IS EVERYONE UNINFORMED?

A STUDY OF THE RELATIONSHIP BETWEEN PROFITABILITY AND IPO UNDERPRICING ACROSS PARADIGMS

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Abstract:

In this paper, we investigate the explanatory power of profitability on IPO underpricing through the lens of information asymmetry over different time paradigms. We find that although profitability does not have an impact on IPO underpricing in general, during the time paradigm of 2001 to 2010 it has a positive significant impact— highlighting the necessity to account for variations over time. This result is contrary to traditional information asymmetry theories and goes against past research findings. We propose to understand this result partly through the variation of informational value of accounting fundamentals in equity valuations over time and a potential mediating effect of news and marketing efforts by investment banks on uninformed investors' post-offering trading behaviour. We hypothesise that during the post-Dot-com bubble paradigm, investment banks were cautious to market firms with questionable financial track records. We propose future researchers to empirically investigate this hypothesis as an explanation of our results.

Keywords:

IPO Underpricing, IPO, Profitability, Information Asymmetry, Accounting Fundamentals

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Introduction

IPO underpricing is a well-documented and studied phenomenon. Yet, the relationship between financial performance and underpricing remains generally unexplored. Although the share of unprofitable companies filing IPO:s in the US has increased substantially over the last 40+ years with peaks during the Dot-com bubble of 1999 to 2000 and in the last few years (Ritter, 2023b), research into the relationship between accounting fundamentals and IPO performance remains limited.

IPO underpricing first received a storm of attention from the financial community following the SEC (1963) report on the special studies of securities market that tried to investigate the frequency of "Hot issues". SEC had found a pattern of new issues, particularly for previously unlisted companies, showing substantial share price increases on the day of the issue. The term would later become IPO underpricing and is a measure of money left on the table. Firms IPO to raise funding to finance their future operations and strategic endeavours and each dollar of underpricing indicates cash that could have been used for that purpose but is lost in the IPO process (Ljungqvist, 2007).

These hot issue waves have drawn media spotlight and caused a lot of attention in recent years. Recent IPOs such as Airbnb and Snowflake saw huge run-ups on the first day of trading (Ritter, 2023b), likened by Ritter to the IPO bubble during the late 1990s and early 2000s (Kruppa & Henderson, 2020; Waters, Kruppa & Lee, 2020). Yet, these companies showed massive accounting losses leading up to their IPOs, posing questions regarding how realised profitability impact investors' uncertainty regarding equity valuations of companies going public.

IPO underpricing has generated a lot of attention and researchers have laid out a variety of theories attempting to explain the phenomenon. These theories can be classified into four categories (Ljungqvist, 2007):

1. Information asymmetry theories pointing at the effects of different types of investors having access to varying quality of information (Benveniste & Spindt, 1989; Ibbotson, 1975; Rock, 1986)
2. Institutional theories explaining the phenomenon through the structure of e.g. tax systems or tools such as price stabilisation in the IPO process (Benveniste, Busaba & Wilhelm, 1996; Rydqvist, 1997; Ritter, Welch, 2002)
3. Ownership and control theories pointing at agency, e.g. agency costs (Brennan & Franks, 1997)
4. Behavioural theories pointing at behavioural deviations from rational models of issuer behaviour (Welch, 1992; Ljungqvist, Nanda & Singh, 2006; Loughran & Ritter, 2004)

Each theory tries to explain and predict underpricing through its own approach, sometimes relying on differences in the IPO process or between investors, the incentives of underwriters or behavioural anomalies. However, no explanation has proven to explain the entire phenomenon. In a meta-study by Butler, Keefe and Kieschnick (2014), only 15 of the 48 variables used in the study prove to be robust determinants of underpricing. Past research has also shown that there reside paradigms

in the explanatory power and significance of such variables (Butler et al. 2014; Loughran & Ritter, 2004). A paradigm is defined as a time period exhibiting specific characteristics impacting the explanatory effect of key variables predicting underpricing, in turn, separating it from other periods. Few variables stand the test of time, and depending on the time period of investigation their significance and impact may vary substantially.

There are also empirical patterns emerging over time. Such a trend that has emerged is the increase in the share of companies issuing equity for the first time on public markets that exhibit accounting losses, as mentioned before. During the late 1990s, underpricing and the share of IPOs not being profitable peaked simultaneously. Loughran and Ritter (2004) took to explaining this pattern, finding that the age of these firms was lower during this period. Moreover, in recent years this empirical pattern has re-emerged (Mackintosh, 2021), this time without such a variation in the average age of firms.

In this paper, we seek to investigate this empirical pattern between IPO underpricing and firm profitability more clearly through the lens of paradigms. We draw our hypothesis from a core statement as presented in Ljungqvist (2007): underpricing increases with ex-ante uncertainty. We rely purely on information asymmetry theories and hypothesize that a firm being unprofitable will in different paradigms contribute to the ex-ante uncertainty, increasing the information asymmetry between informed and uninformed investors, and thus increasing underpricing. Followingly, the purpose of this paper is to investigate the following two research questions:

(1) Does IPO profitability have a significant negative impact on IPO underpricing?

(2) Does the impact of profitability on IPO underpricing vary over time?

We believe in turn that profitability will in some periods have a negative effect on underpricing, decreasing the ex-ante uncertainty, whereas during the Dot-com bubble period and in recent years this impact will vanish as a larger share of IPO:s are unprofitable, yet still show large run-ups.

Our results show that across the entire timespan of 1980 to 2021 profitability does not have a significant impact on IPO underpricing. When granularly examining different time periods we see that during the periods 1980 to 1989, 1990 to 1998, 1999 to 2000 and 2011 to 2021 profitability does not have a significant impact on IPO underpricing. However, during the time period 2001 to 2010 profitability significantly increase the underpricing of an IPO. This suggests that we in part find support for our first hypothesis limited to the period of 2001 to 2010 and find robust support for our second hypothesis. Surprisingly, profitability increased underpricing during the period, thus not reducing ex-ante uncertainty.

There are no clear information asymmetry explanations for this result in past research. The variations of the explanatory power of accounting fundamentals, such as profitability, can be found in past research on stock prices, especially surrounding the Dot-com bubble. It could also be the fact that profitability is a poor proxy of ex-ante

uncertainty as investors often rely on secondary sources of information and could instead be better proxied by variations in financial forecasts.

However, the fact that profitability increases underpricing during the period 2001 to 2010 is more elusive. Information asymmetry theories on underpricing generally substantiate the opposite. Some indications in prior research suggest that ex-ante uncertainty about future firm performance could increase the initial valuation of the firm, and thus reduce the underpricing. In this paper, we suggest one explanation more reliant on media and news attention surrounding the IPOs. We propose future researchers to test if the impact profitability has on underpricing during the time period is an effect of selective media attention granted by investment banks' restrictive marketing of firms' IPO:ing with poor financial track records following the burst of the Dot-com bubble. A paradigm impact that would later subsist to the hype of a new era of technology firms emerging during the period 2011 to 2021.

The remainder of this paper is organized as follows. Firstly, we discuss previous research findings on the relationship between IPO underpricing and profitability. Secondly, we present the research design, methodology and variable definitions. Thirdly, we present the data used in this model. Fourthly, we present the results of the regression models. Followingly, we discuss the results and lastly, we draw our conclusions and present limitations as well as proposed extensions to our paper.

1. Literature Review

Early research into IPO underpricing such as Ibbotson (1975) shows that on the day of the IPO, the share price typically jumps considerably, leaving money on the table that the company could have raised to finance its operations. Although a wide variety of studies have tried to explain the causes of underpricing, less focus has been directed to how a company's financial performance impacts the market's reaction on the day of the offering. Even though multiple data reviews have included profitability data such as Ritter and Welch (2002) and Ritter (2023b), few use it as an explanatory variable when trying to explain underpricing.

1.1. Profitability and IPO Underpricing

Ritter and Welch (2002) find that the fraction of firms going public with negative EPS prior to offering has increased over time. Between 1980 to 1989, the share of IPOs with a negative EPS was 19 percent compared to 79 percent between 1999 to 2000, averaging 34 percent between 1980 to 2001. During the 1960s and 1970s, prestigious investment banks would not underwrite an IPO with not at least a four-year track record of positive earnings. In the 1980s, a year of positive earnings was still considered a minimum. But as fewer firms wanting to go public showed black numbers in the late 1980s and 1990s, investment banks started to adapt, and their valuations would be increasingly based on projected future earnings.

Additionally, the mean first-day return for IPOs with negative EPS was 31.4 percent compared to 12.5 percent for profitable firms between 1980 to 2001, indicating a negative relationship between underpricing and earnings (Ritter & Welch, 2002). But when controlling for the Dot-com bubble period, Ritter and Welch find no cross-sectional pattern between IPOs with positive or negative EPS, suggesting that profitability is not a primary cause for the increase in underpricing over time. Rather, Ritter and Loughran (2004) find that the increased underpricing since the 1990s can be explained by changing risk composition of firms going public and changing incentives to choose an underwriter that has a reputation for leaving money on the table.

1.2. The Decision to Go Public

Firm profitability

Profitability is likely to impact a firm's decision to go public. Pástor, Taylor and Veronesi (2009) develop a model for the optimal IPO decision. Pástor et al. show a positive relation between market-wide ex-ante uncertainty about profitability and ex-post variability in underpricing, meaning that uncertainty regarding forecasted profitability increases the variability in underpricing. Furthermore, they find that going public is optimal when the firm's ex-ante profitability is sufficiently high, meaning that the company's private value is lower than the market value. Therefore, ex-ante rather than ex-post profitability impacts the decision to go public, indicating that actual profitability at the time of the IPO may be less relevant than projected future profitability.

Earnings management

Earnings management is when a company report over-optimistic earnings by adopting adjustments to their financial statements (Teoh, Welch & Wong, 1998). Although this may seem like a tempting move for firms in the process of going public to boost their share price, research shows the opposite. Teoh et al (1998) show that unusually high accruals the year a company goes public are associated with poor stock return three years after offering. Their findings are supported by DuCharme, Malatesta and Sefcik (2004). Consequently, firms going public have limited incentives to boost their profitability before offering to increase post-offering stock returns.

