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Is Venture Capital Equity associated with underpricing of IPOs?

An examination of the impact of Venture Capital Equity on the underpricing of IPOs in the UK

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ABSTRACT

This paper studies the impact of venture capital equity on the underpricing of IPOs. Specifically, it assesses 187 IPOs that took place in the UK from 2005 to 2022. In this paper, an OLS regression with different (dummy) variables is performed and analysed in depth. According to the literature, underpricing is a common phenomenon. In addition, the influence of whether a company uses venture capital and its impact on their IPO is a much-studied topic. Since several papers contradict each other, there is room for more research. Therefore, the main objective of this study is to explore the association of venture capital on the degree of underpricing. The results of this paper show that there is a negative effect of being a venture capital backed company and underpricing of an IPO. Given that IPO is a popular phenomenon, these results will add to the existing knowledge on this topic.

Keywords: *IPO, Underpricing, Venture Capital*

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CHAPTER 1 Introduction

Empirical evidence shows that firms systematically offer their equity lower than the price resulting at the end of the trading day, also known as the phenomenon of underpricing. A reason for underpricing for an initial public offering (IPO) may be whether a company is venture capital (VC) backed or not. Venture capitalists can play an important role in preparing a company for an initial public offering. They can help to get a company's financial records on track, streamline business processes and understand and comply with the legal and regulatory requirements for an IPO. Additionally, Venture Capital equity can help with bringing reassurance to potential investors. A company that is supported by an experienced venture capitalist often has more credibility than a company that is ran solely on its own. The aim of this study is to explain underpricing and the influence of venture capital equity on this phenomenon. In this study, we look at multiples OLS regressions where the main independent dummy variable shows whether a company is VC-backed up or not. This is controlled by adding severel control variable. The answer to this could provide insights for entrepreneurs, investors concerning future investments.

Previous theory states that there is a negative impact of venture capital on IPO underpricing due to certification. In contrary, Tanda & Manzi (2020) show that there is a positive correlation between being a VC-backed up company and the height of underpricing of the IPO in the VS. This may be by reason that companies are brought to market too early by venture capitalists because they want to exit a company via an IPO. The authors also found a slightly negative relationship for the impact of VC on IPO in Europe. Unfortunately, these results were insignificant. The UK could be interesting for testing the robustness of the findings in the VS by Tanda & Manzi (2020) due to the strong difference in size and regulations regarding the IPO market between the UK and the VS. In this study we will choose particularly for the UK because the number of VC-backed companies in the UK is larger, then for continental Europe. This is because more stock financing takes place in the UK, while more bank financing takes place in continental Europe.

There are several key differences between the UK and US IPO market (Ritter 2003). There are several rules and regulations that apply to companies seeking to market their shares through an IPO. For example, the UK has a capital market regulator called the Financial Conduct Authority (FCA) while the Securities and Exchange Commission (SEC) fulfils this role in the US. In general, there are more regulations in the UK than in the US which results in higher costs for bringing a firm to the public market. In addition, the size of the capital market in the US is larger than in the UK. As a result, there are more potential investors and therefore more attention is paid to companies that want to carry out an IPO. The Investor profiles also differ from each other. Whereas in America individual profiles are often important, in the UK institutional investors, such as pension funds and insurance companies, are

often important investors in listed companies. The US also has some prestigious stock market indices like the SP500 and Dow Jones which the UK does not have, which automatically leads to more investments in individual companies in the UK. All these differences can lead to a different outcome when looking at the impact of venture capital equity on an IPO. Therefore, this paper aims to answer the following research question: Is Venture Capital equity negatively associated with IPO underpricing.

To measure the impact of a venture capital equity on the underpricing of its IPO we will use an Ordinary Least Squared (OLS) regression. The dependent variable will be the variable "underpricing" and the independent variable will be a dummy variable named "VC-backed". To calculate underpricing, the offer price is first subtracted from the closing price on the first day of an IPO and then divided by the offer price. The dummy variable VC_backed will have a value of 1 if a company is VC-backed and 0 otherwise. All this information will be taken from the database Eikon. Additionally, we will take control variables into account that could possibly impact underpricing. We will take the following control variables into account. Size of the issuing company (market capitalization): bigger companies usually have a lower percentage of underpricing compared to small companies because investors have more faith in bigger firms. Market sentiment: if a market is bullish there may be more underpricing since investors are more likely to invest in IPOS and are willing to pay more for shares. On the contrary, if a market is bearish there may be less underpricing because investors tend to avoid risk. We will take the index returns of the FTSE 100 for the month of the IPO as proxy for this. Age of the company: starting companies usually are more vulnerable to higher underpricing since their future performances are less sure than older companies. We calculate this variable by taking the difference between the founding date of the company and the date when the IPO took place. Hitech: a dummy variable which is set to 1 for high-tech non internet firm and 0 otherwise. All the information of the control variables come from the eikon database and is taken from 31 December 2005 till the date of 31 December 2022.

