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Understanding the role of Venture Capital Backing in IPO short and long term success

A study on a decade of US IPOs

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ABSTRACT

This research investigates the impact of venture capital (VC) backing on the short and long-term performance of Initial Public Offerings (IPOs) in the US market. The study aims to resolve conflicting findings in existing literature regarding the role of venture capital in different markets. By examining a dataset of 441 US firms that went public between 2009 and 2019, this research explores how venture capital involvement influences IPO underpricing and long-term underperformance, controlling for firm age, size, and industry. The Ordinary Least Squares (OLS) regression models reveal that venture capital backing is associated with increased short-run underpricing but decreased long-term underperformance, indicating an effect reversal. These findings suggest that while venture capitalists may not mitigate initial underpricing, their involvement contributes to the long-term success of IPO firms. This study provides valuable insights for entrepreneurs, investors, and policymakers on the strategic role of venture capital in the IPO process and highlights the importance of considering venture capital as a factor in long-term market success.

Keywords: Venture Capital, IPO, Underpricing, Long-term Performance, US Market

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CHAPTER 1 Introduction

In equity initial public offerings (IPOs), the presence of venture capitalists (VCs) has been theorized to play a pivotal role in influencing both underpricing strategies and the long-term performance of firms making their market debut. In this research I will be studying the effect of Venture Capital (VC) involvement in IPO underpricing and long term underperformance of startups.

Previous literature, as Belghitar and Dixon (2011), sheds light on the intricate dynamics at play. Their study compares the performance of VC-backed IPOs against their non-VC-backed counterparts within the UK market. A key finding is that VC involvement tends to lower the degree of IPO underpricing. This aligns with the broader discourse that shows venture capitalists not merely as financial backers but as entities that convey a degree of validation and credibility to the firms they support. Such endorsement is believed to reduce informational asymmetry among investors, thereby diminishing the need for significant underpricing to attract investment. Otchere and Vong (2016), perform a similar study, examining the effect of VC involvement in IPOs in the Chinese market. They also found that VC-backed start-ups had significantly less underpricing at IPO and better long-term performance compared to non-VC-backed start-ups. However, Tanda and Manzi (2019), found that VC-backed IPOs in US markets tend to have higher underpricing than non-VC-backed, as opposed to European markets. Also, Dimovski, Philavanh,and Brooks (2010), did a study on underwriter reputation and underpricing in the Australian Industrial Market. They found that underwriter presence and prestige was positively correlated to underpricing in IPOs.

Despite the valuable insights provided by existing research, several gaps remain in our understanding of the role of venture capitalists in the IPO process. While previous studies, including those by Belghitar & Dixon, Otchere & Vong, and Tanda & Manzi, have explored the influence of VC backing on IPO underpricing and performance, it is still unclear what the effect is within the U.S. market and if the effect is the same for short and long-term success of the equity offerings. This oversight presents an opportunity to delve deeper into how start-ups can manage their market expectations and decide the firms to work with. These gaps in understanding through different markets suggest that other external factors may also play a critical role in shaping IPO performance. Thus, this study aims to bridge these gaps by employing a comprehensive research strategy that only assesses the direct impact of VC on IPO underpricing and long-term performance in the U.S. market.

This study will replicate the research by Belghitar and Dixon on the impact of venture capitalist (VC) involvement on IPO underpricing and long-term underperformance, focusing on the U.S. market. Leveraging a comparative analysis between VC-backed and non-VC-backed IPOs, we will source data from Refinitiv's Eikon, and the market benchmark will be retrieved from Yahoo Finance's archive of

S&P 500 historical data and annualized returns. The analysis will consist of OLS regression models that evaluate the influence of VC backing on the extent of IPO underpricing, while accounting for firm age, firm size, and industry effects at the time of the IPO. By applying this methodological approach, this study seeks to deepen the understanding of VC's role in IPO underpricing and underperformance within the U.S. market.

This thesis anticipates to find more about venture capitalist backing and IPO underpricing and underperformance in the U.S. market and reconcile the data found in European markets. In contrast to Tanda and Manzi (2019) study, we hypothesize that IPOs backed by VCs will experience less underpricing and potentially exhibit better long-term market performance. This would underscore the value of VC reputation as a signal to investors regarding the quality and potential of IPOs. Ultimately, the findings are expected to contribute to the ongoing discourse on the significance of VC involvement in IPOs, offering stakeholders clearer guidelines on navigating the complexities of the IPO process.

CHAPTER 2 Theoretical Framework

2.1 IPOs and post-IPO Performance

2.1.1 Background

Initial Public Offerings (IPOs) represent a pivotal moment in a company's lifecycle, marking its transition from a private entity to a publicly traded company. This process allows firms to access public equity markets, which can provide essential capital for expansion, increase liquidity for existing shareholders, and enhance the firm's public profile. The motivations for going public are several. Pagano et al. (1998) identified benefits such as diversification of ownership, access to broader capital resources, increased market liquidity, external monitoring, and enhanced corporate image and publicity through signalling.

Further, innovative and high-tech start-ups often pursue IPOs to secure the necessary funding that is difficult to obtain through traditional debt financing, as highlighted by Carpenter & Petersen (2002), and Hall (2002) research on financing constraints of small businesses and R&D. These start-ups face challenges in generating short-term positive cash flows, making equity financing more attractive than debt, which require regular interest payments.

The decision to go public is also influenced by the trade-offs between the benefits and costs associated with IPOs. Ritter and Welch (2002) discussed the life cycle and market-timing theories, emphasizing that firms typically go public when the expected benefits outweigh the costs. They show many IPO phenomena are non-stationary and believe said phenomena are not driven by asymmetric information but due to non-rational, agency conflicts. Firm characteristics such as size and age, as well as market conditions, play a significant role in this decision. Chemmanur & Paeglis (2005) build on this idea and add that management quality affect IPOs and their success through the reduction of asymmetric information and being able to more convincingly convey the firm’s intrinsic value to potential investors.

Understanding these motivations and the strategic considerations involved in the IPO process provides a foundational context for analyzing post-IPO performance, which is crucial for assessing the long-term success and challenges faced by newly public companies.

2.1.2 Short Term post-IPO Performance: Underpricing

IPO underpricing represents a significant anomaly in financial markets, where newly issued shares are sold at a price lower than their expected market value at the time of the initial public offering. This systematic pricing strategy not only affects immediate investor returns but also sets the stage for

assessing the broader market dynamics and investor behavior during IPOs. One of the first papers to investigate this phenomenon was Muscarella & Vetsuypens (1989) who compare IPOs with different offering techniques. They found that self-marketed offers are significantly more underpriced than IPOs through different offering techniques.