Market sentiment

Another prominent factor in deciding to go public is the prevailing market sentiment. According to Loughran and Ritter (1997), prior large stock price increases tend to be the most important explanation for equity offering decisions. This is also confirmed by Bayless and Chaplinsky's (1991) work showing that prior market return is the best explanatory variable in trying to predict when a firm is going public. Hence, market sentiment has a material impact on the decision to go public and needs to be controlled for when assessing IPO performance.

1.3. IPO Underpricing and Profitability in Different Time Periods

According to Ritter and Welch (2002) , it is well established that periods of high issuing volume lead to deteriorating firm quality among companies going public. For instance, during the Dot-com bubble between 1999 to 2000, average IPO underpricing reached 73 percent in 1999, compared to a 19 percent historical average between 1980 to 2022 (Ljungqvist & Wilhelm, 2003; Ritter, 2023b). Ljungqvist and Wilhelm investigate IPO underpricing during the Dot-com bubble and find that certain firm characteristics that were unique to the Dot-com bubble explain much of the inflated IPO underpricing of the period. But pre-IPO profitability had no significant impact on underpricing during the period. This suggests that the impact of profitability on underpricing may be different across time periods, making it interesting to study the relationship over a long period of time, across different time periods and industries.

1.4. Contribution

Although multiple data reviews have investigated the relationship between underpricing and profitability, almost no previous research has tried to investigate if the relationship is significant across time and industries. Therefore, this paper aims to:

(1) Provide insight regarding the relationship between underpricing and profitability across different time periods, industries and market sentiments through the lens of information asymmetry.
(2) Extending Loughran and Ritter's (2004) paper by looking across new time periods and with alternative control variables.
(3) Highlight the importance of looking at several time paradigms rather than trying to find holistic and time-invariant explanations.

2. Research Design

In this section, we present our research design followed by a section about variable definitions and our empirical approach. We have constructed a dataset of observations over the years 1980 to 2021. As each observation is studied at a single point in time, this is not a panel dataset but rather a cross-sectional dataset. We have utilised Dr Jay Ritter's (2022) dataset on IPOs filed in the US between 1975 to 2022 and have complemented his data with the necessary profitability, pricing and control variable data required for our analysis.

Following from information asymmetry theory, past research, and observable pattern in the proportion of unprofitable firms filing IPO:s in conjunction with the time variations in average underpricing we formulate two hypotheses:

$$H_1: Profitability\ has\ a\ significant\ negative\ impact\ on\ IPO\ underpricing$$

$$H_2: The\ impact\ profitability\ has\ on\ underpricing\ varies\ over\ the\ time$$

Previous data reviews have acknowledged the pattern of increases in the share of unprofitable IPO:s prior to and during the Dot-com bubble but have neglected to research it in future paradigms. Furthermore, none have thoroughly investigated the actual links or the explanatory value of profitability on underpricing.

To conduct our analysis, we apply an OLS regression model, akin to Loughran and Ritter's (2004) analysis of changes in IPO underpricing over time, adding time fixed and industry fixed effects. We utilise industry fixed effects in our regressions to control for unobserved heterogeneity between different industries as we believe these unobserved differences between industries are likely to impact the valuation uncertainty at the time of the IPO. Furthermore, earlier research (Loughran & Ritter, 2004) has shown that for instance technology stocks see different patterns in underpricing than for example manufacturing. Technology stocks often also carry negative earnings, so to control for these effects we create dummy variables based on two-digit SIC codes. These dummies take the value of 1 if the firm is operating in a particular industry, and 0 otherwise. We also reason that between different years there reside differences that in turn impact both profitability and IPO underpricing. These could be e.g. business cycles or idiosyncratic events impacting market uncertainty, increases in cost of goods and more. Therefore, we create dummy variables for each year taking the value of 1 if the firm IPO:ed during that year, and 0 otherwise.

In observation of the data residuals distribution as seen in Appendix III and following the results of a Breusch-Pagan test (see Appendix II) we find that our model suffers from heteroscedasticity. This issue is commonly found in past research and Loughran and Ritter (2004) use White (1980) heteroscedasticity constant regressions to resolve this issue.

Heteroscedasticity-consistent standard errors, or simply robust standard errors, first introduced by Eicker (1963), is a technique for obtaining unbiased regression results

under heteroscedasticity. The presence of heteroscedasticity violates the Gauss-Markov Theorem which ensures the lowest variance possible among all estimators to obtain BLUE, the best linear unbiased estimators (Hanck, Arnold, Gerber, & Schmelzer, 2023). Thus, by using robust standard errors, one ensures that the estimates are not biased by the presence of heteroscedasticity in the data and thus reports robust regression estimates.

Since fixed effects both at the time level and at the industry level are applied in the regressions, it is common practice to also cluster the errors accordingly (Pustejovsky & Tipton, 2018). Moreover, clustering at the time level follows the methodology applied by Butler et al. (2014) in their meta-study of robust determinants of underpricing. Previous research by Alti (2005) suggests that clustering IPO:s over time is essential to capture information spill-over effects of earlier IPO:s, reducing the information costs of future IPO:s. However, Butler et al. (2014) find that this is not the only explanatory factor for IPOs clustering over time and suggest that there are additional effects at play. Although the argument is dubious as to the specifics of why IPO:s cluster over time, we have decided to control for these clusters regardless and report as conservative a measure as we can. Therefore, we cluster standard errors on a yearly level. The regression we apply is thus a fixed effects OLS regression with robust standard errors clustered at the time level.

Our original regression model is specified as:

$$UP_i = \beta_1 * P_i + \beta_2 * S_t + \beta_3 * A_i + \beta_4 * VC_i + \beta_5 * MS_i + DT_i + DI_t + \varepsilon_i$$

Where:
UP = Underpricing
P = Profitability
S = Size
A = Age
VC = VC-backed
MS = Market sentiment
DT = Fixed effect dummy for time
DI = Fixed effect dummy for industry

The relevance and operationalisation of these variables are discussed more in-depth in the chapter below.

In our regression model the estimator is selected for efficiency in large samples (Aronow & Samii, 2017) and calculated as below:

$$\hat{\beta} = (X^T X)^{-1} X_y^T$$

Each of these variables are in turn defined in Appendix VIII. However, as we are using clustered robust standard errors, our variance of estimators is calculated as:

$$Var[\hat{\beta}] = (X^T X)^{-1} \sum_{S=1}^{S} [X_S^T A_s e_s e_S^T A_S^T X_s](X^T X)^{-1}$$

As compared to the traditional robust standard error estimator variance:

$$Var[\hat{\beta}] = (X^T X)^{-1} X^T diag\left[\frac{e_i^2}{1 - h_{ii}}\right](X^T X)^{-1}$$

The implications of using such robust standard errors for our estimators are none, and yield the same estimators as if we were to use a traditional non-clustered robust standard error regression. However, confidence intervals become wider. Consequently, we are controlling for any correlation between IPOs over time and thus reporting a more conservative result.

2.1. Variable Definitions

Below we define all variables used in our regression model as well as additional descriptive variables used in this study. Control variables are included if they, from theory or intuition, have an established impact on both profitability and underpricing.

Underpricing - Dependent Variable

Underpricing follow Loughran and Ritter's (2004) definition and measure the return on the first day of trading. This is quantified as (all in USD):

$$\left(\frac{Closing\ price_{T=1} - Offer\ price_{T=1}}{Offer\ price_{T=1}}\right) * 100$$

Profitability – Variable of interest

In this paper, we elect to operationalize profitability through return on assets (ROA). This is done by scaling the profitability of each firm to its assets while maintaining a continuous variable. We believe this is preferable over a dummy variable as the magnitude does not group the observations into two clusters: profitable or unprofitable, but instead can describe differences in the magnitude of profitability. This is calculated as:

$$\left(\frac{Net\ Income_T}{Total\ Assets_{T-1}}\right) * 100$$

In a perfect world, we would like to examine the ROA before the offering. However due to lack of profitability data before IPOs we have instead used net income LTM after offering (in USD), and total assets before offering (in USD). This increases our sample size substantially. This has the potential to create bias in our dataset as firms may become profitable during the 12 months after offering. However, we make the assessment that this bias is negligible in a larger sample as the median profitability (as shown later in Figure 3) follows the pattern of share of profitable IPO:s as depicted by

NASDAQ (Mackintosh, 2021) This potential bias thus should disappear on an aggregate level.

Size - Control variable

Loughran and Ritter (2004) include both sales and total assets as size proxy variables in their study. Due to data availability, we have elected to only utilise total assets before offering (in USD) as a proxy for size since the data availability on sales is limited due to the reporting requirements in the US. This increases our total number of observations substantially. In turn, to scale the variable, we take the natural logarithm, ln(Assets), to proxy the size of the firms. Furthermore, size is a common proxy for ex-ante uncertainty which according to asymmetric information theories about underpricing offers explanatory value (Ljungqvist, 2007). Size also correlates with profitability and should thus be controlled for (Lee, J., 2009).

Age – Control variable

Following Loughran and Ritter (2004), firm age is controlled for in the regression. Due to the vast age differences amongst companies in the dataset, we elect to logarithmise the variable as ln(1+ Age). We use (1+Age) as certain firms IPO the same year as they are founded and thus, we avoid the mathematical problem of not being able to take the natural logarithm of 0. Similarly, to size, age may also act as a proxy for ex-ante uncertainty and is correlated with profitability (Pástor & Veronesi, 2003).

Market sentiment – Control variable

Market sentiment is highly correlated with a firm's decision to go public (Loughran & Ritter, 1997; Bayless & Chaplinsky, 1991). Furthermore, certain fundamentals are correlated with stock return (Lewellen, 2004) which intuitively implies a correlation between fundamentals such as profitability markers and the aggregate return of stock markets. Hence, the prevailing market sentiment at the time of the IPO should thus be controlled for.

