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Venture Capital Backing and IPO Underpricing in the US Market

A detailed study on how VC's affect the underpricing phenomenon

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The views stated in this thesis are those of the author and not necessarily those of the supervisor, second reader, Erasmus School of Economics or Erasmus University Rotterdam.

ABSTRACT

This paper studies the relationship between Venture Capital (VC) backing and the underpricing of Initial Public Offerings (IPO). The study assesses a data set that contains 670 IPOs issued in the United States (US) of which 379 were backed by VC and 291 were not. To test the relationship between the variables of interest, three different OLS models were made. The results of this paper show there is a significant positive relationship between VC backing and IPO underpricing in models 1 and 2, with coefficients of 8.10 and 8.27 respectively, both significant at the 10% level. However, this relationship becomes insignificant in model 3 when additional controls are included, indicating that the effect of VC backing on underpricing is sensitive to model specifications.

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CHAPTER 1 Introduction

The relationship between venture capital (VC) funding and startup exits, particularly through Initial Public Offerings (IPOs), is the main topic of my research proposal. This study delves into how the role of venture capital firms determines the success of IPO exits for startups. Given the interest and participation in the startup ecosystem, understanding this relationship is more relevant than ever. VC firms are not just financial backers. They are strategic partners that provide much more than just financial investment, but whose involvement signals a startup's potential to the market, often facilitating higher valuations and successful IPOs (Hahn, Kim & Ryu, 2023). The importance of this relationship can be seen in the incredible journey of Snowflake Inc. A cloud-based data-warehousing company that, backed by substantial VC investments, made an unforgettable debut on the New York Stock Exchange (NYSE) in September 2020. Snowflake's IPO became the largest software IPO in history, displaying how strategic VC funding can catapult a startup towards a public offering. This real-world example shows the importance of exploring how VCs can influence the IPO outcomes of startups. By analysing the role of VC funding and its impact on the success of startup IPOs, this study aims to shed light on how VC influences startups' journeys to the public markets, providing valuable insights for entrepreneurs, investors, and policymakers.

In constructing the foundation of my thesis, the following academic article offers critical insights. A study by Davila, Foster, and Gupta (2003) on "Venture capital financing and the growth of startup firms" delves into the signalling theory to demonstrate how VC investment is an indicator of startup growth, notably in employee count, underscoring the role of VC in not just financing but also legitimizing startups. This work provides an understanding of the impact of VC on startups, providing a starting point for further investigation into how VC funding can influence IPO outcomes. This work is complimented by Belghitar & Dixon (2012) whose work focuses on the reduction of underpricing and underperformance in IPOs facilitated by VC backing. It emphasizes the strategic judgement venture capitalists bring to the table, which not only prepares startups for the public market transition but also enhances their valuation and market reception. This aligns with the hypothesis that VCs play a critical role in optimizing IPO strategies. Lastly, the relationship of VC investment with startup exits is further explored by Grassi (2017), revealing how the timing and strategic involvement of VC funding significantly affect the likelihood and success of IPOs.

This study is motivated to test the relationship between VC involvement and the success of startup exits through IPOs. While the existing literature underscores the positive impact of VC on startup growth and signals its quality to the market, there remains an underexplored area regarding how VC's strategic contributions directly influence IPO outcomes in the United States (US) market. This gap presents an

opportunity for investigation, leading to the research question: "How does venture capital influence startups to produce a successful IPO in the US?" To address this, this study will adopt a quantitative approach to analyse IPO performance metrics across VC-backed and non-VC-backed firms. The motivation behind this research lies in showing how VCs support impacts on IPO success. The study aims to provide a holistic view of the VC value proposition in guiding startups from inception to a successful market debut. Through this scope, the study seeks to contribute to the discussion on the role of VC in shaping economic innovation.

To investigate the influence of VCs on IPO success, this study will construct a dataset of startups that underwent IPOs in the US within the last 10 years, differentiating between those with and without VC backing. This dataset will take into consideration variables such as IPO valuation, IPO opening price and IPO closing price. Using the previously mentioned variables, IPO underpricing will be calculated, and statistical tests will be made to conclude if VC backing truly reduces underpricing in IPOs. Quantitative analysis will employ three different regression models to assess the impact of VC involvement on these IPO metrics, ensuring control for industry effects, market capitalization, company age, underwriters involved, total IPO proceeds, and stock exchange used to narrow the VC contribution. This holistic methodology aims to offer insights into the role of VCs in a startup's IPO.

Building on the relationship between VC involvement and the trajectory of startup exits through IPOs, this study hypothesizes a positive correlation between strategic VC backing and enhanced IPO outcomes. The literature and the preliminary data suggest that VC-backed startups not only reach the IPO milestone with a higher likelihood but also enjoy more favourable valuations and stronger initial market performances compared to their non-VC-backed counterparts (Bessler & Seim, 2012). This expectation comes from the multifaceted role of VCs, which extends beyond financial support to include mentoring, network access, and signalling to the market. Specifically, the hypothesis predicts that the VC backing will result in a significant reduction of underpricing. This study attempts to show the strategic value provided by VC firms that has remained hidden beneath financial investments. The study seeks to illustrate if there is a significant role of VCs as a cornerstone in the transition of startups from private ventures to publicly traded entities.