Another paper that investigates this phenomenon is Loughran & Ritter (2004), who found that IPO underpricing, or first-day returns in the US, have increased significantly since the 1980s. They argue this is due to decreased incentives in maximizing IPO profits. This goes in line with what is discussed in Ljungqvist (2007) Handbook of Empirical Corporate Finance. Here, Ljungqvist also states that underpricing has increased and relates it to asymmetrical information. Similarly, Salerno et al. (2022) takes another approach and did a cross-industry study. They compare IPO underpricing of FinTech vs non-FinTech startups and find out that FinTech firms had higher degrees of underpricing. This undervaluation is also attributed to higher information asymmetry arising from high R&D costs and intangible assets. The relationship of asymmetric information and degree of underpricing is also studied by Mehmood et al. (2021), who compare underpricing of IPOs in emerging, developing and developed markets. They found that developing markets had the highest amounts of underpricing. They also dive into micro and macro-economic factors, market rigidities and socio-political factors affecting underpricing of IPOs.

IPO underpricing remains a significant anomaly in financial markets, influenced by various factors including offering techniques, incentives, and information asymmetry. Research shows that underpricing has increased over time, with higher levels observed in sectors with greater information asymmetry, such as FinTech, and in developing markets. These studies underscore the complexities of IPO pricing, highlighting how economic, market, and socio-political factors contribute to the extent of underpricing, affecting both immediate investor returns and broader market behaviour.

2.1.3 Long Term post-IPO Performance

IPO underperformance refers to the phenomenon where newly listed companies exhibit poorer financial performance than similar, non-IPO firms over an extended post-IPO period. This trend, often unexpected by investors who predict robust post-IPO trajectories based on the initial offering's excitement, raises critical questions about market efficiencies and the predictive validity of pre-IPO assessments. Ritter (1991) studied this phenomenon in detail throughout the late 20th century. He did so by comparing their closing price of the first day of public trading to their price at their three-year anniversary and matching them with market standards. Ritter found that IPO firms tend to underperform the market, varying significantly across industries and years, with companies that went public in high-volume years performing worst. This is attributed to over-optimistic investors on potential growth

companies and firms taking advantage of them. A more recent study Lin et al. (2021) investigate IPO underpricing through the "Hot Market" hypothesis and earnings management. Hot market refers to a period where investors are over-optimistic and there is a high demand for IPO stocks, leading to clustering of IPOs over a short time period. Lin et al. found that both: hot market and earnings management are significant when explaining IPO long-term underperformance. With hot market IPOs underperforming more severely due to higher information asymmetry and increased expectations. Also, firms that engaged in earnings management tend to underperform less. This effect was non-significant on IPOs issued in cold markets.

Another explanation of IPO underperformance is through idiosyncratic risk. Chen & Zheng (2021) did an extensive study on this phenomenon and realized that underperformance can be explained through surprisingly low returns at high idiosyncratic risk stocks. Also, they found that long-term underperformance disappeared when controlling for idiosyncratic risk. Doug et al. (2011) Also attempt to describe this effect through underwriter reputation. They defined high underwriter quality through the number of managing underwriters and their reputation, which they found to be mutually complementary. A higher underwriter quality is a significant predictor of better long-run performance.
A more modern hypothesis to explain underperformance is shown by Vakram & Kristoufek (2015), who compare Google searches to proxy investor sentiment before and during the day of offer. They concluded that investor attention could partially explain over-optimistic market reactions and underperformance.

Overall, IPO underperformance highlights the ongoing challenges faced by newly listed companies in sustaining their initial market enthusiasm. Despite early optimism, extensive research shows that these firms often underperform relative to non-IPO peers over the long term, influenced by factors such as market conditions, investor sentiment, and managerial decisions. The impact of hot markets, earnings management, idiosyncratic risk, and underwriter reputation all contribute to the nuanced landscape of IPO performance. These findings emphasize the need for investors to adopt a cautious and well-informed approach when engaging with IPOs, considering the multifaceted elements that drive long-term success or failure.

2.2 The Role of Venture Capital

2.2.1 Background

Venture capital (VC) plays a pivotal role in the financial ecosystem, providing not just capital but strategic guidance, network access, and credibility to early-stage companies poised for growth. Understanding the influence of VCs on company trajectories is crucial, as their involvement is often

seen as a marker of confidence and potential in the highly speculative arena of new market entrants. One of the first people to investigate the role of VC in corporate development was Rind (1981). He concludes that VC investments can act as a good first step or as an aid for start-ups. More recently, Jeong et al. (2020) showed a positive sustained impact and better performance of start-ups who received Venture Capital backing in early stages. They attributed this to signalling and information asymmetry. Also, to intangible value generated by VCs such as mentorship and access to a network of industry experts and potential customers. The positive impact of VC involvement is also shown by Greenwood, et al. (2022) who investigate Venture Capital financing and its role in innovation and growth. They find VCs are often involved in high-potential industries such as tech and that they are crucial for success as well as economic growth.

Moreover, Eldar & Grennan (2023) found that synergies for start-ups backed by VCs could increase if the Venture Capital firm had investments in the same industry. This resulted in more capital, less failure, and more successful exits. They related this added success to board experience and less information asymmetry. Synergy effects for start-ups with a common Venture Capitalist is also highlighted in Lindsey (2008), where these effects are investigated in the context of strategic alliances. They also relate this added success to informational advantages.

In conclusion, VC significantly enhances the growth and success of early-stage companies by providing not only financial resources but also strategic guidance, network access, and credibility. The involvement of VCs is critical for reducing risks and facilitating innovation, particularly in high-potential industries such as technology. Research highlights the importance of VC-backed synergies, effective risk management, and industry-specific diversification in driving sustainable growth and superior performance in startups. The empirical evidence underscores the vital role of VCs in fostering a dynamic and thriving entrepreneurial ecosystem.