There is no uncontroversial way to quantify market return. We elect in this paper to follow the definition as determined by Butler et al. (2014) of 30 days prior index return from the date of the IPO expressed as a percentage. The S&P 500 index covers approximately 80 percent of the total market capitalisation of equities listed in the US, making it a good proxy for the prevailing market sentiment in the US (S&P 500, 2023). The 30 days prior S&P 500 index return is calculated as:

$$\left(\frac{S\&P\ 500\ index\ value_{T}}{S\&P\ 500\ index\ value_{T-30}} - 1\right)*100$$

VC-backed – Control variable

VC-backed is categorized as a dummy variable taking the value of 1 if the company has backing from a venture capital company, and 0 if it does not. This data is extracted from Ritter's (2022) dataset. VC-backing acts as certification-of-quality in an IPO and thus impacts underpricing according to asymmetric information models (Lee, P. M. &

Wahal, 2004; Megginson & Weiss, 1991). Furthermore, VC-backing has a significant impact on a firm's financial performance (Puri & Zarutskie, 2012).

Internet dummy – Control variable

To control for if the composition of firms filing an IPO has changed over time toward more internet and tech-related firms and thus impacting the relation between underpricing and profitability, we include an internet dummy in our alternative regression from Dr Jay Ritter's dataset (2022) taking the value of 1 if the company has an internet-based business model, and 0 otherwise. Internet-based business models have both an impact on underpricing as well as affect the importance of profitability as shown by Demers and Lev (2001).

Price stabilisation – Descriptive variable

A price stabilisation dummy is included in the dataset. According to Dr Jay Ritter, when underpricing is zero, this indicates that the underwriter has conducted price stabilisation measures when demand is weak to ensure the success of the IPO[1]. The dummy takes the value of 1 if the underwriter has conducted price stability support and 0 otherwise.

[1] Email communication with Dr Jay Ritter on 24th of March 2023

3. Data and Descriptive Statistics

3.1. Data

In this section, the data collection process is described, and the data used is discussed. Furthermore, we present descriptive statistics for our dataset and show that the data follow patterns akin to previous research on the topic. To compile our dataset, we combine data from several sources. We use Dr Jay Ritter's (2022) dataset of founding dates for IPOs in the US from 1975 to 2022 as our primary data source with a total of 13,945 observations. Although we use the US as the country of listing, there exist cross-listings of foreign firms on US markets. The reason for choosing to focus on the US is two folded. Firstly, data availability is greater compared to other markets. Secondly, the US IPO market has certain characteristics which make it suitable for the study. The IPO process (See Appendix VI for a detailed explanation) involves book building where the underwriter bases the offer price on indicated demand from investors rather than based on auctions, discriminatory-pricing models or direct listings (Ljungqvist, 2007). This implies that information asymmetries may be present and that the IPO is priced according to investors' expectations regarding the firm's true value. Additionally, the offer price in the US is typically set just hours before trading begins, implying that one does not have to control for market movements between when the offer price is set and trading begins (Ljungqvist, 2007).

Dr Ritter's dataset includes information regarding offer date, CUSIP number, ticker, and the founding date of the company as well as a dummy for if the IPO was VC-backed or not and if the company has an internet-based business model or not. Dr Jay Ritter's dataset has been used in multiple studies such as Field and Karpoff (2002), Loughran and Ritter (2004) and Lowery, Officer, & Schwert (2010). Furthermore, SPAC IPOs are excluded and screened out in the dataset since SPACs constitute shell companies trying to buy private firms, making it difficult to assess profitability before the IPO. Furthermore, SPAC acquisitions tend to attract small and levered firms with poor long-term performance on the market (Kolb & Tykvová, 2016). Using Ritter's (2023a) list of auction listings and direct listings in the US between 1980 to 2022, we also screen out such companies to ensure that the IPOs in the dataset only consist of book building processes.

We then match in data on offer price, closing price first day of trading, total assets before offering, net income LTM after offering (all in USE) and SIC-codes from *The Center for Research on Security Prices (CRSP/Compustat), Refinitiv Eikon, SDC Platinum, S&P Capital IQ* and *SEC EDGAR* and *Dr Jay Ritter's 1975-1984 IPO Database* using a combination of CUSIP-number, company name, offer date and ticker as identifiers. This allows us to cross-check data validity across multiple sources as well as maximise data availability. On the occasions when different data sources have conflicting data, we consistently use the data from *S&P Capital IQ*. Capital IQ has, upon manual inspection, been completely accurate in terms of outliers when cross-checked with Ritter's (2023a) run-up dataset in the few cases where other sources have reported differently. Although the reported numbers are generally robust, the fact that the data sources have conflicting and, in some cases, incorrect data is an issue. In an

ideal world, the data would preferably be extracted directly from the published IPO prospectus. We encourage future researchers with less time restraints to perform this task.

For industry classification, we group the observations into ten major groups based on the two first digits in their SIC codes (Standard Industry Classification Code):

(1) Agriculture, Forestry, Fishing (01-09)
(2) Mining (10-14)
(3) Construction (15-17)
(4) Manufacturing (20-39)
(5) Transportation & Public Utilities (40-49)
(6) Wholesale Trade (50-51)
(7) Retail Trade (52-59)
(8) Finance, Insurance, Real Estate (60-67)
(9) Services (70-89)
(10) Public Administration (91-99)

Additionally, we group the data into time periods, allowing us to investigate time period-specific characteristics in the data. five distinct time periods are constructed according to Loughran and Ritter's (2004) first three paradigm definitions and extended up until 2021:

(1) 1980 to 1989
(2) 1990 to 1998
(3) 1999 to 2000
(4) 2001 to 2010
(5) 2011 to 2021

For data on S&P 500 index returns, we use data from *S&P Capital IQ* of historical S&P 500 index returns as a proxy for market sentiment. Furthermore, we exclude IPOs with an offer price below 5 USD due to the difficulty faced by the underwriters to value such small firms. This is done by both Lowery et al. (2010) and Loughran and Ritter (2004).

Furthermore, we also cap ROA according to a lower and higher cut-off value to exclude companies of relatively small size before the offering but who experienced extreme growth in total assets, specifically due to an increase in cash holdings, as a result of the offering. This leads to a skewed ROA measure. Due to the distribution of ROA measures not being symmetrical and being shifted to the left with more extreme negative values (see Appendix VII), we find that winsorizing the data symmetrically removes an unnecessarily large part of the natural variation in the data. Therefore, we define the high cut-off value as the 99^{th} quantile in the data and the lower as the 5^{th} quantile and exclude values greater or smaller than such cut-offs. This is done to ensure that maximum natural variation in the data remains but that extreme values biasing our data are excluded. We favour trimming or cutting the data over winsorizing due to the nature of the firms in the lower 5^{th} and upper 99^{th} quantiles. These firms are in many cases previously "empty" companies, void of an asset base, and without any traditional operations. Upon manual inspection, a large portion of the firms were empty financial holding companies resembling SPAC:s, which are commonly excluded from datasets as discussed above.

Table I

Description of Data Sources

The table reports the various data sources used in the study. We use Dr Jay Ritter's dataset of US IPOs between 1975 to 2022 as the core dataset for the empirical analysis. The dataset consists of information regarding offer date (the date of the IPO), age of the firm at the time of the IPO, A dummy for whether the company was VC-backed or not and a dummy for whether the company have an internet-based business model. The dataset has a total of 13,945 observations. For information regarding offer price (the price at which the shares are offered in the IPO), closing price first day of trading, total assets before offering, net income LTM (Last Twelve Months) after offering (all in USD) and the company's SIC-code (Standard Industry Classification Code), we use a combination of CRSP/Compustat, Refinitive Eikon, SDC Platinum, S&P Capital IQ. To manually check observations, we use S.E.C's (Security Exchange Commission) EDGAR database. The final dataset consists of 5,990 observations between 1980 to 2021.

Data source	Offer date	Offer price	Closing price	Age	Total assets before offering	Net income LTM after offering	VC backed	Internet dummy	SIC	S&P 500
Dr Jay Ritter dataset[1]	x			x			x	x		
CRSP/Compustat[2]									x	
Refinitive Eikon[3]		x	x		x	x			x	
SDC Platinum[4]		x	x		x	x			x	
S&P Capital IQ[5]		x	x		x	x			x	x
SEC EDGAR[6]	x	x								
Dr Jay Ritter 1975-1984 IPO Database[7]	x	x			x					

[1]https://site.warrington.ufl.edu/ritter/files/founding-dates.pdf
[2]https://wrds-www.wharton.upenn.edu/pages/get-data/center-research-security-prices-crsp/annual-update/crspcompustat-merged/fundamentals-annual/
[3]https://www.refinitiv.com/en/products/eikon-trading-software
[4]https://www.refinitiv.com/en/products/sdc-platinum-financial-securities
[5]https://www.spglobal.com/marketintelligence/en/solutions/sp-capital-iq-pro
[6]https://www.sec.gov/edgar/search-and-access
[7]https://site.warrington.ufl.edu/ritter/files/2016/01/Jay-Ritters-1975-1984-IPO-Database.pdf

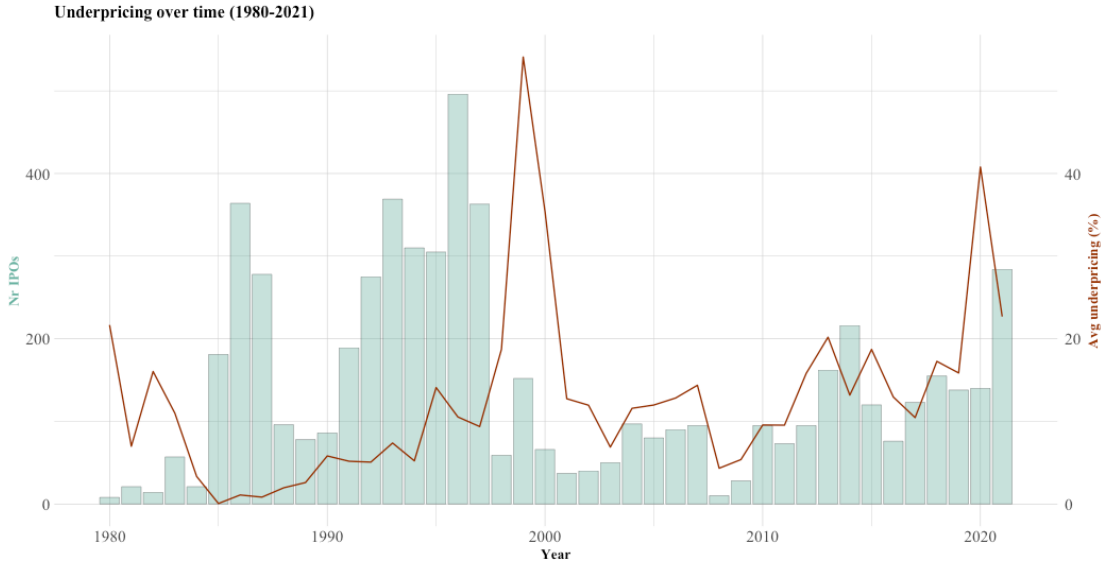
With all data compiled from the various data sources, we end up with a dataset of 5,990 observations between 1980 to 2021 with complete data on offer date, offer price, closing price, age, total assets before offering, net income LTM after offering, dummies for VC-backing and internet business model, SIC-codes for industry classification and the prevailing market sentiment at the time of the IPO.