CHAPTER 2 Theoretical Framework

2.1 Initial Public Offering (IPO)

An IPO is considered as the most successful type of exit for startups and non-publicly traded companies (Lemley et al, 2021). These companies are seeking to raise capital and establish their presence in the public market. This process allows existing shareholders to convert their investments into cash by exchange of equity. However, achieving a successful IPO is anything but easy, it involves numerous steps and meticulous preparations.

The first phase in the IPO process is the preparation phase. During this phase, the company conducts an internal assessment to ensure that it meets the necessary financial and operational standards for public trading. This includes evaluating the company's financial health, scalability, and market potential. An audit of the company's financial statements is typically conducted to ensure compliance with the regulations of the Securities and Exchange Commission (SEC) in the case of the US. Following the assessment, the company hires underwriters, usually investment banks, to assist in the IPO process. These underwriters play a crucial role in structuring the deal, determining the offering price, and the distribution of shares. The selection of underwriters is a critical step as their reputation and expertise can significantly impact the success of the IPO.

Next, the company and its underwriters engage in pre-marketing efforts to generate and confirm interest among potential investors. This often involves a roadshow where company executives present the business to institutional investors across various locations. The feedback received during the roadshow can influence the final pricing of the shares. The pricing phase follows, where the company and its underwriters determine the initial offering price of the shares. This price is critical as it must meet the company's capital-raising goals with investor willingness to pay. Once the price is set, the company finalizes the offering details and prepares for the official launch of the IPO.

On the day of the IPO, the company's shares are listed on a stock exchange, and public trading begins. The initial performance of the shares can be volatile as the market reacts to the new listing. A successful IPO not only provides the company with the desired capital but also enhances its visibility and credibility in the market. However, an IPO is not without its challenges. The process is complex, costly, and time-consuming, requiring significant attention and resources. Additionally, during a firm's IPO, most of the time, there is money left on the table. This happens due to a phenomenon called underpricing, which we will delve deeper into in the following paragraphs.

2.2 Underpricing

IPO underpricing is a common phenomenon observed in the financial markets, where the initial offering price of a company's shares is set lower than the market price at the close of the first day of trading. This results in significant first-day gains for initial investors, but it also indicates that the company might have left some money on the table, meaning it raised less capital than it could have if the shares had been priced higher. The average IPO leaves 9.1 million dollars on the table (Loughran & Ritter, 2002). The study of IPO underpricing is a critical aspect of financial research and has implications for issuers, investors, and underwriters.

$$\text{Underpricing (\%)} = \left(\frac{\text{First Day Closing Price} - \text{IPO Price}}{\text{IPO Price}} \right) * 100$$

One of the primary reasons for IPO underpricing is to ensure a successful launch by creating a positive market reception and encouraging investor participation (Draho, 2004). By setting the offering price below the anticipated market price, underwriters and issuers aim to generate strong demand, which can lead to a rapid increase in the share price once trading begins. This initial surge in the share price is seen as a positive signal, indicating investor confidence and market enthusiasm for the new stock (Welch, 1996).

Several theories attempt to explain the underlying causes of IPO underpricing. The most prominent is the information asymmetry theory, which suggests that there is a difference in the information available to different market participants. Issuers and underwriters possess more detailed knowledge about the company's true value compared to potential investors. To compensate for this information gap and risks, the offering price is set lower to attract investors who might not be willing to overpay for the stock (Ljungqvist, 2007).

Another explanation is the signalling theory, which hypothesizes that companies knowingly underprice their IPOs to signal their quality and future growth potential to the market. By leaving money on the table, the company sends a message that it is confident about its prospects and is willing to incur short-term costs for long-term benefits. This strategy can enhance the company's reputation and investor relations, potentially leading to favorable conditions for future equity offerings (Welch, 1996).

Underpricing can also be attributed to the role of underwriters. Investment banks, which act as intermediaries in the IPO process, have a personal interest in ensuring that the IPO is well-received. Underwriters may set a lower offering price to reduce the risk of undersubscription and the potential for leftover shares, which could harm their reputation and future business prospects. Furthermore,

underpricing can help underwriters build strong relationships with institutional investors, who benefit from the immediate gains and may be more likely to participate in future offerings managed by the same underwriters (Dimovski, Philavanh, Brooks, 2011). While IPO underpricing can lead to substantial gains for initial investors, it has several implications for the issuing company. Foremost, it represents a direct cost to the company in terms of forgone capital. By not capturing the full market value of the shares, the company raises less money than it potentially could have, which could impact its growth and investment plans. Additionally, severe underpricing can signal to the market that the company, or its underwriters lacked confidence in the company's valuation, potentially leading to long-term reputational issues.

In conclusion, IPO underpricing is a multifaceted phenomenon driven by numerous factors, including information asymmetry, signaling motives, and the strategic interests of underwriters. Understanding the dynamics of IPO underpricing is essential for stakeholders involved in the IPO process, as it influences the strategies and outcomes of going public. In this context, the study will explore whether the presence of VC's has any impact on the degree of underpricing, adding another layer of complexity to the analysis of IPO pricing strategies.