2.2.2 Venture Capital and Underpricing

The relationship between venture capital backing and IPO underpricing highlights how VC involvement can influence the initial public offering process. By providing early-stage funding and strategic guidance, venture capitalists can enhance the perceived value of a firm through signalling, potentially reducing the degree of underpricing during the IPO and maximizing IPO profits. Belghitar & Dixon (2011) investigate the effect VC backing has on IPO underpricing and money left one the table in UK IPO markets. They find that VC backed firms have less underpricing, which aligns with the idea that VCs offer intangible value for the startup and helps reduce information asymmetry at the time of IPO. Furthermore, Otchere & Vong (2016) studied this effect in Chinese markets finding the same results. The study found that VC backed IPOs had lower underpricing. They also had a negative relationship

between VC reputation and underpricing of IPOs, which goes in line with reputational capital theory and supports the idea that VCs can provide intangible value to pre-IPO firms.

Another paper that studies this relationship is Chemmanur & Loutskina (2006). They break down the relationship between VC backing and IPO underpricing in different parts to see why VC backed firms turn out less underpriced at IPO. They find that VCs concern for their own reputation does not lead the IPO to be priced closer to true intrinsic firm value. However, they find moderate support that they select better quality firms to back through pre-backing screening and that VCs help create better quality firms by adding value in pre-IPO stage through monitoring. More importantly, found strong support for the hypothesis that VCs reduce underpricing thanks to their market power: attracting a higher quantity and quality of market participants such as underwriters, institutional investors, and analysts.

In contrast to UK markets, Dimovski et al. (2010) did a study on Australian industrial IPOs from 1994-2004 and found that VC backing led to higher underpricing. Additionally, they found a positive relationship between underwriter prestige and degree of underpricing. In the same way, Tanda & Manzi (2019) studied the relationship between VC backing and IPO underpricing in US markets to study differences with European markets. After a meta-regression study it showed a positive relationship between VC backing and IPO underpricing: saying venture capitalists do not effectively reduce underpricing compared to European markets.

Finally, the relationship between venture capital backing and IPO underpricing demonstrates the influential role of VCs in the IPO process. VCs can enhance firm value and reduce underpricing through strategic guidance, signaling, and mitigating information asymmetry. Studies show that VC-backed firms generally experience less underpricing, as seen in UK and Chinese markets, supporting the notion that VCs provide significant intangible value. However, contrasting findings in Australian and US markets indicate that the effectiveness of VC involvement in reducing underpricing may vary by region, suggesting that local market conditions and practices play a critical role in these dynamics.
While venture capitalists can provide significant benefits in terms of initial market reception and strategic support, the long-term performance of VC-backed IPOs remains variable and dependent on multiple factors, including market conditions and the degree of ongoing involvement from high-reputation VCs. These findings highlight the need for further research to fully understand the dynamics of venture capital backing and its impact on long-term IPO performance.

As said by Chemmanur & Loutskina (2006), confirmed by Belghitar & Dixon (2011) in UK, and repeated by Otchere & Vong (2016) in China, VC involvement in IPO firms tends to reduce underpricing. Despite what was found by Tanda & Manzi (2019) that VCs had a reversed effect in the

US and increased underpricing: due to the overwhelming research on the positive, intangible, effects of VC involvement this is the first hypothesis:

H1: Venture Capital backing in IPO firms reduce underpricing

2.2.3 Venture Capital and Long Term Performance

The relationship between venture capital backing and IPO underperformance presents a complex scenario. Although venture capitalists provide vital resources and strategic support to firms during the IPO process, their involvement does not always ensure long-term market success. Various studies have investigated how venture capital backing influences the post-IPO performance of firms, often revealing a mixture of benefits and ongoing challenges in maintaining market performance. These studies suggest that while venture capitalists can enhance initial market reception, the long-term performance of VC-backed IPOs requires further scrutiny.

One of the first people to investigate this relationship were Brav & Gompers (1997) with a sample of VC and non-VC-backed US IPOs in the late 20th century. In their sample, VC-backed IPOs outperformed with equal weighted returns. Also, value weighting reduced differences in long term performance significantly. Using the Fama & French (1993) three-factor model benchmarks, VC-backed IPOs did not underperform, while non-backed did. However, when also comparing to similar size matched and book-to-market ratio firms that have not issued equities, underperform as poorly as IPOs. Campbell & Frye (2006) explore the connection between the degree of involvement of VCs and the long-term underperformance. They found a positive relationship between the proportion of monitoring directors (VC and independent directors) and performance. The findings are consistent with VCs shaping the board for increased monitoring.

Bessler & Seim (2012) Investigate long term performance of VC-backed IPOs in Europe. Their sample includes two stock market cycles and IPO waves from 1996-2010. VC-backed IPOs are found to give positive returns (no underperformance) long term after the issue: also including equity purchased in the secondary market. Also, VC-backed IPOs showed long-term abnormal returns for almost three year after going public. These findings are consistent with the idea that VCs provide intangible value and managerial experience to IPO firms, making them better suited for long-term success. Belghitar & Dixon (2011) also investigated the role of VC in IPO underperformance in the UK. Unlike other research, they use a calendar-time analysis by creating a portfolio with firms that went public within previous T months, and then calculating the IPO calendar time abnormal returns. Furthermore, they also do an event-time analysis and calculate the buy and hold abnormal returns. Instead of using a market benchmark, they compare individual IPO stocks with size-matched portfolios of public firms. The

results show both, VC-backed and non-VC-backed samples underperformed long term relative to the size-matched portfolios, and that VC-backed did not over perform compared to non-VC-backed.

Additionally, as discussed initially by Brav & Gompers (1997) and confirmed by Belghitar & Dixon (2011) and Bessler & Seim (2012): these effects translate to the long term, which leads to decreased long term underperformance. Resulting in the following, second, hypothesis:

H2: Venture Capital backing in IPO firms reduce underperformance

CHAPTER 3 Data

This study utilizes a comprehensive dataset of equity offerings in the USA, focusing on Initial Public Offerings (IPOs) listed on the New York Stock Exchange (NYSE) and NASDAQ between February 2009 and December 2019 in order to avoid financial crises: 2008 recession and COVID-19 in 2020. The data has been meticulously extracted from the Eikon database, which provides extensive financial and market information. The dataset includes key variables such as offering dates and prices, closing day price, post-IPO performance, venture capital involvement, firm founding date, shares outstanding and business sector. Also, daily returns for the S&P 500 index in the same time period were extracted from yahoo finance to use as a market benchmark to compare individual IPO returns to. Moreover, the S&P500 historical annual returns were extracted from Investopedia also to use as a benchmark. This robust dataset forms the foundation for analysing the impact of venture capital backing on IPO underpricing and long-term performance, allowing for a thorough investigation of market dynamics and investor behavior in one of the world's most significant financial markets.