I hypothesize that there will be a negative correlation between a firm being VC-backed and underpricing. Thus, companies that are VC-backed will most likely have lower levels of underpricing than companies that are not VC-backed. This should become visible in significant effects of the dummy variable "VC_backed" on the dependent variable "underpricing". This research could lead to critical insights for investors, companies, and policymakers to comprehend how the IPO market is affected by venture capital equity. For example, investors could use this information to make better investments and to assess the potential risk and returns of a particular IPO. Companies could get insights whether they want to pursue an IPO. Lastly, policymakers could get insights on how to regulate the IPO-market in a better way. Our hypothesis was that companies with venture capital have a negative correlation with underpricing, which should be visible in significant results. However, we

expect that the correlation between the variable VC_backed and underpricing will leave sufficient variance unexplained for further research.

The remainder of this paper is structured as follows. Section 2 discusses relevant literature and previous research. Section 3 will give a further explanation on the used data in this paper.
In section 4, we discuss the methodology step by step followed in this paper. In section 5, we will look at the results and discussion. And finally, a conclusion will be drawn in section 6. Additionally, further information on tables and results of statistical tests can be found in the Appendix.

CHAPTER 2 Theoretical Framework

2.1 The IPO process

The first question is, why do firms want to go public In most cases, the answer is simple - to raise capital and create a public market where founders and other shareholders can convert their value from the company into cash in the future. (Ritter & Welch, 2002) To achieve this, a few things will have to happen.

The Initial Public Offering (IPO) process consists of several steps that ensure that a private company becomes a public company that publicly trades its shares on a stock exchange. On average these companies have a considerable size, market value and financial performances before even considering an IPO. Undertaking an IPO is an intensive process, and the durations can vary from a few months to more than a year. (Ritter, 1998) The company that wants to enter the market usually hires one or more underwriters who will help them in the process of going public. Underwriters, mostly investment banks, play a crucial role in this process. (Cartel et al., 2003). Underwriters provide the right documents necessary to comply with the regulations and guidelines of the stock exchange. Additionally, underwriters advise companies what kind of stock, common of preferred, they should bring to the market and at what price. This initial share price is responsible for the phenomenon of IPO underpricing. This is due the fact that underwriters cannot revise the price once it is set, regardless a potential increase in demand for the relevant share.

2.2 IPO underpricing

IPO underpricing has drawn the attention of scientists, experts, and the financial press in recent decades. The phenomenon of underpricing is seen as one of the most important metrics for measuring the performance of an IPO, although there are few similarities whether it is as a detrimental or a positive outcome. The percentage of underpricing is determined by comparing the price at which IPO shares were initially sold to investors with the price at which those shares are traded on the market at the end of the first trading day (Ljungqvist 2007). Underpricing of an IPO can be seen as costs for the initial stockholders, who are also officers of the company, that goes by the name “money left on the table”. This is defined as the difference between the closing price on the first day of trading and the offer price, multiplied by the number of shares sold. Yet it is not entirely illogical that underpricing occurs. It is difficult to price an IPO since there is no current market price available. The officers are required by law to disclose any relevant information they have regarding the IPO. The underpricing can be seen as a kind of insurance against the false or misinformation contained in the IPO prospectus. On the other hand, it is seen as rational for underwriters. They need to sell a fixed number of shares at the IPO. Underwriters have an incentive to undervalue the IPO company with the aim of attracting more IPO investors, reducing marketing efforts, and avoiding not fully underwriting the IPO (Carter,

Dark, & Singh 1998). Conversely, if the underwriter underprices the IPO too much, there will be more money left on the table and the issuer will no longer work with this underwriter. So, the underwriter must find the perfect balance in underpricing an IPO.

2.3 IPO underpricing theories

Many different articles have been written about different theories towards underpricing. In this section of the paper, we will discuss the most important and common ones. We distinguish between 4 sections: Information asymmetry, institutional explanations, ownership & control and lastly behaviourally explanations.

2.3.1 Information asymmetry

Several papers state that information asymmetry, or the unequal availability of information between parties, is one of the most important factors of underpricing. Loughran, Ritter and Rydqvist (1994) examine the short-term and long-term returns of IPOs. The study is based on 1346 US IPOs that took place from 1992 to 2009. They found empirical evidence that a lack of information between investors and issuers leads to higher returns of an IPO, thus more underpricing.
Benveniste and Spindt (1989) analysed that underwriters, since they are the intermediators between the issuers and the investors, have a crucial role in reducing the amount of asymmetric information in the process of an IPO.
Rock (1986) made a model that existed of 2 types of investors: informed and uninformed investors. Informed investors spend time and money on gaining knowledge during research and because of this only invest in “profitable” public stock offers. Hence, uninformed investors do not spend time on money and research but instead buy every public stock offer. The difference in information between the two types of investors will lead to adverse selection. Ultimately, this will lead to an unfair distribution of the "good" shares, which will lead to a lower return for the uninformed investors. Since the issuers are also reliant on the uninformed investors, they use instruments to increase underpricing to compensate them. The empirical findings of the Rock (1986) are support by several papers for example, Welch (1996), Sherman and Titman (2002) and Carter and Manaster (1990).