2.3 Venture Capital Role

VCs play a pivotal role in the development and success of startup companies. Their involvement extends far beyond providing only funding; they offer strategic guidance, industry connections, and operational expertise. The presence of VCs can significantly influence a company's trajectory, from its early stages to an IPO (Humphery-Jennerd, Suchard, 2013). Understanding the role of VCs and how they might affect IPO underpricing is essential for comprehending the dynamics of the IPO process.

VCs typically invest in high-potential startups, providing the necessary capital for growth in exchange for equity stakes (Tams, 2023). This investment comes with expectations of substantial returns, which often materialize when the company goes public. However, the influence of VCs is not limited to financial support. They bring valuable experience and resources to the table, helping companies navigate through various stages of development, refine their business models, and implement governance structures. VCs often occupy board positions, allowing them to directly impact strategic decisions and operational efficiencies.

One of the critical aspects of VCs' involvement is their impact on the company's credibility and attractiveness to other investors (Musthafa, 2024). Companies backed by reputable VCs are generally perceived as lower-risk investments due to the assessment VCs perform before committing funds. This enhanced credibility can lead to higher investor confidence during the IPO process, potentially reducing the need for significant underpricing to attract interest.

The presence of VCs can also affect the pricing strategy during an IPO. VCs, with their vested interest in maximizing returns, may push for a higher offering price to ensure better capital recovery. However, they also understand the importance of a successful IPO launch and might support a balanced approach to pricing that ensures strong market reception while minimizing excessive underpricing (Sauren, 2023).

Empirical studies have shown mixed results regarding the impact of VCs on IPO underpricing (de Blied, 2023). Some research suggests that VC-backed companies experience lower underpricing due to the added credibility and reduced information asymmetry. VCs' involvement can signal to the market that the company has undergone rigorous scrutiny, thereby reducing perceived risks. On the other hand, some studies indicate that the aggressive growth strategies and higher visibility of VC-backed companies might lead to higher demand and consequently higher underpricing to capitalize on investor enthusiasm (Gelfer, 2014).

Moreover, VCs often engage in pre-IPO activities that can influence the extent of underpricing (Berglund & Granelli, 2023). These activities include preparing the company for the public market, aligning incentives, and engaging in strategic marketing efforts to boost investor interest. By enhancing the company's readiness and visibility, VCs can help create a more favorable environment for the IPO, potentially reducing the need for deep underpricing.

In conclusion, venture capitalists play a pivotal role in shaping the success of companies, especially as they transition to public ownership through an IPO. The presence of VCs can enhance a company's credibility, influence strategic decisions, and impact the pricing strategy during the IPO process (Qi et al 2023). While the relationship between VCs and IPO underpricing is complex, our study will delve deeper to understand how VC involvement specifically affects underpricing levels. This analysis will provide valuable insights into the interplay between venture capital and public market entry strategies.

2.4 Hypothesis

In assessing the dynamics of IPOs, this study aims to delve into how VC backing can influence the degree of underpricing at the time of the IPO. VC firms do not only provide financial resources but are also believed to enhance a company's credibility and market visibility. Despite the acknowledged role of VC firms in nurturing startups, empirical evidence on how they affect IPO outcomes, particularly underpricing in the US market, remains mixed. This research seeks to clarify this relationship by testing the following hypotheses:

H0: There is no significant relationship between IPO underpricing and VC backing.

This hypothesis aligns with the efficient market hypothesis, suggesting that market forces dictate IPO pricing dynamics, irrespective of VC involvement. Testing this hypothesis will allow us to determine whether VC backing does not statistically affect the pricing strategies at IPO (Fama, 1970).

H1: There is a significant relationship between IPO underpricing and VC backing.

Based on the signalling theory, underpricing might be reduced by mitigating information asymmetry and enhancing investor confidence. By examining this hypothesis, the study will explore whether startups backed by venture capitalists experience less underpricing due to perceived higher quality or better growth prospects, as signalled by VC endorsement (Megginson & Weiss, 1991).

Testing these hypotheses helps us understand the impact of VC on the initial market performance of IPOs. It will provide insights into whether VC involvement truly mitigates the traditional risks associated with investing in new public entities.

CHAPTER 3 Data

1. Introduction to the Data Section

This section presents the data used in the study, detailing the collection methods, description of the variables used, and key findings. The data focuses on US issuers of IPOs from 01/01/2013 to 31/12/2023, with a specific emphasis on whether these IPOs were VC backed or not.

2. Data Collection Methods

The data was collected from Eikon, a comprehensive financial analysis platform. The dataset includes IPOs issued by US companies over a ten-year period, removing every company whose offer price was below 1 dollar to eliminate penny stocks. Eikon is a trusted source for financial data, providing accurate and comprehensive information necessary for analysing IPO trends and performance.

Table 1: Descriptive statistics IPOs (2013-2023)

The table presents descriptive statistics for 670 IPOs from 2013 to 2023, showing an average company age of 9.81 years and underpricing of 22.78%. VC backing is present in 57% of cases, with 14% classified as high-tech. Market capitalization averages \$224 million, and 29% of IPOs have reputable underwriters.

Descriptive Statistics				
Variable	Mean	Sd	Min	Max
Company Age	9.81	12.03	0	100
Underpricing	22.78	56.22	-90	682
VC Backed	0.57	0.50	0	1
Hi-Tech	0.14	0.35	0	1
Market Cap	2.24e+08	4.45e+08	768153	7.48e+09
Underwriter	0.29	0.46	0	1
Observations	670			

3. Variables

Company Age

Definition: The number of years between the founding date and the IPO issue date.