Initially, the sample included 4873 IPO equity offerings. However, only IPOs with no missing variable values were taken into consideration. This leaded to the dataset consisting of 441 IPOs. The average firm size of firms in the sample is 10 years and the average size of them is 808.49 million euros. Out of these 441 IPOs, 215 (49%) were not backed by VCs and 226 (51%) were backed by VCs. Also, 191 (43.3%) of the firms operated mainly in sectors that do not regard high-tech and 250 (56.7%) operated in high-tech sectors.

3.1 Variables

Firm: (firm_id) unique number appointed by Eikon for each IPO firm. It was used mainly to match firm specific data from different datasets.

Date: The offering date of IPO, extracted from Eikon. From this, firm age can be calculated.

Firm age: As seen in previous research by Pagano et al. (1998) and Carpenter & Petersen (2002), firm age affects the decision to IPO as said firms could go public for broader capital resources, while older firms can seek more liquidity and diversification for existing shareholders. Age was calculated by subtracting founding date, fd_i, from offering date, od_i.

$$age_i = od_i - fd_i$$

If answer was "0", age was converted to "1". The natural logarithm was taken due to skewness in the data and the variable is converted for the regressions.

Firm size: Market cap. Previous research by Belghitar & Dixon (2011) showed that market cap was a significant predictor of both: short and long term post-IPO performance. Market cap was calculated by multiplying the shares outstanding at offer by offer price, OP_i.

$$size = shares\ outstanding_i \times OP_i$$

Just like for firm age, the variable distribution for this is skewed, resulting in it being converted to its natural logarithm.

Venture Capital Backing: (vc) dummy variable to indicate if the firm had venture capital backing. This is the independent variable for both hypotheses and regressions. As seen throughout subsection 2.2 The Role of Venture Capital, VC can greatly affect the decision to IPO and post-IPO short and long-term success and profitability. 1 = yes, 0 = no. Extracted from Eikon

High-technology Sector Operations: (Hi-tech) dummy variable to indicate if the firm's main business was in Hi-tech sector. 1 = yes, 0 = no. As seen in Greenwood et al. (2022), VCs often support high-potential industries with high information asymmetry such as High-tech in an attempt to lower information asymmetry and increase their profits. This also relates to what Lin et al. (2021) states about hot markets with increased expectations: increasing long term post-IPO performance. Due to this, it is important to have this variable as a control. The criterion to decide whether the sector is High-Tech or not is from Eikon

Offering price: (OP_i) offering price of IPO. Used to calculate initial returns as well as long term returns to test both hypotheses. Extracted from Eikon

First Day Closing Price: (P_i) closing price after 1st day of public trading.

First Day Returns: (r_i) Initial return of the IPO stock for the first day. Used as the dependent variable for testing the short term post-IPO performance. Calculated by getting the difference between the stock price at close and open of the first day of trading:

$$r_i = \frac{P_i}{OP_i} - 1$$

Long Term Stock returns: (P_t) panel of stock prices of IPO_i stock at T= 7, 28, 180, 365 days after issue. Used to calculate long term underperformance through Buy-and-Hold-Abnormal-Returns (BHAR). Extracted from Eikon.

3.2 Descriptive statistics

The data was distributed in the following way, per year, shown in the descriptive statistics:

Table 1: summary statistics of the sample

Year	Observations	ln_age	ln_size	vc	Hi-tech	OPi	Pi	ri	rm
2009	12	2.2812	19.2654	0.4167	0.5833	15.1250	16.7517	0.1079	0.0073
2010	25	1.7476	19.0388	0.4400	0.3600	12.0200	13.7532	0.2729	0.0006
2011	13	1.3681	18.5001	0.1538	0.1538	17.2115	18.0985	0.0543	0.0038
2012	18	1.7381	18.3215	0.2222	0.5000	12.3333	13.2622	0.0985	0.0027
2013	18	1.2026	16.3406	0.2778	0.3333	15.4722	17.5091	0.1261	0.0022
2014	137	1.6864	19.4724	0.4891	0.5912	14.9854	17.6342	0.1611	0.0004
2015	106	1.6382	19.3863	0.5189	0.5849	15.1698	18.5163	0.1849	0.0007
2016	15	1.7362	19.2159	0.8000	0.6000	14.0667	15.8853	0.1029	0.0002
2017	24	2.0049	18.7995	0.4167	0.5417	13.9896	16.0913	0.1698	0.0013
2018	27	1.4416	20.0446	0.7407	0.7037	16.4907	21.8589	0.2999	0.0053
2019	46	1.8005	19.5365	0.7609	0.7174	15.4457	17.8572	0.1278	0.0014

Notes: summary of USA IPOs in NYSE and NASDAQ from 2009-2019 used for the sample. Extracted from Eikon

Table 1 shows the descriptive statistics of the sample. It is interesting to note the clustering of IPOs in 2014 and 2015 between the two recessions (2008 & 2021). The results are sorted by year and the value shown is the variable's mean in that year. For example, in 2016, 80% of the IPOs in the sample were VC backed and 60% were companies whose main business was in the high tech sector.

Also, it is important to notice that neither, IPO first day return stocks on average, nor the S&P 500 average daily returns were negative for any year. Additionally, for every year in the sample, the first day returns for IPO stocks were higher than the average daily return of the market benchmark.

Furthermore, to assess the order of variables in the regression, correlation matrices are performed for each hypothesis. For H1:

Table 2: Correlation matrix for first day returns

	ri	vc	Firm age *(log)*	Firm size *(log)*	Hitech
ri	1.0000				
vc	0.1405	1.0000			
Firm age *(log)*	0.1334	0.2049	1.0000		
Firm size *(log)*	0.1146	0.1113	0.2348	1.0000	
Hitech	0.0846	0.5940	0.1900	0.1045	1.0000

Notes: correlation matrix of regression variables to test H1

Table 2 shows that all variables have a weak, positive correlation with underpricing (ri). This suggests that venture capital backing can increase underpricing, as seen in previous literature but against the first hypothesis. Also, firm age and size show that older, larger firms experience higher degrees of underpricing. Furthermore, venture capital backing and the High technology industry dummy have a high correlation. Showing possible signs of multicollinearity that are tested afterwards.