2.3.2 Institutional explanations

Institutional explanations also play an important role regarding underpricing an IPO. Institutional explanations can be seen as decisions made by issuers or underwriters that effect IPO underpricing. Issuers and underwriters fear exposure to disappointed and angry investors after a poor post IPO performance of a stock. Logue (1973) did research on factors that influence the behaviour of underwriters. He found evidence that companies deliberately underprice their IPO with the aim not to disappoint investors and thus prevent costly lawsuits, reputation loss, etc. On the other hand, Terai &

Levine (1992) state that this could only be a local effect of the US since they have a far more litigious culture compared to the rest of the world.

The price stability hypothesis is a second institutional argument for underpricing an IPO. This hypothesis states that underwriters are involved in activities to support and ensure the price of the issued share to avoid the risk of a potential fall in the share. This means they buy shares in the secondary market equal to the price of the issued share or higher than the price of the issued share to keep the share above the bid price. Booth and Smith (1986), Ruud, (1993) and Jenkinson and Ljungqvist (2001) support this theory in their articles.

Additionally, we have the tax argument regarding the institutional explanations. Rydqvist's (1997) studied the relation between taxes and IPO underpricing. The data sample he used existed of 251 IPOs based in Sweden from January 1980 to July 1994. His research showed that managers in Sweden use the phenomenon of underpricing to gain tax advantages. Guenther and Willenborg (1999) researched the issue prices of IPOs around the 1993 tax law that reduced the capital gains tax on qualified business stock. His data existed of 177 IPOs in the US. they find that after reducing the tax law on capital gains, IPO prices are significantly higher and there is less underpricing. In contrary, Uddin and Raj (2012) investigate this for the international market with different samples and find that underpricing still takes place even in countries where no tax must be paid.

2.3.3 Ownership and control

When a company enters the public market, this naturally means a change in ownership and control. Ownership is important because it could influence the motivation of managers to take the right decisions and make the right investments. Especially when there is separation between ownership and control, managers are more likely to maximize their private utility at the expense of the stockholders'. If this happens it will lead to the principal agent problem between managing and non-managing-shareholders (Jensen & Meckling, 1976). Hanafi and Setiawan investigated IPO underpricing using the agency theory framework. He did this using a sample of 182 IPOs that took place in Indonesia from 2006-2015. He found out that ownership concentration has a negative effect on IPO underpricing.

2.3.4 Behavioural explanations

Several papers argue that we need to take behavioural explanations into account regarding IPO underpricing. These theories speculate that irrational behaviour of investors could lead to an excessively high share price because investors pay a price that is too high for the IPO. It also states that issuers of companies are exposed to behavioural biases and and therefore not putting enough pressure on underwriters to reduce the IPO underpricing (Ljungqvist, 2007). Grinblatt and Hwang (1989) looked at investors' irrational overreaction when new information regarding an IPO came out.

They argue that investors often react to recent news items, which in turn can lead to an underestimation of the value of an IPO. Arisanti and Arsi (2018) have investigated whether herding behaviour takes place in the IPO phenomenon. They studied this in Indonesia with a sample of 205 IPOs. The results show that there is indeed irrational herding behaviour.

The academic literature on underpricing was outlined in this paragraph. Outstanding where information asymmetry, institutional explanations, ownership & control, and lastly behavioural explanations. Next on we will discuss factors affecting IPO underpricing.

2.4 Factors Affecting IPO underpricing

2.4.1 Venture capital equity

Venture capital equity is money invested in mostly young, innovative (technical) companies with high growth potential. These investments are provided by venture capital firms or high net worth individuals also known as angel investors. The main purpose of these venture capital investments is to support the development and growth of start-up companies. For the investment the venture capitalists give to the company, they receive shares in the company in return. By doing this, venture capitalists take a risk because they often invest in new companies that offer no security. Besides offering capital to the companies, they also share their expertise in various fields and often participate in the management of the company invested in. The goal of venture capitalists is to recoup the invested money and most of the times this is done via an IPO. When a venture capital backed company goes public the shares the venture capitalist got from the investment can be sold. If this is successful, a venture capitalist will make a significant profit from it.

An important factor that could potential have a negative effect on underpricing of an IPO is whether the issuer is backed by venture capital or not. Megginson and Weiss (1991) found that being backed up by venture capital equity can reduce the cost of going public. They also found evidence of significantly lower underpricing and underwriter compensation, while holding the following variables: size, underwriter quality, and firm age. Pennacchio (2014), who conducted this research in Italy, draws the same conclusion. Chemmanur and Fulghieri (1999) state the average investor is more confident about a company being VC-backed since it reduces investors uncertainty due to believing that a VC-backed company will have greater growth and financial potentials than a company that is not backed by venture capital. This results in making them willing to pay a higher price for an IPO and thus less underpricing takes place. Unlike previous studies Belghitar and Dixon (2012) controlled for new listing and rebalancing biases in the analysis of the long-term performances. They found that being VC

backed up has a negative relationship with underpricing in the UK. Nevertheless, when they compared the long term returns the VC backed companies do not outperform their non VC backed peers. Bradley and Jordan (2002) examine which variables that are readily observable before the offer date may influence the underpricing of IPOs. Their data sample contains of all US IPOs from 1 January, 1990 to December 31, 1999. Unlike the previous parapgraph, the writings of this paper find a postive effect of venture capital equity and IPO underpricing. The results of Lee & Wahal (2004) also show that VC backed IPOs display greater underpricing than their non-VC backed peers. The return differential spans the whole sample period, from 5.0% to 10.3%. The difference is noticeably higher between 1999 and 2000, the height of the internet bubble.