3.2. Descriptive Statistics

Figure 1

Graph over Average IPO Underpricing and Number of IPOs 1980 to 2021

The graph reports average IPO underpricing (defined as the difference between closing and offer price divided by the offer price and expressed as a percentage) which indicates how mispriced an IPO is by the underwriter. Furthermore, the number of IPOs filed each year between 1980 to 2021 is reported in the graph. One can detect an overall increase in underpricing over time with a peak during the Dot-com bubble in 1999 to 2000. Furthermore, the number of IPOs filed peaked in the years leading up to the Dot-com bubble with a large drop when the bubble burst. Since 2009, the average underpricing has increased with a new peak of around 40 percent in 2020. In general, this pattern corresponds to other established datasets measuring underpricing over time.



According to Figure 1, the number of IPOs and average underpricing has varied greatly over time. Leading up to the Dot-com bubble, one can see a large increase in filed IPOs in the US and average underpricing peaking in 1999, before it was reduced greatly after the bubble burst in 2000. The number of IPOs and average underpricing then stayed at a moderate level until a new peak was experienced in 2020. This pattern corresponds to other established datasets measuring underpricing over time (Ritter, 2023b).

Table II

Descriptive Statistics for Key Variables

Descriptive statistics are reported for the key variables in the dataset. The dataset consists of 5,990 observations between 1980 to 2021. The underpricing, reported as a percentage, averaged 11.84 percent during the period, with a minimum of -97.68 percent and a maximum of 605.56 percent. The median underpricing is 0 percent due to the practice of price stability support by the underwriter. Profitability (defined as net income LTM after offering in USD divided by total assets before offering in USD and expressed as a percentage) averages -7.61 percent with a minimum of -144.09 percent and a maximum of 62.31 percent. For the size of the company, the natural logarithm of total assets before the offering in USD is reported. The age (in years) is reported with a mean of 18.02, a minimum of 0 and a max of 179. Market sentiment, defined as the last thirty days' S&P 500 index return expressed as a percentage, averages 2.1 percent with a minimum of -27.04 percent and a maximum of 20.13 percent.

	N	Min	25th Percentile	Mean	Median	75th Percentile	Max	Kurtosis	Skewness
Underpricing	5,990	-97.68	0.00	11.84	0.00	15.00	605.56	81.85	6.47
Profitability	5,990	-144.09	-11.81	-7.61	2.34	9.63	62.31	6.28	-1.77
Size	5,990	11.51	16.66	18.09	17.92	19.38	26.34	3.15	0.36
Age	5,990	0.00	5.00	18.02	9.00	19.00	179.00	10.38	2.57
Market sentiment	5,990	-27.04	-0.47	2.10	2.21	4.54	20.13	4.66	-0.19

According to Table II, underpricing ranges from -98 percent to 606 percent with a mean of 11.84 percent indicating that the data is skewed to the right which the skewness measure of 6.47 in the table confirms. The mean of 11.84 percent is lower than that reported by Ritter (2023b). This indicates that the data loss we are seeing is affecting our aggregate underpricing and may bias the study. However, upon manually researching the observations lost due to incomplete data, we can find no pattern or reason for why firms experiencing higher underpricing is less inclined to have reported financials. Hence, we believe the bias is marginal but need to be taken into consideration when reviewing our results.

Moreover, the reason why the median underpricing is zero in the table is due to price stability support from the underwriters. According to Dr Jay Ritter and Ljungqvist (2007), underwriters conduct price support on certain IPOs to stabilise the share price if the demand is uncertain, thus ensuring the success of the IPO[2]. Underwriters allocate 110-115 percent of the issue size with the extra shares being an overallotment option, a so-called greenshoe option. If there is weak demand for the stock during the first day of trading, underwriters would then buy back the extra 10-15 percent, placing a limit order at the offer price. This kinks the supply curve and stabilises the price of the shares. Furthermore, the consequence of this practise, meaning an IPO underpricing of zero, can be seen across multiple datasets on IPO underpricing such as Jay Ritter's 1975 to 1984 IPO Database or IPOScoop's 2000 to 2020 IPO database (IPO Scoop, 2020;

[2] Email communication with Dr Jay Ritter on 24th of March 2023

Ritter, 1984a). From Figure 2 one can also see that the usage of overallotment options has decreased drastically since the early 2000s.

Furthermore, profitability, measured as ROA, ranges from -144 percent to 62 percent with a mean of -7.61 percent, indicating a left skewness in the distribution of the data (see Appendix VII). The mean age (measured in years) ranges from 0 to 179 years with a mean of 18 indicating a large variability in the age of companies filing IPOs. Prevailing market sentiment at the time of the IPO, defined as the 30-day prior S&P 500 index return, ranges from -27 to 20 percent with a mean of 2.1 percent showing that the variability of the market sentiment at the time of the IPO varies greatly over time.

Figure 2

The Usage of Price Stability Support 1980 to 2021

The figure reports the number of IPOs for each year in which the underwriter has conducted price stability support (defined as a dummy whether the offer price equals the closing price on the first day of trading). The underwriter can stabilize the share price if the demand is uncertain by allocating 110-115 percent of the issue size to allow the underwriter to buy back the extra 10-15 percent thus placing a limit order on the offer price. According to the figure, the usage of price stability support peaked in the 1990s and declined drastically during and after the Dot-com bubble in 1999 to 2000 and has remained at low levels since then.

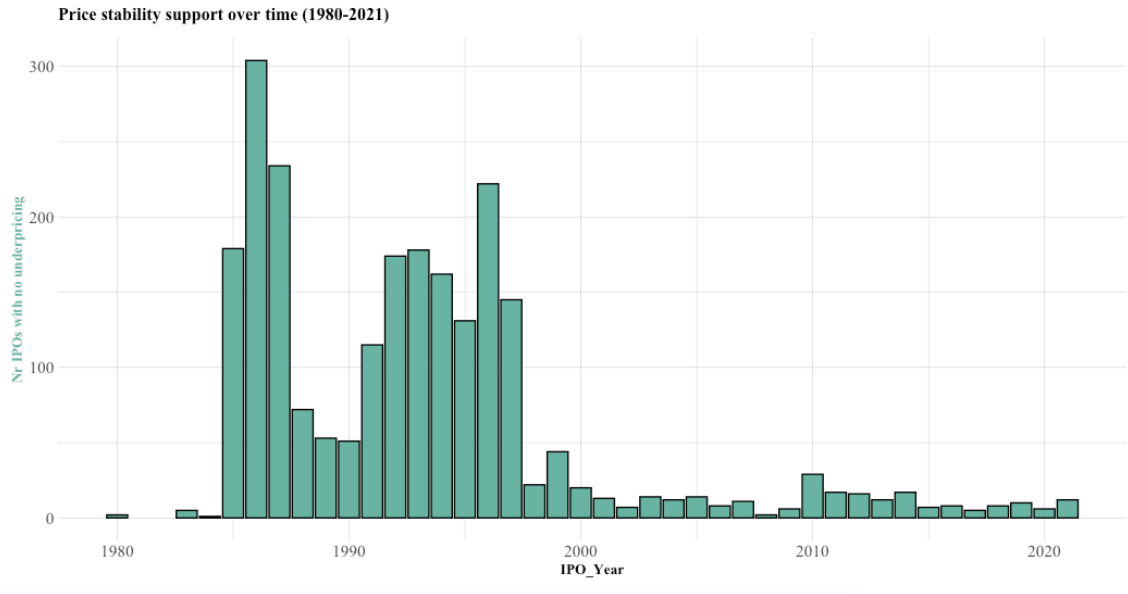


Table III report the mean and median underpricing and profitability for the defined time periods. One can detect slight variations in underpricing and profitability across different time periods. The median underpricing for the period 1980 to 1989 and 1990 to 1998 is slightly skewed due to the usage of price stability support during these periods, but the average underpricing has increased over time. Furthermore, during the last 10 years, there has been a substantial increase in unprofitable companies filing IPO:s as well as during the Dot-com bubble of 1999 to 2000. Overall, the US IPO scene has experienced increased underpricing and deteriorating profitability amongst firms filing IPO:s over time.

Table III

Descriptive Statistics per Time Period 1980 to 2021

The table reports the number of observations, mean and median underpricing as well as mean and median profitability across the defined time periods 1980 to 1989, 1990 to 1998, 1999 to 2000, 2001 to 2010, and 2011 to 2011. The average underpricing has increased over time from 2.03 percent in 1980 to 1989, to 18.88 percent in 2011 to 2021 with a peak during the Dot-com bubble (1999 to 2000) of 48.44 percent. Furthermore, average profitability has decreased over time from 6.14 percent in 1980 to 1989 to -7.24 percent from 2011 to 2021 with a negative peak during the Dot-com bubble of -16.11 percent.