The correlation matrix for H2 is:

Table 3: Correlation matrix for Long term underperfermance

	BHAR	vc	Firm age *(log)*	Firm size *(log)*	Hitech
BHAR	1.0000				
vc	0.1538	1.0000			
Firm age *(log)*	0.0438	0.2049	1.0000		
Firm size *(log)*	0.1357	0.1113	0.2348	1.0000	
Hitech	0.1442	0.5940	0.1900	0.1045	1.0000

Notes: correlation matrix of regression variables to test H1

Similarly to table 2: table 3 exhibits weak, positive correlation between long-term performance (expressed in Buy and Hold Abnormal Returns) and all the other variables in the model. Positive correlation between long-term performance and venture capital backing goes in line with the 2nd hypothesis proposed.

CHAPTER 4 Method

4.1 Post-IPO short term performance

To test the first hypothesis (H1: Venture Capital backing in IPO firms reduces underpricing), we will analyse the short-term performance of IPOs immediately following their public offering. This analysis focuses on underpricing, r_i. The aim is to isolate the effect of VC backing on underpricing while controlling for other relevant factors. For this, we will employ an OLS regression. The assumptions include linearity, independence of errors, homoscedasticity, the normality of residuals, no perfect multicollinearity, and correct model specification. Through these assumptions we can achieve a proper estimate to test H1. This results in the following regression:

$$Underpricing_i = \beta_1 VC_i + \beta_2 \text{firm } age\ (log)_i + \beta_3 \text{firm } size\ (log)_i + \beta_4 Hi - tech + \varepsilon_i$$

Where underpricing is defined as r_i showed in subsection 3.1 VC_i is the dependent variable referring to whether the firm is backed by venture capital or not. firm $age\ (log)_i$, firm $size\ (log)_i$ and $Hi - tech_i$ are control variables. $\beta_1$is the coefficient associated to the dependent variable and β_2, β_3, β_4 are the coefficients associated to the controls. The order of the variables is defined through the correlation matrix of table 2 above.

In order to check for the econometric validity of the OLS regression, first we test for heteroscedasticity. For this, we perform a white test. Also, for multicollinearity, we check for the Variance Inflation Factor (VIF). Finally, for the normality of residuals, we visually test through a histogram. Meeting these assumptions guarantees that the OLS estimators are unbiased, consistent, and efficient, thereby validating the reliability of our regression results.

4.2 Post-IPO long term performance

To test the second hypothesis (H2: Venture Capital backing in IPO firms reduces underperformance), we will analyse the long-term performance of IPOs. This analysis will focus on the event-time analysis of Buy-and-Hold Abnormal Returns (BHAR) over the first year post-IPO. BHAR consists of comparing the IPO firms with a control group, which in this case is the S&P 500 annualized returns. Thus, the difference in returns can be attributed to abnormal returns from the event, IPO. To calculate this, we analyse the returns of the data extracted of IPO stock prices at T= 7, 28, 180, 365 days after issue. With this, we can introduce the formula:

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

Where the first section is the product of stock returns, $R_{i,t}$, for each time period, *t*, and the second part is the product of market returns, $R_{m,t}$, (S&P 500) for each corresponding time period, *t*.

This aims to understand the initial market reception's sustainability and the extent to which VC involvement impacts the lasting success of IPO firms. This approach will provide insights into the long-term value added by venture capitalists beyond the initial public offering. To test how the long-term abnormal returns are affected by venture capital backing in IPO firms we will do an OLS regression with the same assumptions mentioned before. This leads us to the following regression:

$$BHAR_{i,T} = \beta_1 VC_i + \beta_2 Hi - tech_i + \beta_3 \text{firm } size\ (log)_i + \beta_4 \text{firm } age\ (log)_i + \varepsilon_i$$

In this regression, $BHAR_{i,T}$ is the dependent variable we are measuring and VC_i is the independent variable. β_1 is the independent variable's coefficient., $Hi - tech_i$ firm $size\ (log)_i$ and firm $age\ (log)_i$ are control variables. β_2, β_3 and β_4 are the coefficients associated to the controls. The order of the variables in the regression was decided through the correlation matrix in table 3.

Once again, to check for the econometric validity of the OLS regression; first, white's test for heteroscedasticity. Afterwards, multicollinearity is tested with the Variance Inflation Factor (VIF), and for the normality of residuals we visually test with a histogram.

CHAPTER 5 Results & Discussion

5.1 Post-IPO short term returns

The results for the model to test H1 was, as shown above, estimated with Ordinary Least Squares (OLS). An increase in 1 of x, constitutes an increase of β_1 in y. Having said this, the regression is as follows:

Table 5.1: regression to see the effect of venture capital involvement in initial returns with robust standard errors and fixed year effects of venture capital

	(1)	(2)	(3)	(4)
	ri	ri	ri	ri
vc	0.11***	0.09**	0.09**	0.09**
	(0.04)	(0.04)	(0.04)	(0.04)
Year				
2009	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)
2010	0.16	0.19	0.19	0.18
	(0.23)	(0.24)	(0.24)	(0.24)
2011	-0.02	0.01	0.01	0.01
	(0.05)	(0.05)	(0.05)	(0.05)
2012	0.01	0.03	0.04	0.04
	(0.07)	(0.06)	(0.06)	(0.06)
2013	0.03	0.08	0.12*	0.11*
	(0.07)	(0.07)	(0.07)	(0.07)
2014	0.05	0.07	0.06	0.06
	(0.05)	(0.05)	(0.05)	(0.05)
2015	0.07	0.09*	0.09*	0.09*
	(0.05)	(0.05)	(0.05)	(0.05)
2016	-0.05	-0.02	-0.02	-0.02
	(0.06)	(0.06)	(0.06)	(0.06)
2017	0.06	0.07	0.08	0.08
	(0.07)	(0.07)	(0.07)	(0.07)
2018	0.16**	0.20***	0.18**	0.18**
	(0.07)	(0.08)	(0.08)	(0.08)
2019	-0.02	0.01	0.00	0.00
	(0.06)	(0.06)	(0.06)	(0.06)
ln_age		0.04**	0.04	0.04
		(0.02)	(0.02)	(0.02)
ln_size			0.02*	0.02*
			(0.01)	(0.01)
Hi-tech				-0.01
				(0.03)
Constant	0.06	-0.03	-0.32**	-0.32**
	(0.05)	(0.05)	(0.15)	(0.15)
Observations	441	441	441	441
R^2	0.04	0.05	0.05	0.05
Adjusted R^2	0.01	0.02	0.03	0.02

*Notes: OLS Effect of venture capital on initial IPO returns. 4 models introducing new controls. Robust Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

All models had quite low values of R^2, with the final model including all controls having an R^2 of 0.04, signifying a 4% variance in the underpricing can be explained by the variables in the model. Since they only explain a small portion of the variability, it suggests possible omitted variables that can help understand the remaining 96% of variance. This also shows the nuanced nature of market behaviour and the unpredictability of market returns. However, this is not necessarily a problem as the independent variable, VC backing is significant at 99%.