Thus, the literature does not always agree on the impact that venture capital has on the degree of undervaluation of an IPO, even more reason for more research. But following the most papers, I aim to confirm the following hypothesis in this paper:

H1: Venture capital is negatively associated with IPO underpricing

2.4.2 Firm size

Firm size could potentially effect underpricing of an IPO. Several studies show a negative relationship between the size of a company and the degree of underpricing. So this means that large firms generally have a lesser degree of underpricing than smaller firms. First of all, large firms have more market recognition and visibility, which leads to less information assymetry (Ljungqvist, 2007). This ultimately leads to less investor uncertainty, resulting in less underpricing.
Additionally, smaller companies have achieved less financial performance and are therefore a greater risk for underwriters. Underwriters do not want to burn their hands on these risky small companies to avoid a reputation loss. Large companies also have more financial resources and can afford more reputable underwriters which leads to less underpricing (Carter et all, 1998).
Lastly, being a large company means having better financial performance, an established name and financial resources of a larger company gives potential investors more confidence and reduces perceived risk (Mikkelson & Partch, 2003).

2.4.3 Age

Much has been written in the literature about the impact of a firm's age on the degree of underpricing. Accordingly, the surplus of papers argues that there is a negative relationship between the age of a company and the degree of underpricing. The older a firm is the lower the form of underpricing since

younger firms are more risky than older firms (Ritter 2004). Again, we see that investor risk is reduced here and now in the form of longer operating history. Indeed, this leads to a better insight into future financial performance and prospects (Boulton, Smart, & Zutter, 2010). In addition, if a company is older, it is also more likely to have established and more solid customer base and a better brand reputation which in turn brings less risk for the potential investor (Megginson & Weiss, 1991).

2.4.4 Hitech

Whether a firm is Hi-tech or not can play significant implications in underpricing. According to numerous studies that have looked at the underpricing phenomena in various industries, Hi-tech businesses regularly encounter higher levels of underpricing. Loughran & Ritter (2004) researched IPO underpricing in the US from 1980 till 2003 and examined several variables for this purpose. They empirically found that Hi-tech companies face higher degrees of underpricing. According to them, this would be because Hi-tech companies receive a lot of attention from investors due to their high potential growth, technological innovation and disruptive business models. Ritter and Welch (2002) studied Hi-tech companies over the past 25 years, and they too found that Hi-tech companies are more underpriced than their non-Hi-tech peers.

2.4.5 Market sentiment

The market fluctuates constantly, and this also affects underpricing. We distinguish between a bullish and a bearish market. A bullish market is characterised by the optimistic atmosphere and rising share prices. Potential investors are confident about the economy and expect stock prices to continue rising. Therefore, during a bullish market, there is more demand for equities. This can drive up the initial offer price which will lead to a larger gap between the opening and the closing price and thus more underpricing. In a bearish market, it is the other way around. Investors are pessimistic and expect stocks to fall even further. There is less demand for equities so there will be lower form of underpricing (Ritter, 1984). We will use the market return of the UK's largest index namely the FTSE 100 to mimic this effect. We will link the monthly return of the FTSE 100 to the month of issue of the IPO and this will allow us to see the impact of the market on the underpricing of the IPO.

CHAPTER 3 Data

3.1 Data Sample

The initial public offering information I used in my research is all found in the database of Eikon. Eikon is a financial data and analytics platform developed by Refinitiv, which was formerly the Financial & Risk business division of Thomson Reuters.

In the database, we first filtered on 3 important things. The deal type must be IPO, the region must be the UK and lastly, we use dates from December 2005 to December 2022. Ticking these characteristics gave us 535 IPOs. By changing the data to even further into the past it hardly changes in numbers of IPOs in this database and outweighed how much further back in time the IPOs were. For these 535 IPOs, we needed the following data for these studies. Of course, whether the IPO is VC backed or not, the percentage of underpricing, issue offer price, company founding date, IPO issue date, whether the company is a Hi-tech company or not, the index return of the FTSE100 per month and total amount of shares. Lastly, we needed to check the IPO status and logically only the successful IPOs are filtered out. Requiring all these variables, Eikon gave us observations but not all of them were complete. After removing all observations that were not available on all the previously mentioned variables, 187 observations remained. De data sample that we will use consists of 156 IPOs that are non VC backed and 31 IPOs that are VC backed. The following table shows descriptive statistics of the dataset.

Table 1: Descriptive statistics IPOs 2005-2022

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Underpricing	187	14.535	25.085	-32.5	186.016
VC_backed	187	.166	.373	0	1
Ln(Marketcap)	187	16.814	1.987	13.528	21.267
Age	187	7.263	13.684	-.016	97.447
Marketreturn	187	.297	2.994	-9.682	12.352
Hi-tech	187	.358	.481	0	1

3.2 Variables

3.2.1 dependent variable (underpricing)

The dependent variable is the variable underpricing. Underpricing is calculated as the closing price of the IPO on the first day minus the offer price, divided by the offer price. This variable was directly

findable in Eikon and is represented as a percentage of the difference between issue offer price and closing price on the first trading day.