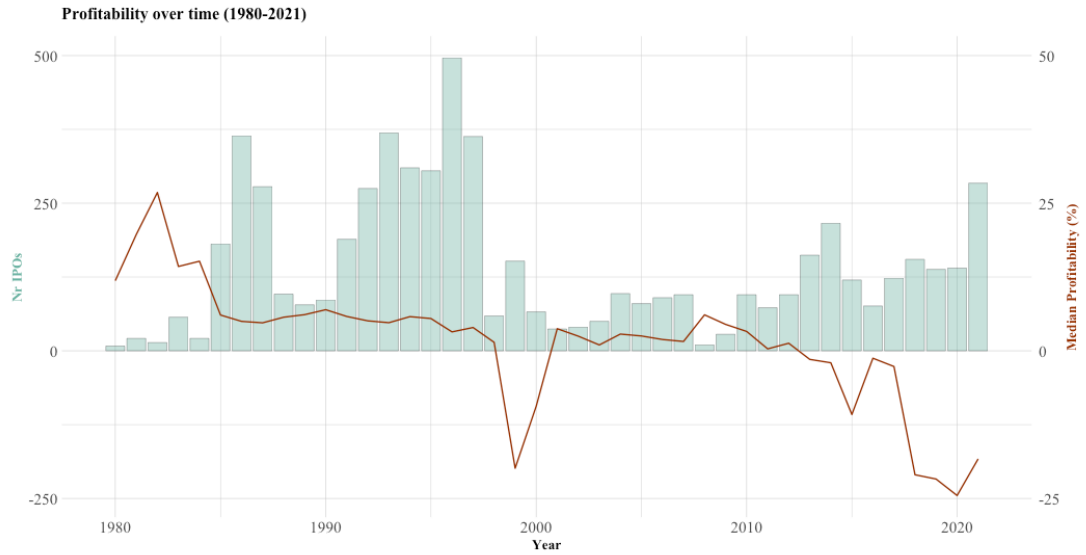
	N	Underpricing mean (%)	Underpricing median (%)	Profitability mean (%)	Profitability median (%)
1980-1989	1,118	2.03	0.00	4.96	6.14
1990-1998	2,452	8.66	0.00	-2.89	4.69
1999-2000	218	48.44	10.05	-29.47	-16.11
2001-2010	621	11.27	5.20	-2.60	2.47
2011-2021	1,581	18.88	10.00	-22.76	-7.24

Figure 3 reports the median profitability and numbers of IPOs from 1980 to 2021. Median profitability and the number of firms filing IPOs seem to be uncorrelated over the period with great variability over time. However, profitability is showing a downward sloping trend with two negative peaks in 1999 and 2020.

Figure 3

Median Profitability and Number of IPOs 1980 to 2021

The figure reports the median profitability and the number of IPOs per year between 1980 to 2021. The median profitability has a negative trend with two negative peaks in 1999 and 2020. The number of IPOs peaked in the 1990s leading up to the Dot-com bubble and dropped drastically when the bubble burst. Median profitability has remained negative for the last 8+ years.



Overall, the descriptive statistics correspond to previous research and data reviews on the topic. There is an overall trend of increasing underpricing and decreasing profitability over time in the data, making it interesting to investigate the relationship between financial performance and the market's valuation of a firm's equity in an IPO over time and in different time periods and market sentiments.

4. Results

In this section, we present our empirical findings from our regressions, test the hypothesises and discuss the regression results' implications for the defined research questions.

Table IV and Table V report the regression results for the empirical analysis using an OLS regression with time fixed effects (on a yearly level) and entity fixed effects (on an industry level) with clustered robust standard errors on a yearly basis at a 5 and 10 percent significance level. Confidence intervals are reported for all variables as well as estimates for the variables in the regressions over the whole dataset 1980 to 2021 and for the time periods 1980 to 1989, 1990 to 1998, 1999 to 2000, 2001 to 2010 and 2011 to 2021.

Table IV shows that profitability does not have a significant impact on underpricing over the period 1980 to 2021. When assessing the defined time periods, underpricing has a significant and positive impact on underpricing during the period 2001 to 2010 indicating that profitability increases underpricing. Furthermore, size shows a negative and significant impact on underpricing during the period 1980 to 2021 and 1990 to 1998 but remains insignificant during the other periods. Age has a significant negative impact on underpricing during the period 1990 to 1998 and remains insignificant during the other periods. Market sentiment has a significant positive impact on underpricing for the regression over the whole dataset indicating that prior positive S&P 500 index returns seem to increase underpricing, indicating a positive relationship between the state of the market and the level of underpricing. The VC-backed dummy remains significantly positive in the regression over the whole dataset, as well as from 1999 to 2000 and 2011 to 2021.

Table IV

Regression Results for IPO Underpricing on Profitability and Several Control Variables at a 5 percent Significance Level

The table report regression results at a 5 percent significance level using an OLS regression with time fixed effects (on a yearly basis) and entity fixed effects (on an industry level). Furthermore, standard errors are clustered on a yearly basis to deal with heteroscedasticity concerns in the data. Regressions for the whole dataset (1980 to 2021) as well as for each defined time period are reported in the table. Profitability has a significant positive impact on IPO underpricing in the period 2001 to 2010 and no significant impact in all other periods. We thus reject our first hypothesis that profitability, as measured in this study, has an overall impact on IPO underpricing.

$$Underpricing_i = \beta_1 * Profitability_i + \beta_2 * Size_t + \beta_3 * Age_i + \beta_4 * VC - backed_i + Time\ dummy_t + Industry\ dummy_i + \varepsilon_i$$

	1980-2021	**1980-1989**	**1990-1998**	**1999-2000**	**2001-2010**	**2011-2021**
Profitability	0.01	-0.00	-0.00	0.10	0.06*	0.07
	[-0.03; 0.06]	[-0.05; 0.05]	[-0.10; 0.09]	[-0.14; 0.33]	[0.01; 0.12]	[-0.04; 0.18]
Size	-0.53*	-0.08	-0.46*	4.20	-0.40	-1.27
	[-1.06; -0.00]	[-0.66; 0.50]	[-0.90; -0.01]	[-32.05; 40.45]	[-1.29; 0.49]	[-3.41; 0.87]
Age	-0.48	-0.02	-0.87*	-12.35	0.14	-0.47
	[-1.23; 0.27]	[-0.74; 0.71]	[-1.72; -0.02]	[-93.65; 68.95]	[-2.23; 2.50]	[-2.04; 1.09]
Market sentiment	0.58*	0.16	0.48	1.77	0.31	1.10
	[0.18; 0.98]	[-0.15; 0.47]	[-0.32; 1.29]	[-6.91; 10.46]	[-0.26; 0.88]	[-0.23; 2.43]
VC-backed	4.82*	0.46	1.53	36.51*	5.77	8.15*
	[2.26; 7.38]	[-1.64; 2.56]	[-0.03; 3.09]	[13.40; 59.61]	[-0.11; 11.65]	[2.28; 14.02]
R^2	0.14	0.22	0.04	0.15	0.07	0.10
Adj. R^2	0.13	0.20	0.03	0.09	0.04	0.09
Num. obs.	5990	1118	2452	218	621	1581
RMSE	28.42	6.62	21.71	81.54	20.24	33.82
N Clusters	42	10	9	2	10	11

Table V show that profitability does not have a significant impact on underpricing over the period 1980 to 2021 at a 10 percent significance level. When assessing the defined time periods, underpricing has a significant and positive impact on underpricing during the period 2001 to 2010 indicating that profitability increases underpricing during the period and confirms the results from Table IV. Size shows a negative and significant impact on underpricing during the period 1990 to 1998 and in the regression on the whole dataset but remains insignificant during the other periods. Similarly to size, age has a significant negative impact on underpricing during the period 1990 to 1998 but remains insignificant during the other periods. Market sentiment has a significant positive impact on underpricing for the regression over the whole dataset and from 1980 to 2021 indicating that prior positive S&P 500 index returns seem to increase underpricing, indicating a positive relationship between the state of the market and the level of underpricing. The VC-backed dummy remains significantly positive in all regressions except from 1980 to 1989.

Table V

Regression Results for IPO Underpricing on Profitability and Several Control Variables at 10 Percent Significance Level

The table report regression results at a 10 percent significance level using and OLS regression with time fixed effects (on a yearly basis) and entity fixed effects (on an industry level). Furthermore, standard errors are clustered on a yearly basis to deal with heteroscedasticity concerns in the data. Regressions for the whole dataset (1980 to 2021) as well as for each defined time period are reported in the table. Profitability has a significant positive impact on IPO underpricing in the period 2001 to 2010 and no significant impact in all other periods. We thus reject our first hypothesis that profitability, as measured in this study, has an overall impact on IPO underpricing.

$$Underpricing_i = \beta_1 * Profitability_i + \beta_2 * Size_t + \beta_3 * Age_i + \beta_4 * VC - backed_i + Time\ dummy_t + Industry\ dummy_i + \varepsilon_i$$

	1980-2021	**1980-1989**	**1990-1998**	**1999-2000**	**2001-2010**	**2011-2021**
Profitability	0.01	-0.00	-0.00	0.10	0.06*	0.07
	[-0.02; 0.05]	[-0.04; 0.03]	[-0.08; 0.07]	[-0.02; 0.22]	[0.02; 0.11]	[-0.02; 0.16]
Size	-0.52*	-0.08	-0.45*	4.28	-0.36	-1.26
	[-0.96; -0.09]	[-0.52; 0.36]	[-0.81; -0.09]	[-14.52; 23.08]	[-1.03; 0.30]	[-2.98; 0.45]
Age	-0.50	-0.02	-0.90*	-12.74	0.06	-0.44
	[-1.14; 0.14]	[-0.57; 0.53]	[-1.59; -0.22]	[-55.71; 30.22]	[-1.88; 2.00]	[-1.72; 0.84]
Market sentiment	0.58*	0.16	0.48	1.77	0.31	1.10*
	[0.25; 0.91]	[-0.07; 0.39]	[-0.14; 1.11]	[-2.57; 6.12]	[-0.14; 0.76]	[0.04; 2.16]
VC-backed	4.82*	0.46	1.52*	36.46*	5.79*	8.20*
	[2.70; 6.95]	[-1.17; 2.09]	[0.27; 2.77]	[24.96; 47.95]	[1.05; 10.53]	[3.44; 12.97]
R^2	0.14	0.22	0.04	0.15	0.07	0.10
Adj. R^2	0.13	0.20	0.03	0.09	0.04	0.09
Num. obs.	5990	1118	2452	218	621	1581
RMSE	28.42	6.62	21.71	81.52	20.23	33.81
N Clusters	42	10	9	2	10	11

Since profitability does not have a significant impact on underpricing when regressing over the whole dataset from 1980 to 2021, we thus need to reject our first hypothesis, and cannot claim that profitability has an overall impact on the IPO underpricing. The rejection of our hypothesis, which is derived from information asymmetry theories of IPO underpricing, thus suggests that we do not find support for unprofitable companies increasing the width of information gaps between informed and uninformed investors over the time period. To try the second hypothesis, we extend previous research (Loughran and Ritter, 2004) by including new data for 2003 to 2021. These regressions show that profitability does not have a significant impact on IPO underpricing during the paradigms defined by Loughran and Ritter (2004). However, we can see that profitability has a positive significant impact on IPO underpricing during the post-Dot-com bubble time period. From 2001 to 2010 we find that profitability is significant and positive at both a 5 percent and 10 percent significance level.