The overall effect of venture capital involvement can be interpreted as being backed by a venture capital firm pre-IPO increases underpricing by 0.09. This effect is statistically significant at 95%. Age appears to increase underpricing as well. When introduced by itself to the model, it is significant at 90% and has a coefficient of 0.04; however, in the final model (4), it loses its significance and its coefficient lowers to 0.03. Size increases underpricing in models 3 and 4. It is significant at 90% in both models and has a coefficient of 0.02. Whether or not the firm operates mainly in a high technology sector decreases underpricing by a coefficient of 0.01. Nevertheless, it is statistically insignificant. The constant can be thought of as a hypothetical, unreal, scenario of the expected underpricing of a firm that is 0 years old and has a market cap of 0, does not operate in high tech and is not backed by venture capital. Due to this impossibility, it cannot be interpreted. Also, it is insignificant.

To further understand the effect of venture capital backing, individual, fixed year effects are also calculated. As seen in table 5.1, the effect of venture capital backing is not consistently positive to underpricing. In 2011, 2016 and 2019, venture capital backing decreases underpricing by relatively small magnitudes in model 1. In the rest of the models, the effect is only consistently negative in 2016. Additionally, even though the overall effect throughout the sample is statistically significant, fixed year effects appear insignificant apart from 2018, which saw significant (at least at 95%) increases in underpricing in all models ranging from 0.16-0.20. Furthermore, the large standard errors of the fixed year effects suggest there may be biased results.

To test how much the variance of regression coefficients is inflated due to multicollinearity we test for the variance inflation factor (VIF), which can be seen in table 5.3 in appendix A. With a mean VIF of 1.32 and a maximum VIF of 1.57 in venture capital backing, it is safe to assume no perfect multicollinearity. Thus, it does not have to be addressed and poses no concern for the regression model.

To test for the robustness of the model, White's test for heteroscedasticity is performed. H_0 of White's is that there is homoscedasticity. With a $p>\chi^2=0.2093>0.05$, we fail to reject the null hypothesis; hence, no significant evidence of heteroscedasticity. Regardless of this, the regression still uses robust standard errors as there could still be heteroscedasticity not captured by White's test or potential misspecifications

in the model. Even with the assumption of homoscedasticity being met, the loss of efficiency in the model is minor. However, if it is violated and there is uncaptured heteroscedasticity: robust standard errors provide more accurate inference. Therefore, the tradeoff is minimal and robust standard errors are still used.

Due to the low R^2 values, possible model misspecification and omitted variable bias: Ramsey RESET test is also performed. p>F=0.7399>0.05: the null hypothesis of misspecification and omitted variable bias is not rejected. Since there is no evidence of significant misspecification, it poses no threat to model and no adjustments are necessary for the results to be able to be interpreted.

Finally, we also check the normality of the residuals. As seen in histogram 1 in Appendix A, they appear to follow a mostly normal distribution with a slight skewness to the right. To address this we could transform the dependent variable, venture capital backing, into its natural log, apply interaction effects, check for outliers or add robustness techniques.

After weighing the regression results and the robustness tests for the model, H1 can be rejected: Venture Capital backing in IPO firms does not reduce underpricing.

5.2 Post-IPO long term returns

The results for the model to test H2 was, just like for H1, estimated with Ordinary Least Squares (OLS). An increase in 1 of x, constitutes an increase of β_1 in y. Having said this, the regression is as follows:

Table 5.2: regression to see the effect of venture capital involvement in buy and hold abnormal returns with robust standard errors

	(1) BHAR	(2) BHAR	(3) BHAR	(4) BHAR
vc	1.67***	1.14	1.05	1.07
	(0.51)	(0.76)	(0.75)	(0.75)
Hi-tech		0.89	0.82	0.84
		(0.74)	(0.74)	(0.75)
ln_size			0.32***	0.33***
			(0.10)	(0.11)
ln_age				-0.10
				(0.21)
Constant	0.86***	0.62***	-5.48***	-5.56***
	(0.26)	(0.24)	(1.76)	(1.82)
Observations	441	441	441	441
R^2	0.02	0.03	0.04	0.04
Adjusted R^2	0.02	0.02	0.03	0.03

*Notes: OLS Effect of venture capital on Buy and Hold Abnormal Returns. 4 models introducing new controls. Robust Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01*

Once again, all models have a very low R^2 value with the highest (0.04) being for the full model. This means that 4% of the variance in the buy and hold abnormal returns can be attributed to the variables in the models. The other 96% of the variance can be attributed to possible omitted variables or other exogenous market factors, highlighting the complexity in calculating and understanding market returns.

When first introduced, the effect of venture capital backing is positive and significant. This means higher returns compared to the market benchmark: lower underperformance. However, as more controls are added into the model, venture capital backing loses its significance and a decrease in long term underperformance cannot be properly attributed to it. In the full model (4) being a firm that mainly operates in a high technology sector also decreases long term underperformance. Nevertheless, it is insignificant. Firm size also decreases long term underperformance and is statistically significant at 99%. On the other hand, firm age increases underperformance, although insignificant. The constant, in all models, is statistically significant. However, it is the expected 1-year buy and hold abnormal returns of a firm that is not backed by venture capital, does not operate in a high technology sector, has no age and a market cap of 0. As this is impossible, we cannot interpret the constant and can disregard it.

When testing for multicollinearity, as the regressors used are the same as in section 5.1, we can refer back to table 5.3, showing the VIF of said regressors. Since the mean VIF is 1.32 and all VIF scores are under 5: we can assume no perfect multicollinearity in the model and no adjustments have to be made in this regard.

To test the robustness of the model we use White's test. With a $p>\chi^2=0.1693>0.05$, we fail to reject the null hypothesis and assume White's test does not detect heteroscedasticity. Due to all the reasons mentioned previously in section 5.1, we once again will remain to use robust standard errors in the regression as the trade-off of using them is positive.