Calculation: Difference between the company's founding date and IPO issue date.

Relevance: Company age can impact investor perceptions. Older companies might be seen as more stable, while younger companies may be viewed as high-growth opportunities.

Previous literature: A study by Ritter (1991), highlights how the age of a company at the time of IPO can affect its long-term market performance, suggesting that older companies may offer more stability, which can influence investor perceptions and IPO success.

Underpricing

Definition: Difference in percentage between IPO price and first day of trading closing price.

Calculation:

$$\text{Underpricing (\%)} = \left(\frac{\text{First Day Closing Price} - \text{IPO Price}}{\text{IPO Price}} \right) * 100$$

Relevance: This is the explained variable of the study.

Previous literature: An article by Loughran & Ritter (2002), delves into the dynamics of IPO underpricing and its necessity to ensure successful market debut, serving as a critical measure in understanding IPO performance dynamics.

Underwriter

Definition: The number of financial institutions managing the IPO process. A dummy variable was generated that indicated a true value if the company that underwent the IPO had more than the average number of underwriters in the sample and false if it had less.

Relevance: The amount and quality underwriter can impact the success of the IPO, with well-known underwriters typically leading to higher investor trust.

Previous literature: A study made by Carter & Manaster (1990), demonstrates how the reputation of underwriters is crucial to the success of an IPO, with more reputable underwriters often associated with less underpricing and better post-IPO performance.

Market Capitalization

Definition: The total market value of the company's outstanding shares post-IPO.

Calculation: `Number of Shares Issued * Closing Price on the First Day`

Relevance: Market capitalization is the company's value as perceived by the market.

Previous literature: A study by Pagano, Panetta & Zingales (1998), explored the significance of market capitalization as a reflection of market valuation post-IPO, indicating its importance in obtaining the market's perception of a company's value.

VCBacked

Definition: A binary variable indicating if the company had venture capital support.

Relevance: VC backing often signals credibility and growth potential to investors, possibly leading to higher demand and underpricing during the IPO.

Previous literature: A study by Megginson & Weiss (1991), argues that VC backing acts as a certification mechanism for IPOs, reducing information asymmetry and signaling company quality, which can lead to better IPO outcomes and reduced underpricing.

Industry

Definition: Industry sector of the company.

Relevance: The industry sector can influence investor interest and perceived risk. Some industries may be seen as more stable or having higher growth potential, impacting the IPO's performance.

Previous literature: A study made by Fernando, Krishnamurthy & Spindt (2004), discusses how different industries have an influence on the structure and outcomes of IPOs.

HiTech

Definition: A binary variable indicating if the company operates in the high technology sector.

Relevance: High-tech companies are often associated with higher growth potential and innovation, which can attract more investors and affect the valuation and performance of the IPO.

Previous literature: A study made by Jain & Kini (1994), focuses on high-tech firms' IPOs, highlighting how such companies typically exhibit higher growth expectations, which can lead to different pricing dynamics and market reactions compared to non-high-tech firms.

StockExchange

Definition: The stock exchange where the company's shares are listed post-IPO.

Relevance: The choice of stock exchange can affect the visibility and liquidity of the shares. Major exchanges like NYSE or NASDAQ can provide greater exposure and investor confidence.

Previous literature: A study by Merton (1987), discussed the impact of a company's listing choice on its visibility and investor base, explaining how major exchanges like NYSE or NASDAQ enhance credibility and attract a broader investor pool, thereby influencing IPO pricing.

4. Data Preparation and Cleaning

Initially, the dataset comprised 10,069 data points. After applying a series of filters, the dataset was refined to ensure the relevance and accuracy of the information. The filtering process included the following steps:

1. **Country Filter:** Limited the dataset to IPOs issued in the United States (4346 data points).
2. **Transaction Status:** Selected only transactions with a status of "Live" (2799 data points).

3. **Security Type:** Included only common stock securities (989 data points).

4. **Founding Date Completeness:** Excluded companies with missing founding dates to accurately calculate the age of the company at the time of the IPO (766 data points).

5. **Variable Completeness:** Removed data points with missing values in the key variables (670 data points).

After these steps, the final dataset consisted of 670 data points, of which 379 were backed by VC and 291 were not.

The following table is a multicollinearity check to test if the independent variables are correlated with each other. The consequences of having multicollinearity present in the regression model and ignoring it, is that the coefficients will have high standard errors and will not be significant.

Table 2: Matrix correlation of independent variables

**Matrix of
Correlations**

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Company Age (1)	1.00						
VC Backed (2)	-0.12	1.00					
Hi-Tech (3)	0.05	0.03	1.00				
Market Cap (4)	-0.03	0.07	-0.03	1.00			
Underwriter (5)	-0.01	-0.02	0.03	-0.03	1.00		

CHAPTER 4 Method

The objective of this study is to investigate the relationship between IPO underpricing and VC backing, while controlling for other variables to ensure statistical significance.

Statistical Analysis

To test the hypothesis, we will conduct a multiple regression analysis where the dependent variable is IPO underpricing, and the independent variables include VC backing and other control variables.