Although this shows support for our second hypothesis, that profitability has a varying impact on IPO underpricing over time, the estimator takes on a contrary direction to what we have hypothesized from the theory. A positive estimator suggests that IPO underpricing is exasperated by a company showing high profitability. Following information asymmetry theories of IPO underpricing this would indicate that the gap of information between uninformed and informed investors increases with profitability. In turn, this is highly contra intuitive to what our intuition leading up to our hypothesis would indicate: uninformed investor premia should instead be lowered, boosting IPO price.

4.1. Diagnostics Checking

To ensure the robustness of the regression results, we conduct diagnostics checking to detect possible errors that may bias the regressions. Since the data suffers from heteroscedasticity (see Appendix III), we control for such heteroscedasticity by using robust standard errors clustered on a yearly level. When using such robust standard errors, the Breusch-Pagan test indicates that heteroscedasticity remains an issue for the regression over the whole dataset from 1980 to 2021 and 1980 to 1989, 1990 to 1998 and 2011 to 2021 (see Appendix II). However, the test shows no signs of heteroscedasticity during the periods 1999 to 2000 and 2001 to 2010. This indicates that the positive significant relation between underpricing and profitability is likely not biased by unequal residual variance and the robustness of the regression results is therefore not negatively impacted by heteroscedasticity during the periods.

Furthermore, the outliers that, from observation, are likely to cause the heteroscedasticity or biasing of our estimator are clustered around the Dot-com bubble as well as during the period 2011 to 2021 as seen in Appendix IV. Followingly, our significant results during the period 2001 to 2010 remain robust when controlling for the underpricing outliers.

Furthermore, we test for multicollinearity amongst the independent variables in the regression. According to Appendix I, the correlations between independent variables are low indicating that there is likely no issue of multicollinearity biasing our regression results.

Conclusively, the diagnostic checking shows no signs of multicollinearity but signs of heteroscedasticity in certain periods. However, in the period where profitability has a significant impact on underpricing, there is no visible issue with heteroscedasticity biasing the regression. However, the issue persists in other periods and although addressed with robust standard errors clustered at the time level this needs to be taken into consideration when reviewing our results.

5. Discussion of information asymmetry explanations for our results

Our results indicate that contrary to what we theorised, profitability does not have a significant impact on IPO underpricing overall. However, during some periods examined, it is one of few significant explanatory variables in our model. The estimator also takes on a direction counterintuitive to our hypothesis: profitability does, in fact, increase underpricing. We will first approach our results with classic asymmetric information explanations found in IPO theory and research discussing ex-ante explanations of the results. We will then move over to understand the difference in significance between paradigms through the lens of share price research. Lastly, we will investigate how information asymmetry and differences in information sources of retail investors might explain our results.

5.1. Ex-ante Explanations

5.1.1. Traditional Information Asymmetry Theories on Underpricing

Extensive empirical evidence points toward information frictions as a primary explanation for underpricing (Ljungqvist, 2007). The book building process is characterised by such information asymmetries. Due to it being costly to create, and transfer information, each party in the transaction has different insights about the quality and the true value of the firm, bearing way for different price expectations in the book building process. Assuming that the market consists of unequally informed investors, Rock (1986) proposes a winner's curse model to explain underpricing, namely that to allow the uninformed investors to participate in the IPO, the underwriter must compensate with underpricing to ensure market participation for all investors and hence guarantee full subscription. Our results indicate that the information gap would become wider if a firm is profitable from 2001 to 2010 which is strictly counter-intuitive. Moreover, Rock's model presupposes that underwriters utilise a pro-rata allocation model which underwriters, especially in the US, have departed from (Ljungqvist, 2007). Followingly, Rock's winner's curse model does not appear applicable.

Although, connected to the winner's curse model, one of the most empirically supported asymmetric information explanations of underpricing, is that underpricing should increase in the ex-ante uncertainty about the true value of the firm filing the IPO (Ljungqvist, 2007). This model was first formalised by Beatty and Ritter (1986) with the intuition that an investor who is engaging in information production indirectly invests in a call option on the IPO which will be exercised if the true value of the shares exceeds the offer price. This option's value increase with valuation uncertainty, implying that more investors will become informed and required underpricing increase. The increase in the number of informed investors thus increases the winner's curse problem, leading to an increase in underpricing. Constructing a proxy for ex-ante uncertainty regarding firm value has proven challenging in past literature (Ljungqvist, 2007) with common proxies being company characteristics (Ritter, 1984b), size proxies

(Ritter, 1984b) or industry (Benveniste, Ljungqvist, Wilhelm, & Yu, 2003). Such proxies are included in our regressions when controlling for size, age and industry. However, another reasonable proxy for ex-ante uncertainty would be financial performance.

Consequently, an unprofitable company filing an IPO is expected to have higher ex-ante uncertainty, implying a negative relation between profitability and underpricing according to Beatty and Ritter's (1986) information asymmetry framework. Although this relation holds intuitively, it is not supported by our empirical findings. The regression results show a positive and significant relationship between profitability and underpricing between 2001 to 2010. This may indicate that accounting profitability markers is not a robust proxy for ex-ante uncertainty regarding the true firm value.

Moreover, as many underwriters have departed from the pro-rata allocation model, theories have emerged focusing on information revelation during book building processes. Benveniste and Spindt (1989) suggest that reductions in information asymmetries due to information production by informed investors are decreasing underpricing. This information production can take place through aggressive bidding, raising the offer price. However, the decision is incentive incompatible as investors profit from information production and thus need to be compensated. In turn, when underwriters can allocate shares freely, such as in the US, investors are rewarded with a large share of the allotment along with, an although a lesser degree of, underpricing (Ljungqvist 2007). The uninformed investors are therefore awarded a lower share of the allotment. This resembles the structure of the winner's curse model. When there is valuation uncertainty, uninformed investors are cautious to bid up the price with a risk of receiving a large allotment at a higher price of a bad IPO. Intuitively, they require more underpricing to participate. As Ljungqvist (2007) stated, in information asymmetry theories underpricing is increasing in ex-ante uncertainty. Followingly, our results are not supported by information revelation theories either.

Moreover, due to underpricing being costly for the issuer in terms of leaving money on the table, it is in the issuer's interest to reduce potential information asymmetries. Assuming that there exist information asymmetries between investors and the issuing firm regarding the quality of the firm, the firm has a variety of options to reduce such discrepancies. Firstly, a reputable underwriter may act as a quality certifier for the firm (Carter & Manaster, 1990; Booth & Smith, 1986) and reduce the winner's curse issue. Assuming that the difficulty to accurately value an unprofitable company is higher compared to a profitable one, an unprofitable issuer may gain from choosing a reputable underwriter to signal firm quality when the issuer expects higher underpricing. Endogeneity concerns make the empirical evidence for this mixed (Habib & Ljungqvist, 2001) since issuers do not choose banks randomly but rather according to expected underpricing, but we suggest an extension in controlling for underwriter reputation to further investigate how accurately realised profitability may proxy ex-ante uncertainty.

Underpricing may also serve as a signal of firm quality from the issuer assuming that all investors are equally informed about the value of the firm. Although costly, high-quality firms that aim to raise additional capital later in a seasoned equity offering (SEOs) may deliberately underprice to signal their higher quality by "[…] leaving a good taste in

investor's mouth" (Ibbotson, 1975 s.264). Assuming that the true quality of the firm will be revealed before the SEO, low-quality firms will refrain from mimicking due to the risk of detection (Ljungqvist, 2007). Intuitively, an unprofitable company has a higher probability of needing to raise additional capital through an SEO in the future, implying that the underpricing should be higher which is not supported by our empirical findings.

In general, we find no explanation for our results in traditional theories on information asymmetry. These theories appear void of any explanation as to why the results would vary in significance over time and indicate that profitability would rather decrease underpricing than increase it – contrary to the results we find.

5.1.2. Perspectives on Fundamentals Explanations – Understanding the Variation Between Paradigms

To understand why the significance of profitability varies over time, we turn to research directed at stock prices, rather than IPOs. Traditional theoretical explanations regarding IPO underpricing as discussed above appear void of any explanation for our empirical findings. As research on the link between accounting fundamentals and underpricing is scarce, we turn to research on stock performance instead, which is richer.

The root connection between earnings and stock price has been extensively investigated. Research has shown that the primary explanation of movements in stock price connected to earnings releases is with respect to surprises, that is, deviations from analyst estimates, and not the historic earnings numbers in themselves (Kinney, Burgstahler & Martin, 2002). As U.S. legislation does not require unlisted companies to publish financial information before being publicly listed, the first earnings announcement or release is usually the IPO prospectus, which is filed before the IPO, and before the offer price is set. Any surprising content in the prospectus should thus be priced into the offer price and could followingly not be a reason for the underpricing.

Moreover, the notion that earnings surprises, and thus the forecasts made by financial analysts compared to actual numbers are decisive, comes naturally as equities valuations traditionally look at the future cash flows of a firm, to find the market price of its equity. Regardless of which model one applies, the estimated future cash flows or earnings are often a better representation than historic figures of the de-facto past financial performance (Liu, Nissim & Thomas, 2007). In turn, this would suggest that in terms of equity valuation, investors tend to rely heavily on secondary sources of information other than firm-released financial earnings in their assessment of firm value. In turn, a better proxy of ex-ante uncertainty could be variations in estimates of financials from these secondary sources, that are not necessarily related to current profitability. This could explain why the significance of profitability is generally absent but does not provide a reason for why it is significant during the 2001 to 2010 period.