3.2.2 Independent variable (VC_backed)

The independent variable is whether a company is backed by Venture Capital or not. We found this data in Eikon with the text "TRUE" if the company was VC backed and "FALSE" if the company was not VC Backed. We changed this into a dummy variable which has the value 1 if the company is VC backed and zero otherwise.

3.2.3Control variables

Ln (Firm Size)

The first control variable is Ln(firm size). Eikon did not have a column market cap which is normally a good proxy for firm size. The proxy we will use for firm size in this paper will be found from multiplying the offer price with the total amount of shares outstanding. (Robbins, 2012) states that we should take the logarithm of firm size instead of the absolute firm size to minimize the skewness towards large values.

Firm Age

The second control variable is Firm Age. There was no variable to be found in Eikon that gave the Age of a company on the date of the IPO. Although, I was able to made a proxy with the founding and the IPO date. By taking the difference between the founding date and the IPO date the age of a company on the IPO date can be found. The age of the firms is measured in years.

Hi-Tech

The third control variable is whether a company is hitech or not. Eikon gave us a string "Primary Business not Hi-Tech" if a company was not Hi-Tech and if the company was Hi-tech, a precise name of what sort of Hi-Tech company it is. We translated this into dummy variable with the value 1 if the company was Hi-Tech and zero otherwise.

Market Sentiment

The last control variable we use, is the market sentiment. We use the market returns of the FTSE100 as a proxy to mimic this effect. There was no option in Eikon to see the return of the FTSE 100 index on the day of the IPO or something similar. I gathered the monthly returns of the FTSE 100 stock index from 31 December 2005 up to and including 31 December 2022. Then the percentage of return per month is linked to the month in which the relevant IPO took place.

The following table shows a correlation matrix of the variables to show there is no multicollinearity between the independent variables. Further explanation of this table can be found in table 2 in the appendix.

Table2: Matrix correlation of the independent variables

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) VC_backed	1.000				
(2) ln_marketcap	0.218	1.000			
(3) age_year	-0.033	0.163	1.000		
(4) marketreturns	-0.061	0.003	0.188	1.000	
(5) hitech	0.417	0.194	-0.015	-0.069	1.000

CHAPTER 4 Method

To empirically examine the effect of the variables we use an OLS regression. The formula will look like:

$$\boldsymbol{underpricing = \beta 0 + \beta 1 * VC_{backed} + \beta 2 * Firmsize + \beta 3 * Age + \beta 4 * Marketreturn + \beta 5 * HiTech + \varepsilon}$$

The β's are unknown parameters and ε is assumed N ~ (0, σ^2).

The results in table 3 are gained using the statistic tool STATA, which made it possible to perform multiple regressions and statistical tests. First of all, we made a Kernel Density Plot to analyse the distribution for the data, in our case underpricing. The results are shown in figure 1 in the Appendix. The Kernel density plot shows that the distribution of underpricing is narrower than the normal Kernel Density Plot and show that the most observations lie around 0%. We also did this for the distribution of the residuals. The results are shown in figure 2 in the Appendix. They show that it roughly follows a normal kernel density with most observations around 40. We then looked for outliers and these were indeed present, which can be seen in figure 3 in the Appendix. These could negatively affect the results, so we used a method called Winsorization. In our case, the outliers are present at the upper end of the underpricing. Therefore, we have winstorized the observations above the 95 percentiles. For statistical validation we ran an F-test and found a F-statistic of 1.825 with a p-value of 0.1101, suggesting that the overall regression model is not statistically significant at conventional significance levels. Since we want to check the model for heteroskedacity a Breusch-Pagan/Cook-Weisber test is used. Table 1 in the Appendix show the results and a chi-square statistic of 35.21 with a p-value of 0.000 is found, indicating evidence of heteroskedasticity in the model. To tackle this problem, we will use the robust standard errors when performing an OLS regression. By doing so, the coefficients will be reliable despite the presence of heteroskedacity. In addition, it is important to check the independent variable multicollinearity. This is because it is important that these variables are independent and not too strongly correlated with each other. Namely, if there is a high correlation between certain variable, the results coming out may not be interpreted or may not be interpreted properly. Table 2 in the Appendix shows a correlation matrix of the variables used. Seviratna and Cooray (2019) state that the rule of thumb is that multicollinearity may exist if the correlation between 2 variables is 0.8 or higher. As shown in table 2 in the Appendix, this is not the case for our variables in any situation. Another way to check for multicollinearity is through Variance Inflation Factors (VIF). The results of this can be found in Table 3 in the Appendix. The Variance Inflation Factor (VIF) values indicate no significant multicollinearity issues among the independent variables.

CHAPTER 5 Results & Discussion

In this chapter we will discuss the empirical results of this research, which allows us to analyse our hypothesis.