To empirically examine the effect of the variables on underpricing, we employ an Ordinary Least Squares (OLS) regression model. The specific regression model used in this study is as follows:

$$\text{Underpricing} = \beta_0 + \beta_1 \times \text{VCBacked} + \beta_2 \times \text{CompanyAge} + \beta_3 \times \text{MarketCap} + \beta_4 \times \text{Industry} + \beta_5 \times \text{HiTech} + \beta_6 \times \text{StockExchange} + \beta_7 \times \text{Underwriter} + \varepsilon$$

Data Analysis and Tests

To analyse the data and ensure the robustness of our results, we performed several statistical tests and procedures using STATA, as detailed below.

1. Kernel Density Plot

Purpose: To analyse the distribution of underpricing.

Procedure: We created a Kernel Density Plot to visualize the distribution of underpricing in our dataset. The results are shown in Figure 1 in the Appendix.

Results: The plot indicated that the distribution of underpricing is narrower than the normal distribution, with most observations lying around 10% to 15%. Additionally, we performed a Kernel Density Plot for the residuals (Figure 1.1).

2. Multiple OLS regressions

Model 1: Test the overall correlation and significance between VC backing and underpricing.

Purpose: The relationship of interest of this study is between VC backing and underpricing. This is a bivariate model; hence, it does not have much validity. However, it allows us to see if the coefficients change when other variables are included in the mode.

Procedure: An OLS regression was made after testing for heteroskedasticity and multicollinearity.

Model 2: Test the overall correlation and significance between underpricing and VC backing, company age, market cap, hi-tech, and underwriters.

Purpose: Including relevant variables is a key step in the OLS process to understand their individual contributions to underpricing and how they collectively affect the relationship with VC backing.

Procedure: OLS regression analysis was conducted to test the relationships between underpricing (dependent variable) and the independent variables: VC backing, CompanyAge, MarketCap, Hi-Tech, and Underwriters. Before the regression was ran, tests were performed to ensure there were no issues of heteroskedasticity or multicollinearity.

Model 3: Test the overall correlation and significance of the same variables in Model 2, including control variables for Industry and Stock Exchange used.

Purpose: To account for variations in underpricing that may be influenced by different industries and stock exchanges.

Procedure: OLS regression was conducted with underpricing as the dependent variable and independent variables including the same as in Model 2, and Stock Exchange and Industry control variables. Prior to the regression, checks were performed for heteroskedasticity and multicollinearity.

Results: The results for all three regression models can be found in the Appendix in Table 3.

3. White Test for Heteroskedasticity

Purpose: To check for heteroskedasticity in the regression model. If heteroskedasticity is present in the regression model, the OLS estimators will still be unbiased and consistent, however they will no longer be BLUE.

Procedure: We conducted a White test to detect the presence of heteroskedasticity.

Results: The test revealed a chi-square statistic of 82 with a p-value of 1, indicating no presence of heteroskedasticity. Therefore, there was no need to use robust standard errors in our OLS regression (Table 4).

4. Multicollinearity Check

Purpose: To ensure the independent variables are not too strongly correlated with each other.

Procedure: We checked for multicollinearity using a correlation matrix.

Correlation Matrix: We examined the correlation matrix of the variables shown in Table 2 in the Appendix to ensure that no correlation exceeded 0.8, as per the rule of thumb suggested by Seviratna and Cooray (2019).

5. Underpricing percentage trend

Purpose: To have a visible graph of how underpricing has changed throughout the years for VC and non-backed companies.

Procedure: A line graph was generated using the raw data on underpricing for backed and non-VC backed companies according to their IPO years. It can be found in the Appendix in Figure 2.

Results: Figure 2 shows a constant trend for both VC backed and non-backed firms. However, there can be observed a couple of high peaks of high underpricing for VC backed companies in the last two years.

6. Volume of IPOs

Purpose: To display and observe the trend of the number of IPOs issued for VC backed and non-backed firms in the last 10 years.

Procedure: Using the raw data of the number of IPOs per year for VC backed and non-backed, a bar graph was generated.

Results: It can be observed that there is sort of a constant trend of roughly under 40 IPOs issued per year for backed and non-backed. However, there is an abnormal number of IPOs in 2014, 2015 and 2021 there is an abnormal number of IPOs (Figure 3).

CHAPTER 5 Results & Discussion

In this chapter, we discuss the empirical results of the regression analysis, allowing us to analyse our hypotheses.

Table 3 presents the results of multiple OLS regression models examining factors influencing underpricing in IPOs from 2013 to 2023. Several independent variables were included across three regression specifications to provide a comprehensive view of the determinants of underpricing.

Model 1

In the first model, only the VC-backed variable was regressed against underpricing. The coefficient for being VC-backed is 8.10 with a standard error of 4.37. This indicates that VC-backed companies experience 8.10 units more underpricing on average compared to non-VC-backed companies. This result is statistically significant at the 10% level ($p < 0.10$), suggesting a moderate confidence in this positive effect.