However, Pástor & Veronesi (2003) show that uncertainty about a firm's average profitability increases the M/B ratio of equity in the short run, especially for newly

listed young firms. The convex relation between the growth rate of book equity and the future value of equity implies that greater uncertainty regarding the growth rate of book equity (profitability minus dividend yield) results in a higher M/B ratio today. If one assumes that the uncertainty regarding the growth rate of book equity is lower for a profitable firm, one would expect that the average underpricing, holding all other factors impacting underpricing such as information asymmetries constant, would be higher for profitable companies filing an IPO due to a lower offer price. This is consistent with our empirical findings. However, it does not provide an explanation for why the significance would vary over time.

Moreover, looking at the overarching picture of value-relevance of fundamentals, Morris and Alam (2012) confirm past research results in their study by showing that the relevance of accounting measures in explaining the market value of a firm strictly decreased before the Dot-com bubble, and increased in the aftermath of the bubble. This narrative follows our results showing that the significance of profitability only appears after the Dot-com bubble. This indicates the presence of paradigms in the relevance of these accounting fundamentals. The departure from fundamentals is further supported by the research of Core, Guay and Buskirk (2003) who find a substantial decrease in the explanatory power of accounting fundamentals in equities valuations, especially surrounding the Dot-com bubble. This would provide an explanation for the variations in the significance of profitability on underpricing over time.

Furthermore, Demers and Lev (2001) find that, while specifically studying internet-related stocks, the valuation implications of a firm's marketing- and R&D spending and cash burn varied between the years of 1999 and 2000, as investor optimism started to wither during the early 2000s. This furthermore indicates how ideologies of firm value can change very quickly and further support the notion of paradigms in research. These results are, although, specific to internet-related stocks and could imply that the perceptions of these firms can move contrary to non-internet stocks. It is not necessary for our industry fixed effects to capture this effect as internet stocks are not necessarily cantered in any single of the major SIC codes. In turn, this could explain why there is no significant impact of profitability on underpricing during this era. However, when controlling for this effect by including an internet dummy in the regression as seen in Appendix V we receive the same results, and no other paradigm becomes significant.

However, the intuition persists. Accounting fundamentals vary in value relevance over time and sometimes, as in the case of Demers and Lev's (2001) study, change the direction of its impact. An explanation for why profitability only impacts underpricing significantly over a single period of time could simply be that its importance for valuation and risk change over time. The fact that it is just after the Dot-com bubble, when investors, as per Demers and Lev (2001) lost their optimism of excessive losses is no coincidence. The eyes of investors turned to profitability as the shake-out of the unprofitable internet companies started to manifest. The paradigm before the Dot-com bubble maintained that at least a year of profitability was customary before conducting an IPO (Ritter & Welch, 2002). This custom also cements why during this paradigm, profitability is a poor proxy of uncertainty – it had no reason to be considered.

In conclusion, this could prove to explain why the significance of profitability on underpricing varies over time. However, this is no explanation for why, during the post-Dot-com bubble period, profitability increased underpricing. To understand this, we propose to turn to the marketing endeavours of investment banks and the post-issue trading behaviour of retail investors.

5.2. Ex-post Trading Behaviour by Uninformed Investors and Ex-ante Marketing Efforts of Investment Banks

To explain the positive impact of profitability on underpricing from 2001 to 2010 we propose to investigate the post-issue retail trader activities, enforced by variations in information flow to these (uninformed) investors. Past research on accounting fundamentals' relation to stock prices has cemented the importance of the relationship between media and especially retail investors. News is also one of few robust significant variables in Butler et al.'s (2014) study that increase underpricing which we believe could be related to profitability.

Butler et al (2014) find that news reporting is a robust determinant of IPO underpricing with a positive impact on overall time paradigms laid out by Loughran and Ritter (2004). The positive estimator is related to the ex-post effects of "hyping" a company before the issue and increasing public exposure, essentially decreasing information asymmetries between informed and uninformed investors.

This intuition is further laid out by the findings of Cook, Kieschnick and Van Ness (2006) who empirically investigate the marketing actions of investment banks from IPOs to further derive the incentives behind these marketing measures by underwriters. They find that marketing the IPO attracts the interest of retail investors which in turn benefits the underwriter and their regular investors as well as the issuer. Consequently, those who have the potential to lose out on the marketing efforts of the investment bank are the retail investors. Furthermore, retail investors have limited access to IPO:s and participation is usually restricted to having accounts held with the underwriter (SEC, n.d), and those who fulfil the demands of being an "accredited investor" (SEC, 2023). This implies that retail investors can usually only take a position in the stock post-IPO.

Additionally, earlier research has shown that retail investor optimism often is exploited by underwriters and book building investors as their inflated appetite for post-issue IPO shares suggests they are willing to pay an irrational "premium" to obtain these shares (Cornelli, Goldreich, David & Ljungvist, 2006). In turn, this could prove to be an explanation for the positive sign in our regression, as investor optimism could be triggered by profitability following the Dot-com bubble where investors lost a lot of money due to investments in unprofitable IPO stocks. However, this is purely speculative and would need to be investigated empirically by future research. Moreover, this speculation presupposes that retail investors conduct fundamental accounting analysis on the firms they invest in whereas research has shown that individual investor behaviour is rather guided by attention-grabbing news (Barber & Odean, 2008).

Followingly, Bajo and Raimondo (2017) find that the significant impact of news stories and sentiment in media is only confined to positive sentiments. There is no significant impact of negative news reporting on the underpricing of an IPO in their findings contrary to the findings of Loughran and McDonald (2013). Bajo and Raimondo, state that these news publications are only of importance for uninformed, retail investors and do not concern informed investors privy to exclusive insights into the business. The findings of selective attention hosted by retail investors, only informing their actions by positive sentiments, cements the power of investment banks during speculative IPO bubbles. Essentially, this drives retail investor optimism and is undoubtedly linked to the Cornelli et. al.'s (2006) findings.

This indicates that news is a robust and driving factor of IPO underpricing, with marketing efforts of underwriters relayed through media significantly increasing the degree of underpricing of a firm, by attracting uninformed retail investors. We hypothesize that investment banks, following the burst of the Dot-com bubble, refrained from over-hyping stocks lacking core fundamentals. This is supported by the fact that the share of IPOs during this paradigm (2001 to 2010) with negative earnings decreased substantially compared to the 1990s. There are also indications that investment banks were in part to blame for the bubble event, overselling the hype (Quinn & Mills, 2001), and faced large fines for misleading marketing (Treanor, 2002). For our paper, this would imply a substantially higher degree of marketing of profitable IPOs from 2001 to 2010 than for unprofitable IPOs, attracting more retail investors to the profitable IPOs and increasing underpricing as media creates investor optimism. This would imply that the impact profitability has on underpricing is mediated through positively generated media attention and ex-post retail investor behaviour, but this hypothesis would need to be tested empirically.

6. Summary and Conclusions

In this paper, we have investigated the impact of a firm's profitability at the time of its first new equity issue on public markets and its impact on IPO underpricing. Trends in IPO behaviour have shown that the share of IPOs having negative EPS has increased over time, and most notably peaked during the Dot-com bubble. The Dot-com bubble is also the period in history where average underpricing was the highest. Due to a resurgence in the share of unprofitable IPOs vastly increasing in recent years, we have in this paper tried to cement the relationship with two hypotheses:

(1) Profitability has a significant negative impact on IPO underpricing
(2) The impact of profitability on IPO underpricing varies over time

We derive these hypotheses from information asymmetry theory, which generally suggests that underpricing is increasing in ex-ante uncertainty. We believe that an unprofitable firm is a more uncertain investment than a profitable one. In turn, we believe that profitability would decrease underpricing.

Our results show that profitability does not have a significant impact on IPO underpricing in general, when running over the complete time frame of 1980 to 2021. We therefore do not find support for our first hypothesis. However, when separating the dataset into different time paradigms we find that during the post-Dot-com bubble period, defined as 2001 to 2010, profitability has a robust significant positive impact on IPO underpricing. We thereby find support for our second hypothesis; the impact profitability has on IPO underpricing varies over time. This indicates the importance of studying explanatory variables of IPO underpricing across different time paradigms. Holistic explanations disregard any potential changes in the dynamics that create ex-ante uncertainty about firm value.

However, our results are counterintuitive as they suggest that firms being unprofitable would decrease underpricing, rather than increase it. As traditional information asymmetry theories on underpricing appear void of any explanation for our results, we propose three major potential explanations for our phenomena relying on information asymmetries:

Firstly, share price research has shown that the importance of accounting fundamentals in equities valuation has varied significantly over time. In turn, we hypothesize that this correlates with the impact accounting fundamentals have on IPO valuations as well. More specifically, during the Dot-com bubble, the explanatory power of accounting fundamentals was at its lowest and rebounded following the bubble. This would suggest that the informational value of accounting fundamentals vary over time. This could intuitively suggest an explanation for why we only see a significant impact during this period.

Secondly, to explain the direction of the relationship, we need to deviate from classic information asymmetry theories on underpricing. These theories unify over the fact that uncertainty magnifies underpricing. However, research has shown that uncertainty

about a firm's future performance increases valuation in the short run. This would prove to be one explanation for our findings.

Lastly, other theories suggest that the core effect of earnings announcements, on stock prices, is connected to the attention they draw, and not necessarily the contents. This substantiates a difference between the sources of information for informed contra uninformed investors. Applying this to IPOs would imply that aggressively marketed IPOs would draw trading behaviour from uninformed investors and generate higher underpricing, which is supported by previous research. If investment banks during the post-bubble period were more hesitant to aggressively market IPOs without a strong track record of positive financial performance, this could imply that our significant result during this period is mediated through news attention and retail investor behaviour, thus providing an explanation for our results.

6.1. Limitations and Extensions

Our paper has investigated solely the IPO climate in the US. The preferred IPO methods vary between countries, as well as within countries along with other idiosyncratic factors. Our results are thus only applicable to the US equities market and cannot be guaranteed to be transferable to other markets. We thus propose that our study should be replicated in other markets, to assure that the results are generally robust.

Furthermore, we propose that future research delves deeper into profitability as a proxy for ex-ante uncertainty by controlling for variations in financial forecasts by financial analysts. This could prove to be a better accounting-related fundamental proxy than profitability before offering.

Furthermore, our study has limitations as profitability data is generally scarce in the databases we have used. As we have relied on net profit 12 months after offering, and assets before offering, we encourage future research under less time constraints to extract profitability data from the IPO prospectuses of these firms. Consequently, this would increase the number of observations and ensure that the entire dataset of Dr Ritter is included and ensure that the profitability before the offering is the same as being evaluated by potential investors in the prospectus.

