343	1,183
R^2	0.0111	0.0107	0.0127
Adjusted R^2	0.0097	0.0085	0.0094

*Note: *p<0.1; **p<0.05; ***p<0.01*

Panel B: Results for the equal-weighted BHAR model, full version. *ewBHAR* is the buy-and-hold abnormal return using the equal-weighted CRSP index to adjust for market returns. Its values are in percentiles. *Ln (Size)* is the natural logarithm of the market capitalization which was measured in USD. *AgeatIPO* is the age of a firm when going public in number of years. *Ranking* is the score of the underwriter and has values ranging from zero to nine. The first column shows the regression without the age and ranking variables. The second column shows the addition of *AgeatIPO*, while the third column shows the full regression with all variables.

	ewBHAR		
	(1)	*(2)*	*(3)*
VC	0.2134471**	0.2244456***	0.1587633**
	(0.0691467)	(0.0644477)	(0.0572442)
Ln (Size)	0.0227857	0.0178707	-0.0055022
	(0.0253451)	(0.029709)	(0.04184510)
AgeatIPO		0.0013086	0.0006451
		(0.0012843)	(0.0016008)
Ranking			0.0446825
			(0.02855)
Constant	-0.3393181	-0.2991891	-0.2852809
	(0.3094342)	(0.3456389)	(0.3481939)
Observations	1,419	1,343	1,183
R^2	0.0110	0.0108	0.0128
Adjusted R^2	0.0096	0.0085	0.0094

*Note: *p<0.1; **p<0.05; ***p<0.01*