For further robustness testing and to check model misspecification and omitted variable bias, the Ramsey RESET test is performed. The test yields a result of $p>F=0.96>0.05$, we cannot reject the null hypothesis. There is no significant evidence of model misspecification and omitted variable bias.

The normality of residuals is also tested in histogram 2 of Appendix A, where the residuals appear to be skewed to the left. Some possible adjustments that can be done from this are adding interaction effects, transforming the dependent variable, venture capital backing, using robust regression techniques such as a quantile regression and checking for outliers.

Considering the results of the regression, and the validity of the regression, H2 can be partially accepted: venture capital backing can lead to decreased long-term post-IPO underperformance.

5.3 Discussion of results

Belghitar & Dixon (2011) found in their UK IPO sample that venture capital involvement pre-IPO decreased underpricing. This is similar to what Otchere & Vong (2016) found in the Chinese market: adding to the narrative that VC backing decreases underpricing. However, my results showed a reversed effect in US markets, where venture capital backing increased underpricing: confirming the findings of Tanda & Manzi (2019). Nevertheless, my results differed in the sense that analysing fixed year effects showed that for some years: venture capital backing also decreased underpricing. A possible explanation for this can be the hot market hypothesis by Lin et al. (2021). Over the sample, the coefficient for venture capital backing had a higher coefficient than in the Belghitar & Dixon (2011) study.

All studies discussed found that if the effect of venture capital involvement pre-IPO was increased (or decreased) short term post-IPO underpricing, it also increased (or decreased) long term post-IPO underperformance. This was the case for Belghitar & Dixon (2011) in the UK, Otchere & Vong (2016) in china, Tanda & Manzi (2019) in the US and Dimovski et al. (2010) in Australia. On the contrary, my research showed that while venture capital backing increased underpricing, it reduced long term underperformance. This discrepancy and reversed effect of venture capital backing between short and long term could just be boiled down to the fact that the coefficients in long term underperformance are not significant. Although, it can also be inferred that there are possible biases and effects not captured by the model or the robustness tests performed: giving potential light to further research in this area, adding interaction or moderator effects, investigating with more control variables or expanding the dataset by investigating other time periods, markets, countries and industries.

CHAPTER 6 Conclusion

The purpose of this study was to investigate the impact of venture capital backing on short and long-term post-IPO performance in the US market. This research was motivated by conflicting findings in existing literature regarding the role of venture capital in different markets, such as the UK, China, Australia and US. Understanding these dynamics is crucial as IPOs represent a significant event for firms seeking capital for growth and development, and venture capitalists play a pivotal role in this process. By exploring whether venture capital involvement influences short-term and long-term IPO outcomes, this study aims to provide insights into the effectiveness of venture capital in fostering sustainable growth and market success as well as intrinsic value they can give to start-ups. Thus, the question studied in this dissertation is: How does pre-IPO venture capital backing in firms affect short and long-term IPO success? Addressing this problem is important for entrepreneurs, investors, and policymakers to make informed decisions regarding IPO strategies and the role of venture capital in capital markets.

To answer this, 441 US firms who IPO'd in NYSE and NASDAQ between 2009 and 2019 were studied. Their short (underpricing) and long-term (underperformance) success studied while controlling for their age, size and industry. We employed OLS regressions to test these both. The results revealed that venture capital backing, contrary to what was hypothesized, increased short-run underpricing. However, it decreased long term underperformance: giving light to an effect reversal.

This study, therefore, concludes that while venture capital involvement pre-IPO is associated with increased underpricing in the US market, it contributes to reducing long-term underperformance. This effect reversal is suggests that venture capitalists provide substantial post-IPO support and resources that enhance the long-term success of IPO firms. These findings challenge the traditional narrative that venture capital backing affects short and long-term post-IPO success equally.

Some possible implications for start-up managers include careful consideration of who they choose as venture capital partners if given the opportunity. As they may provide additional value apart from loans, which they could get at a bank. It is cautious to consider possible synergies, mentorship and strategic guidance they could receive from venture capital firms. Also, weigh out their possibilities and decide if they would rather maximize their initial returns or focus on long term growth and adjust their market expectations accordingly.

For venture capital firms, they can focus on enhancing value beyond capital provided and seek a more active investment role. As well as building a strong post-IPO support system and industry-specific strategies.

A potential limitation in this study is that venture capital reputation was not included. Most of the similar papers discussed implement underwriter reputation as a control. Future researchers are encouraged to include this as well as adding possible interaction effects between venture capital backing and underwriter reputation: analysing how they affect IPO success in different industries. Additionally, market conditions are not accounted for. Market Volatility is not considered in the experiment. Once again, future research is recommended to include this to add towards the robustness of the results.