Model 2

The second model includes additional variables. The coefficient for VC-backed companies is 8.27 with a standard error of 4.42, maintaining a statistically significant positive impact on underpricing at the 10% level. The coefficient for Company Age is 0.07 with a standard error of 0.18, suggesting a negligible and statistically insignificant impact of company age on underpricing. The coefficient for the Hi-Tech variable is -9.23 with a standard error of 6.26, indicating that Hi-Tech companies experience 9.23 units less underpricing on average. However, this result is not statistically significant, given the high standard error. The coefficient for Market Cap is 0.00, with a standard error of 0.00, suggesting no discernible impact on underpricing. The coefficient for the Underwriter variable is 2.43 with a standard error of 4.77, indicating a positive but statistically insignificant impact on underpricing.

Model 3

The third model introduces industry and stock exchange controls. The coefficient for VC-backed companies drops to 1.29 with a standard error of 5.57, losing its statistical significance. The coefficient for Company Age is 0.13 with a standard error of 0.19, suggesting a slight increase in underpricing with older companies, though this effect remains statistically insignificant. Hi-Tech companies continue to exhibit a negative coefficient (-22.47) with a high standard error (24.02), indicating no statistically significant impact on underpricing. Market Cap's coefficient remains 0.00, with no standard error variation, indicating no effect. The Underwriter variable has a coefficient of 3.17 with a standard error of 4.87, maintaining an insignificant positive effect. The inclusion of industry and stock exchange

dummy variables in Model 3 did not result in any statistically significant coefficients for these controls, indicating that neither industry nor the specific stock exchange has a significant impact on underpricing.

Model Summary

Observations: All three models are based on 670 observations.

R²: The R² value is 0.01 for the first two models and 0.02 for the third model, suggesting that only 1-2% of the variability in underpricing is explained by these models.

Adjusted R²: The adjusted R² values are 0.00 for the first two models and -0.01 for the third model, indicating that these models do not improve upon a simple mean model.

In summary, while VC backing appears to have a positive and statistically significant impact on underpricing in the first two models, this effect diminishes when industry and stock exchange controls are added. Other factors, such as company age, Hi-Tech, market capitalization, and underwriter involvement, do not show statistically significant impacts on underpricing across the models.

Table 3: Underpricing regression on IPOs (2013-2023)

Variable	(1)	(2)	(3)
	Underpricing	Underpricing	Underpricing
VC Backed	8.10*	8.27*	1.29
	(4.37)	(4.42)	(5.57)
Company Age		0.07	0.13
		(0.18)	(0.19)
Hi-Tech		-9.23	-22.47
		(6.26)	(24.02)
Market Cap		0.00	0.00
		(0.00)	(0.00)
Underwriter		2.43	3.17
		(4.77)	(4.87)
Industry Control	No	No	Yes
Stock Exchange Control	No	No	Yes
Constant	18.19***	16.92***	78.10
	(3.29)	(4.33)	(61.84)

Observations	670	670	670
R^2	0.01	0.01	0.02
Adjusted R^2	0.00	0.00	-0.01

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Limitations

The primary limitation of this study is the low explanatory power of the models, as evidenced by the R^2 and adjusted R^2 values. This suggests that important variables influencing underpricing may be missing from the models. Future research should consider including other potential predictors and exploring different model specifications to better understand the factors influencing underpricing. Additionally, expanding the analysis to include international issuers or exploring post-IPO performance metrics could provide a more comprehensive understanding of the determinants of underpricing.

CHAPTER 6 Conclusion

In conclusion, the regression results do not provide strong evidence for the significance of the regressors included on underpricing. Specifically, the null hypothesis that was being tested, H_0 : "There is no significant relationship between IPO underpricing and VC backing," cannot be rejected based on the results given. This finding aligns with the efficient market hypothesis, suggesting that market forces alone may dictate IPO pricing dynamics, irrespective of venture capital involvement.

On the other hand, the alternative hypothesis H_1 : "There is a significant relationship between IPO underpricing and VC backing," was not supported, indicating that VC backing may not serve as a strong enough signal to significantly reduce IPO underpricing within this dataset. This result challenges the applicability of signaling theory in this sample.

The findings highlight the need for further investigation into additional factors that may influence underpricing and the importance of model specification in regression analysis. It may be beneficial to consider variables that were not included in the current model, such as the specific characteristics of venture capitalists or macroeconomic conditions. Moreover, improving the model to better capture complex interactions are crucial steps in enhancing the reliability of the conclusions. Future research should aim to expand the dataset and incorporate a wider array of variables to provide a more comprehensive understanding of the dynamics at play in IPO underpricing and should look further into the life cycle of an IPO and test how VC backing affects short and long-term performance of the new public company.

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APPENDIX

Figure 1: Kernel density plot of underpricing of IPOs for the US (2013-2023).

To visualize the distribution of the underpricing data points, a Kernel density plot was generated and as can be observed, most concentration is at around 10% to 15% underpricing. The distribution is positively skewed, and the presence of a long right tail suggests that while most firms experience little to negative underpricing, some experience significantly higher levels.