Table 3 shows the results of multiple OLS regression. Several regressions were made to provide a detailed picture of the results. We will discuss the hypothesis that venture capital is negatively associated using the results derived from the regressions from table 3. In the first column, we see that the results are correct according to the hypothesis and being a venture capital backed up company has a coefficient of -0.359% on underpricing. Unfortunately, we cannot draw any conclusions from this as the p-value > 0.05. In addition, the R-squared shows that the percentage explained by the independent variable is close to 0%. However, the results will change if we start adding control variable.

We see that adding a variable one by one in models 2, 3 and 4 affects the coefficient of VC_backed. When adding the variable ln_marketcap, the variable VC_backed no longer has a negative influence but a positive one. By adding the variables age and market returns, this gradually decreases. Still VC_backed is not significant and so we cannot draw any conclusions from this data. The variable lm_marketcap is significant but only in model 2 which means that in model 2, 1 unit increase in ln(marketcap) is a reduction in undervaluation by 1,803%. Age on the other hand is significant with a significance level of 1% and that means for model 2, if a firm is 1 year older there is 0.000539% less underpricing and for model 4 it is 0.000531% less underpricing. The variable market return is not significant, so we cannot draw a conclusion from this in Model 4. We will now look at the final model 5.

First, the R-squared of model 5 is the highest of all models, hence the best model of all. The value of 0.048 indicates that 4.8% of the model's variance is explained by the independent variables. As shown in the table, the variable VC_backed has a coefficient of -2.635. Which means that if a company is VC backed this results in 2.635% less underpricing than a company that is not VC backed. This is consistent with the previous written literature by Chemmanur & Fulghieri (1999) that we discussed earlier in the theoretical framework. Unfortunately, we cannot confirm our hypothesis as the coefficient is not significant. The variable ln(marketcap) has a coefficient, significant at a level of 5%, of -1.769, meaning that a unit increase in ln(marketcap) lowers underpricing by 1.769%. This runs in line with the results found by Ljungqvist, (2007). The variable age has a coefficient of -0.000522 and is significant at a significance level of 1%. This means that if a company is 1 year older than another company it experiences 0.000522% less underpricing on average. Again, this goes in line with the theory discussed earlier for example with the empirical results of (Ritter 2004). The variable market returns has a coefficient of -0.0152 which means a 1% increase in market returns of the FTSE 100 will

reduce underpricing with 0.0152%. The negative coefficient of this variable confirms the theory of Ritter (1984). We just cannot draw a conclusion for this variable since it is insignificant at a significance level of 5%. Finally, we see that the variable Hitech has a positive coefficient of 7.615. This is consistent with the earlier theory discussed by Loughran & Ritter (2004). This variable is not significant and so we cannot draw an inference here.

Table 3 IPO's 2005-2022 regressions

	(1) Underpricing	(2) Underpricing	(3) Underpricing	(4) Underpricing	(5) Underpricing
VC_Backed	-0.359	1.731	1.217	1.189	-2.635
	(4.946)	(5.031)	(5.029)	(5.049)	(5.442)
Ln(Marketcap)		-1.803*	-1.562	-1.564	-1.769*
		(0.944)	(0.956)	(0.958)	(0.959)
Age			-0.000539**	-0.000531**	-0.000522**
			(0.000371)	(0.000379)	(0.000377)
Marketreturn				-0.0676	-0.0152
				(0.624)	(0.620)
Hitech					7.615
					(4.196)
Constant	14.59***	44.56**	42.03**	42.06**	43.37**
	(2.014)	(15.82)	(15.87)	(15.91)	(15.83)
Observations	187	187	187	187	187
R^2	0.000	0.019	0.031	0.031	0.048
adj. R^2	-0.005	0.009	0.015	0.009	0.022

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Limitations

The main limitation of this study is that no data could be found regarding our data sample for underwriter score. According to literature already written, this seems to be one of the most important variables that could potentially impact underpricing.

Overall, the model's performance is limited, as indicated by the low R-squared and non-significant F-statistic. Additionally, the presence of heteroskedasticity suggests that the standard errors of the coefficients may not be reliable. One reason may be that only 190 observations are present. In addition, in the sample used, the ratio of VC backed and non-VC backed companies is also not evenly

distributed. There are many more non-VC backed companies compared to VC backed companies. A larger data sample could provide better results. Taking these issues into account, there is room for improvement for further analyses of the model and to improve its explanatory power and robustness.

CHAPTER 6 Conclusion

This research aims to identify the role of venture capital on underpricing for IPOs that went public in the UK from 2005 to 2022. Most previous studies state that being a venture capital-backed company has a negative effect on the degree of underpricing. In contrast, there is a substantial number of articles showing empirical evidence of a positive effect, thus suggesting that venture capital causes more underpricing. Since there is no clear answer, it is important to conduct further research. This thesis tried to identify a new piece of information about venture capital equity what could potentially affect the share price after the first trading date. This new information could provide insights for entrepreneurs, investors concerning future investments. Therefore, our research question:

"Is venture capital negatively associated with IPO underpricing.'