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APPENDIX A

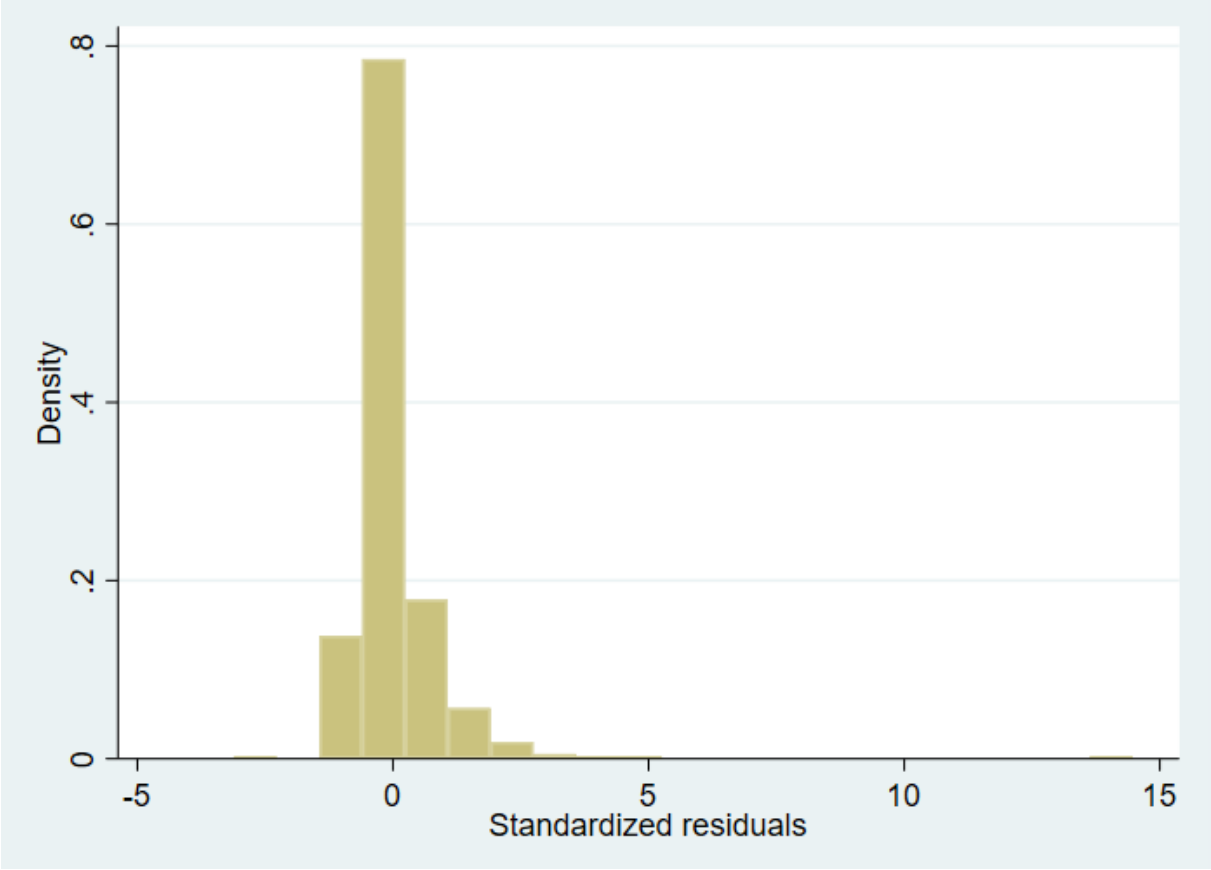
Table 5.3: Variance Inflation Factor of regressors

Variable	VIF	1/VIF
vc	1.57	0.6369
Hitech	1.56	0.6410
ln_age	1.10	0.9091
ln_size	1.06	0.9434
mean VIF	1.32	0.7576

Notes: Table showing the VIF of variables used for testing both regressions

Table 5.3 shows low VIF values for the variables indicating no significant multicollinearity. Usually values of VIF<5 are acceptable. With the max VIF=1.57 and mean VIF=1.32, all variables used in the models can be regarded as appropriate in terms of multicollinearity.

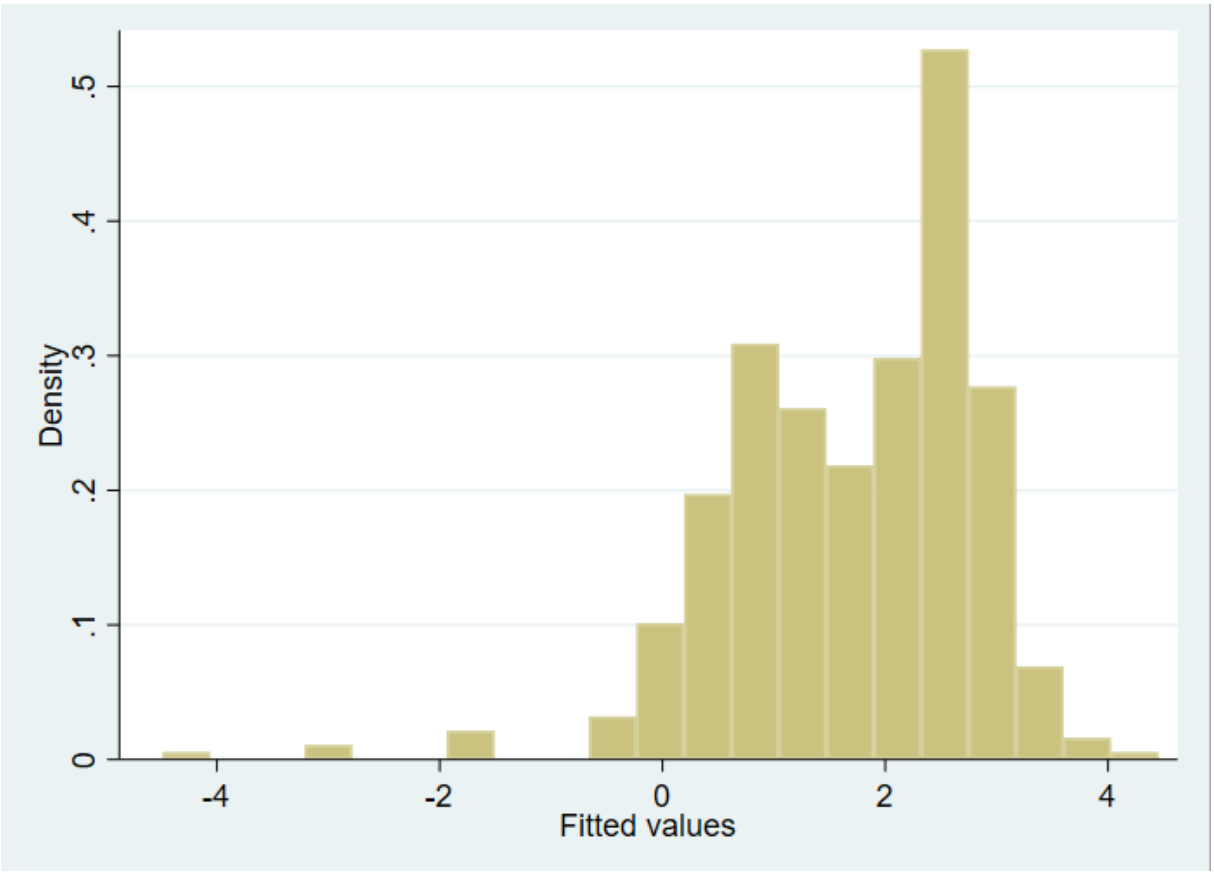
Figure 1: Histogram of residuals in regression 1 (for testing H1)



Notes: distribution of standardized residuals of the regression in subsection 5.1

As seen in Figure 1, the distribution is mostly normal, with a slight skewness to the right.

Figure 2: Histogram of residuals in regression 2 (for testing H2)



Notes: distribution of standardized residuals of the regression in subsection 5.2

As seen in Figure 2, the distribution is mostly normal, with a slight skewness to the left.