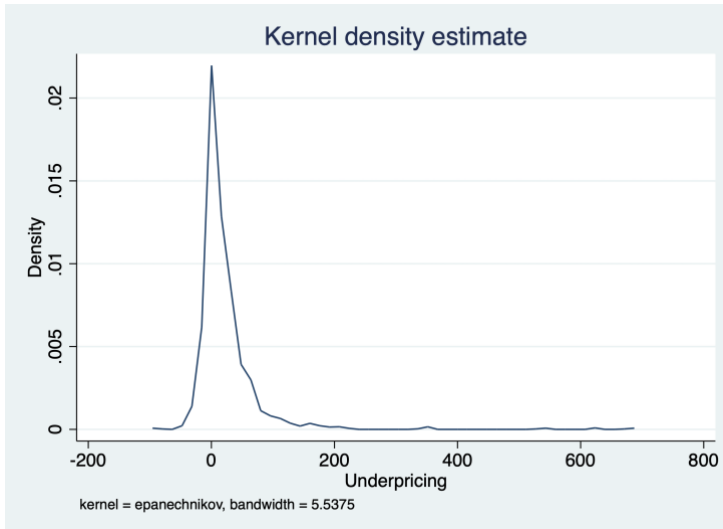


Figure 1.1: Kernel density plot for residuals.

The kernel density estimate plot illustrates the distribution of residuals from a model. The density is highest around zero, suggesting that most residuals are close to zero, indicating a good model fit. The distribution tails off towards higher values, with a few outliers present, as shown by the long right tail.

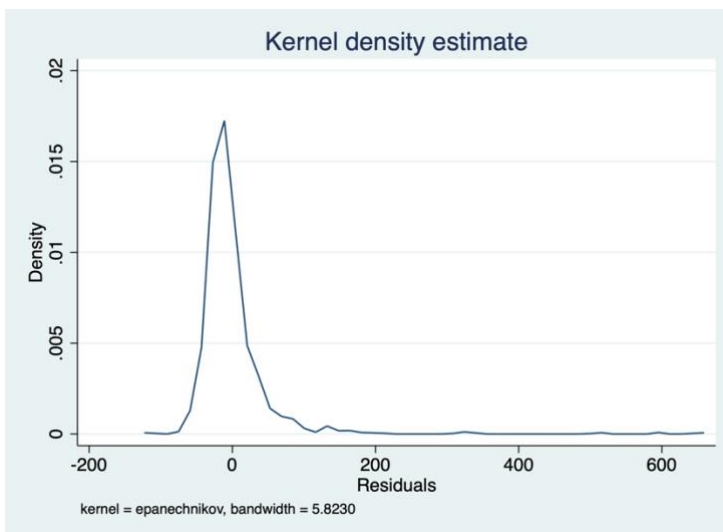


Figure 2: Underpricing percentage throughout the years for VC and Non-VC backed US firms (2013-2023).

The graph illustrates the underpricing percentage of IPOs from 2013 to 2023, differentiating between VC-backed and non-VC-backed companies. Over the observed period, both groups exhibit fluctuating underpricing trends, with VC-backed IPOs showing higher volatility and peaks, especially notable in recent years, indicating a greater variability in initial returns.

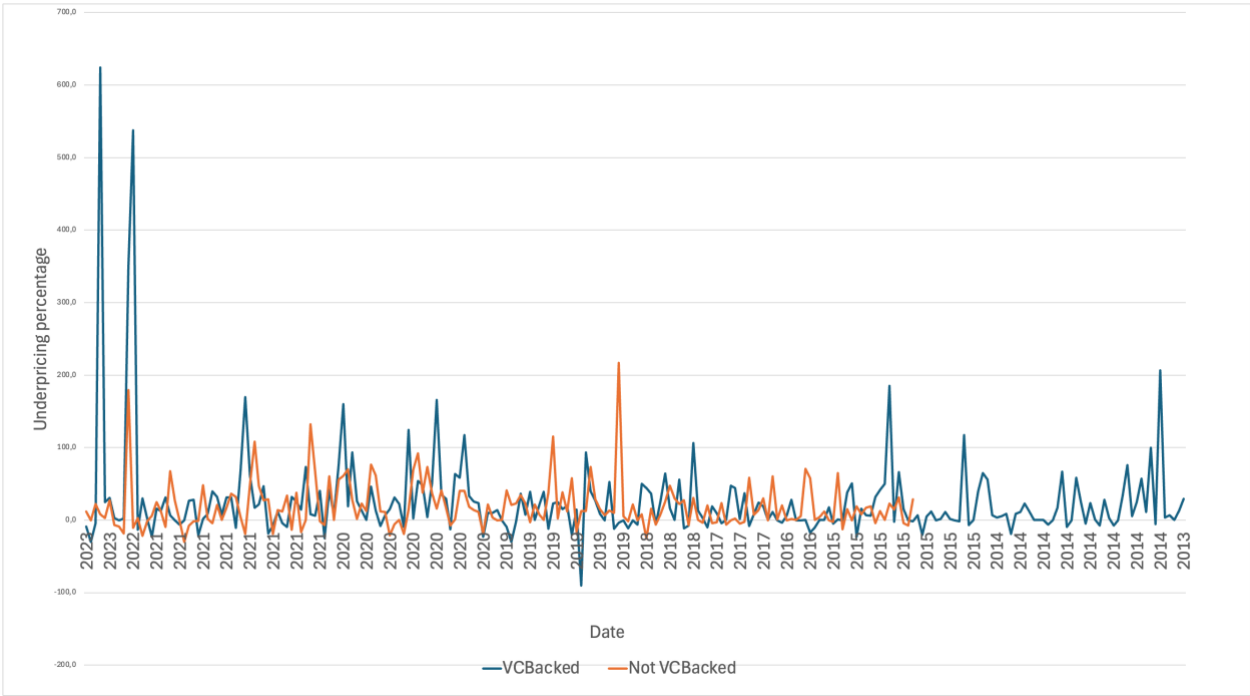


Figure 3: Number of IPOs issued in the US in the last 10 years.