To answer this question, we ran several OLS regressions using a sample of 187 IPOs in the UK from 2005 to 2022. It follows from the analysis that underpricing has a negative effect on underpricing, thus in other words, if a company is associated with venture capital it experiences lower measures of underpricing than a company not backed by venture capital. Unfortunately, the results are not significant so we cannot draw a conclusion from this.

In the future, this study can be further expanded and analysed. In this study, the choice was made to study IPOs in the UK over a period of 17 years starting in 2005. In addition, we used certain control variable. In further analysis in the future, it makes sense to control learning for other geographical locations, other time periods and other control variables.

All in all, we can conclude that venture capital equity has a negative effect on the underpricing of any IPOs that went public in the UK from 2005 to 2022. This is in line with earlier expectations in this paper. The results of this paper will contribute to the already existing literature on IPO underpricing. As IPOs are a hot topic in the present, it is important to continue research on this study to better understand the phenom of IPO underpricing.

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APPENDIX

Figure 1: Kernel Density Plot of IPO underpricing 2005-2022 (UK)

To visualise the distribution of the data, we used a Kernel Density Plot. As shown below, it can be seen that underpricing occurs most often around 10 per cent

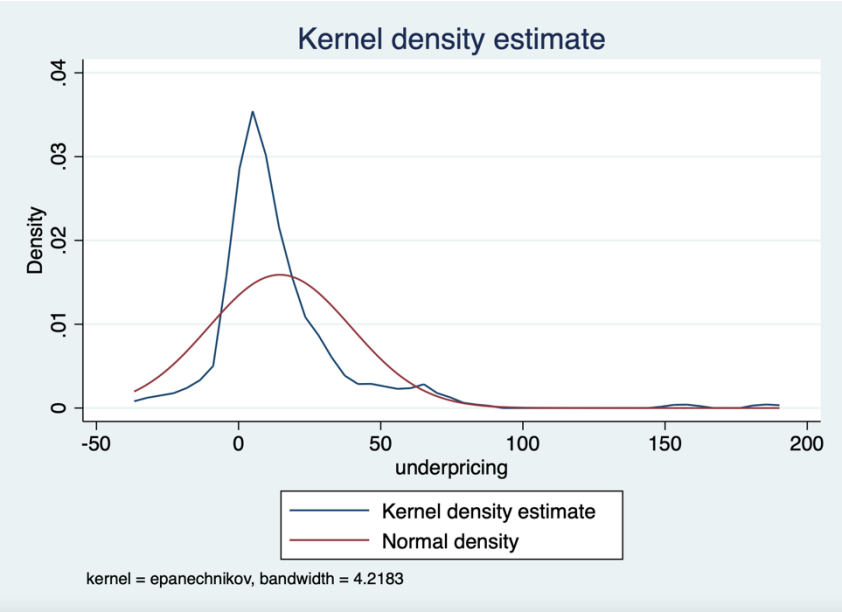

Figure 2: Kernel Density Plot of residuals 2005-2022 (UK)

To visualise the distribution of the data, we used a Kernel Density Plot. As shown below, it can be seen that the residuals of the data are approximately normally distributed according to Normal density.

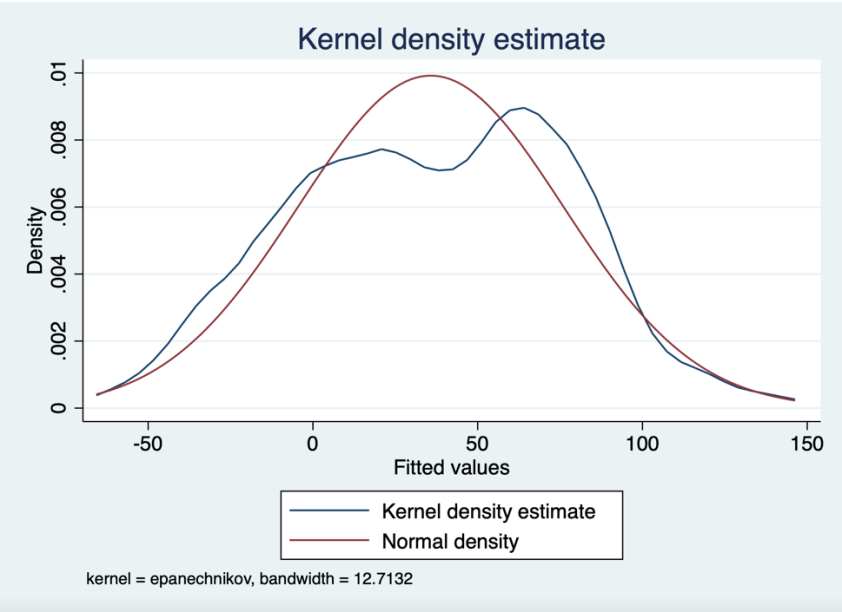

Figure 3Multiple outliers:

Since outliers affect the results negatively, we created a scatterplot of the oberservations of underpricing to check for outliers. As can be seen in the scatterplot, several data points can be seen that are far away from the other data points. So we are talking about outliers here. In our case, the outliers are present at the upper end of the underpricing. Therefore, we have winsorized the observations above the 95 percentile.

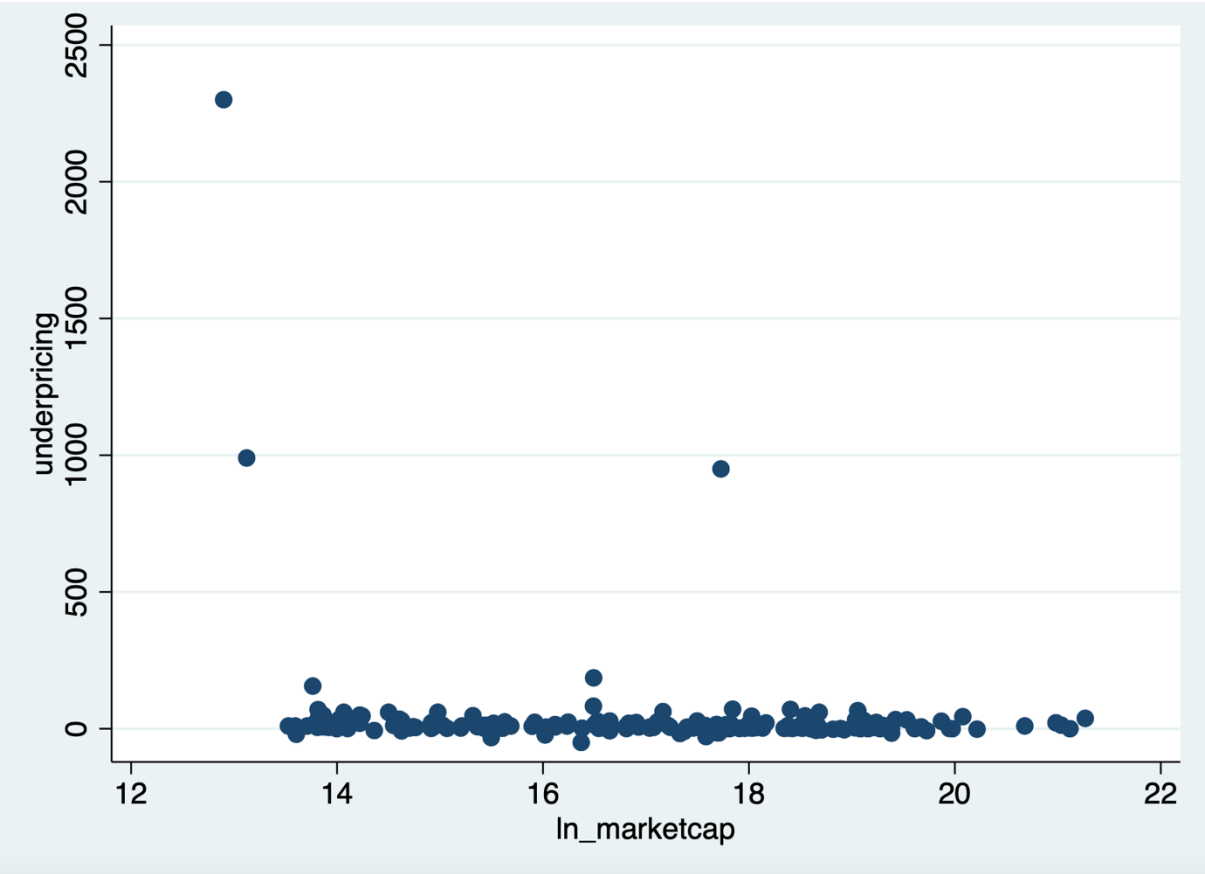

Table 1: Breusch-Pagan / Cook-Weisberg test

It is important to check for heteroskedacity, as this can both affect the results and bias the coefficients. To test this, we use the : Breusch-Pagan / Cook-Weisberg The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity has a chi-square statistic of 35.21 with a p-value of 0.0000, indicating evidence of heteroskedasticity in the model.

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Variable: Fitted values of underpricing
H0: Constant variance
chi2(1) = 35.21
Prob > chi2 = 0.0000

Table 2: Pairwise correlation

To see whether there is multicollinearity between independent variables, we look at a matrix of correlations. Multicollinearity means that the independent variables are correlated with each other, which creates problems in interpreting the results. The rule of thumb is that if there is a correlation of 0.8 or higher between two independent variables, there is a chance of multicollinearity. As shown in Table 2, this is not the case for our variables.

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) VC_backed	1.000				
(2) ln_marketcap	0.218	1.000			
(3) age_year	-0.033	0.163	1.000		
(4) marketreturns	-0.061	0.003	0.188	1.000	
(5) hitech	0.417	0.194	-0.015	-0.069	1.000

Table 3: Variance Inflation Factors

Another way to check for multicolinearity is by using a Variance Inflation Factors test. This VIF score shows how much of a variable is explained by the other variables. In the literature, a VIF score of 5 is considered high multicolinearity. Table 3 shows that this does not apply to our variables.

Variance inflation factor

	VIF	1/VIF
VC_backed	1.244	.804
hitech	1.23	.813
ln marketcap	1.098	.911
age	1.07	.935
marketreturns	1.043	.959
Mean VIF	1.137	.