The bar chart shows the number of IPOs issued each year from 2013 to 2023, distinguishing between VC-backed and non-VC-backed companies. It highlights the higher frequency of VC-backed IPOs in most years, with notable peaks in 2021, 2015 and 2014, indicating significant activity in these years compared to others.

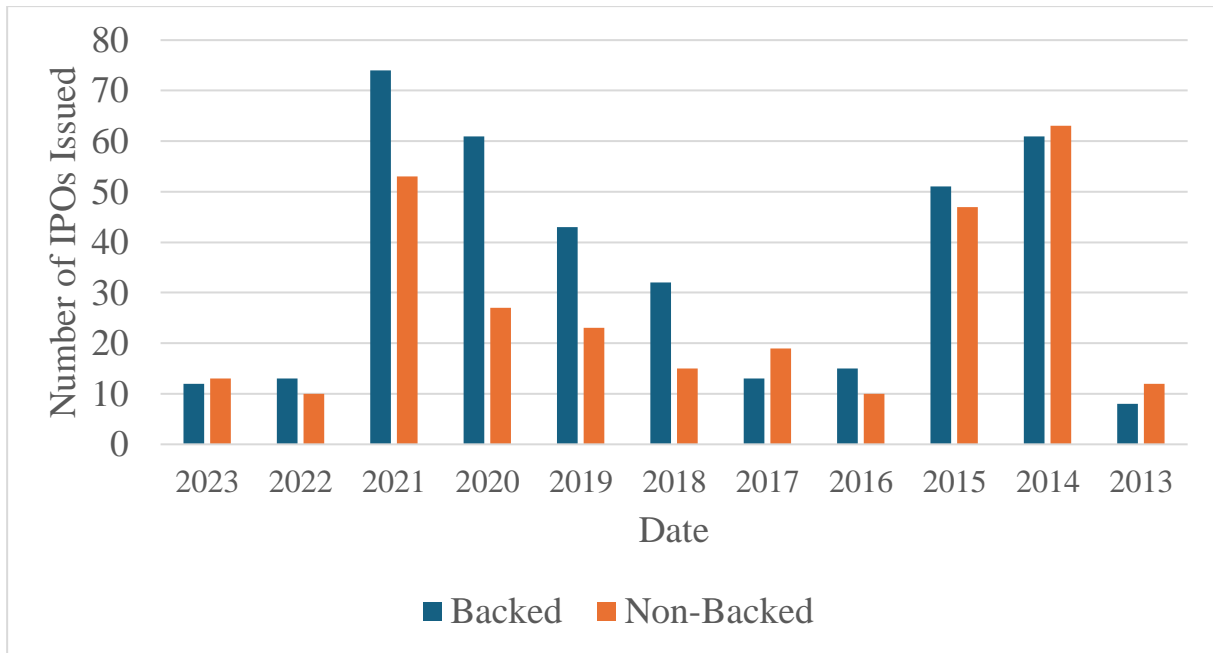


Table 1: Descriptive statistics IPOs (2013-2023)

Variable	Mean	Sd	Min	Max
Company Age	9.81	12.03	0	100
Underpricing	22.78	56.22	-90	682
VC Backed	0.57	0.50	0	1
Hi-Tech	0.14	0.35	0	1
Market Cap	2.24e+08	4.45e+08	768153	7.48e+09
Underwriter	0.29	0.46	0	1
Observations	670			

Table 2: Matrix correlation of independent variables

This table is used to test multicollinearity between the independent variables. A common rule of thumb for identifying strong correlations is a coefficient of 0.8 or higher. As shown in Table 1.1, the variables meet this criterion.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Company Age (1)	1.00						
VC Backed (2)	-0.12	1.00					

Hi-Tech (3)	0.05	0.03	1.00		
Market Cap (4)	-0.03	0.07	-0.03	1.00	
Underwriter (5)	-0.01	-0.02	0.03	-0.03	1.00

Table 3: Underpricing regression on IPOs (2013-2023)

Variable	(1)	(2)	(3)
	Underpricing	Underpricing	Underpricing
VC Backed	8.10*	8.27*	1.29
	(4.37)	(4.42)	(5.57)
Company Age		0.07	0.13
		(0.18)	(0.19)
Hi-Tech		-9.23	-22.47
		(6.26)	(24.02)
Market Cap		0.00	0.00
		(0.00)	(0.00)
Underwriter		2.43	3.17
		(4.77)	(4.87)
Industry Control	No	No	Yes
Stock Exchange Control	No	No	Yes
Constant	18.19***	16.92***	78.10
	(3.29)	(4.33)	(61.84)
Observations	670	670	670
R^2	0.01	0.01	0.02
Adjusted R^2	0.00	0.00	-0.01

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: White test results.

The White test was conducted to check for heteroskedasticity. With a p-value of 1, the test indicates that there is no heteroskedasticity present. Therefore, there is no need to use robust standard errors in the regression.

White test			
White test statistic	7.54939	Chi-sq(82)	P-value = 1