Additionally, we propose that further research extend this study by empirically testing our hypothesis that the relationship between profitability and IPO underpricing could potentially be mediated by news reporting and ex-post retail investor trading behaviour. If this relation holds, it will provide deeper insight into the importance of media and marketing efforts in IPOs as well as lay a stronger foundation for explaining variations in explanatory power of variables over different time paradigms. Furthermore, such research would shed light on how investments bank may use retail investors with restricted access to information to ensure the success of their underwritings.

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Appendix

Appendix I

Correlogram over Key Variables

The table reports the correlation between the independent variable profitability and the control variables age, size, market sentiment and the VC-backed dummy. According to the table, there is no correlation between variables larger than 50 percent indicating that there is likely no issue with multicollinearity in the regression results.

	Age	**Size**	**Market sentiment**	**VC-backed**	**Profitability**
Age	1				
Size	0.36	1			
Market sentiment	0.01	0	1		
VC-backed	-0.21	-0.14	0	1	
Profitability	0.2	0.15	-0.03	-0.32	1

Appendix II

Breusch-Pagan Test Result for Regressions

The table reports test results from Breusch-Pagan tests detecting heteroscedasticity in the data. The null hypothesis of the test is that standard errors are homoscedastic, meaning that the variance of the error terms is constant which is assumed in an OLS regression. If we fail to reject the null hypothesis, the homoscedasticity assumption is not violated, and the regression results are not biased by heteroscedasticity. According to the test, heteroscedasticity is still present in the regressions 1980 to 2021, 1980 to 1989, 1990 to 1998 and 2011 to 2021 since the null hypothesis is not rejected at either a one, five or ten percent significant level. However, in the period 1999 to 2000 and 2001 to 2010, the null hypothesis can be rejected, and the errors are homoscedastic. This coincides with the period in which our regression finds that underpricing has a significant positive impact on underpricing at both a 5 and 10 percent significance level. Thus, heteroscedasticity is likely not biasing our regression results during those periods.

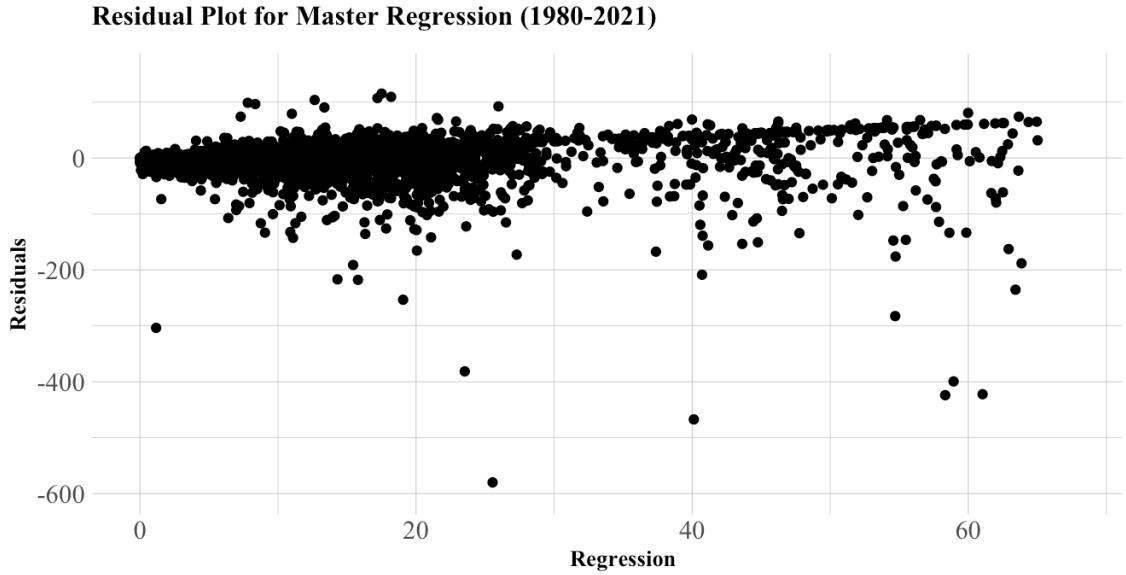
Regression	**BP Test Value**	**Degrees of Freedom**
1980-2021	61.96***	5
1980-1989	16.80**	5
1990-1998	31.20***	5
1999-2000	8.17	5
2001-2010	7.42	5
2011-2021	31.22***	5

*** p-value<0.01, ** p-value<0.05, * p-value<0.1

Appendix III

Residual Plot for the 1980 to 2021 Regression

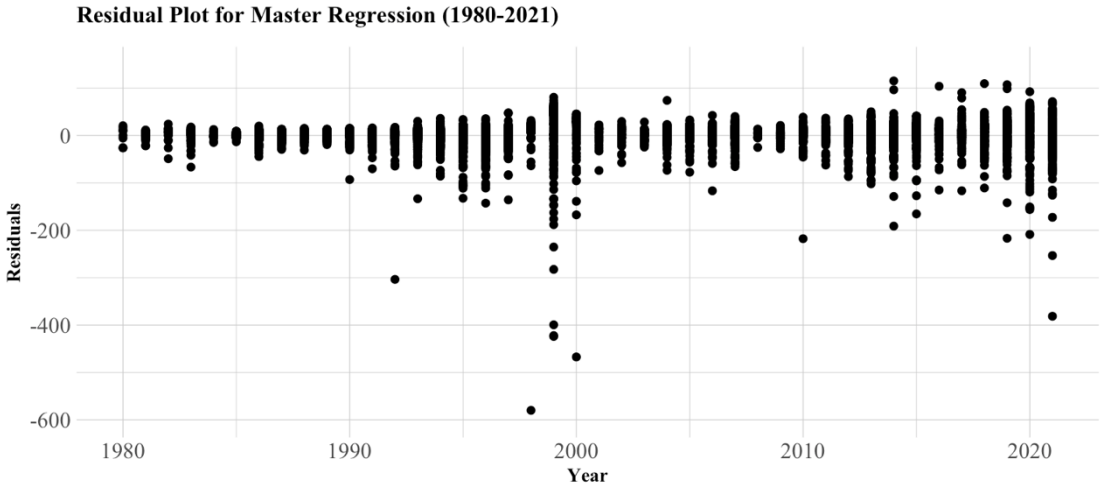
The figure reports a plot of the residuals for the 1980 to 2021 regression. The residuals are calculated as the difference between the fitted values from the regression and the actual values of underpricing. According to the figure, the OLS assumption of homoscedastic error terms is violated since the variance of the residuals is not constant. Therefore, the regressions must account for heteroscedastic errors by using robust standard errors to ensure the robustness of the results.



Appendix IV

Residual Plot Grouped on a Yearly Basis

The figure reports a plot over the residuals for the master regression grouped on a yearly basis. The residuals are calculated as the difference between the fitted values from the regression and the actual values of underpricing. According to the figure, the OLS assumption of homoscedastic error terms is violated since the variance of the residuals is not constant. Therefore, the regressions must account for heteroscedastic errors by using robust standard errors to ensure the robustness of the results. However, we can see that the outlier residuals are clustered around the Dot-com bubble and during the 2011 to 2021 period and not during the period where the regression yield significant results (2001 to 2010).



Appendix IV

Regression Results for IPO Underpricing on Profitability and Several Control Variables at 10 percent Significance Level Including Internet Dummy

The table report regression results at a 10 percent significance level using an OLS regression with time fixed effects (on a yearly basis) and entity fixed effects (on an industry level). Furthermore, standard errors are clustered on a yearly basis to deal with heteroscedasticity concerns in the data. An internet dummy, indicating if the company filing the IPO has an internet-based business model or not, is added to the regression. Regressions for the whole dataset (1980 to 2021) as well as for each defined time period are reported in the table. Profitability has a significant positive impact on IPO underpricing in the period 2001 to 2010 and no significant impact in all others. We thus reject our first hypothesis that profitability, as measured in this study, has an overall impact on IPO underpricing. Furthermore, we can conclude that the significant impact of profitability on underpricing from 2001 to 2010 is robust when controlling for a possible change of the composition of firms filing IPOs over time.

$$Underpricing_i = \beta_1 * Profitability_i + \beta_2 * Size_t + \beta_3 * Age_i + \beta_4 * VC - backed_i + Time\ dummy_t + Industry\ dummy_i + Internet\ dummy_i + \varepsilon_i$$

Internet-dummy regression at 10 percent significance level

	1980-2021	**1980-1989**	**1990-1998**	**1999-2000**	**2001-2010**	**2011-2021**
Profitability	0.02	-0.00	0.01	0.24	0.06*	0.07
	[-0.02; 0.05]	[-0.04; 0.03]	[-0.06; 0.07]	[-0.04; 0.51]	[0.01; 0.11]	[-0.02; 0.15]
Size	-0.59*	-0.08	-0.44*	3.13	-0.31	-1.37
	[-1.02; -0.17]	[-0.52; 0.36]	[-0.78; -0.11]	[-12.28; 18.54]	[-0.97; 0.36]	[-3.08; 0.34]
Age	-0.36	-0.02	-0.74*	-6.07	0.15	-0.43
	[-0.90; 0.18]	[-0.55; 0.52]	[-1.45; -0.03]	[-45.23; 33.09]	[-1.68; 1.97]	[-1.66; 0.80]
Market sentiment	0.58*	0.16	0.51	1.38	0.33	1.09*
	[0.27; 0.90]	[-0.07; 0.39]	[-0.16; 1.18]	[-3.09; 5.86]	[-0.11; 0.77]	[0.07; 2.11]
VC-backed	4.18*	0.46	1.51*	39.10*	4.87*	7.43*
	[2.21; 6.14]	[-1.17; 2.09]	[0.18; 2.83]	[14.12; 64.08]	[0.64; 9.10]	[2.55; 12.31]
Internet dummy	14.23*	-1.66*	20.99	47.25	7.15	5.97*
	[7.48; 20.98]	[-2.66; -0.67]	[-8.12; 50.10]	[-49.78; 144.27]	[-5.91; 20.21]	[2.23; 9.71]

Internet-dummy regression at 10 percent significance level

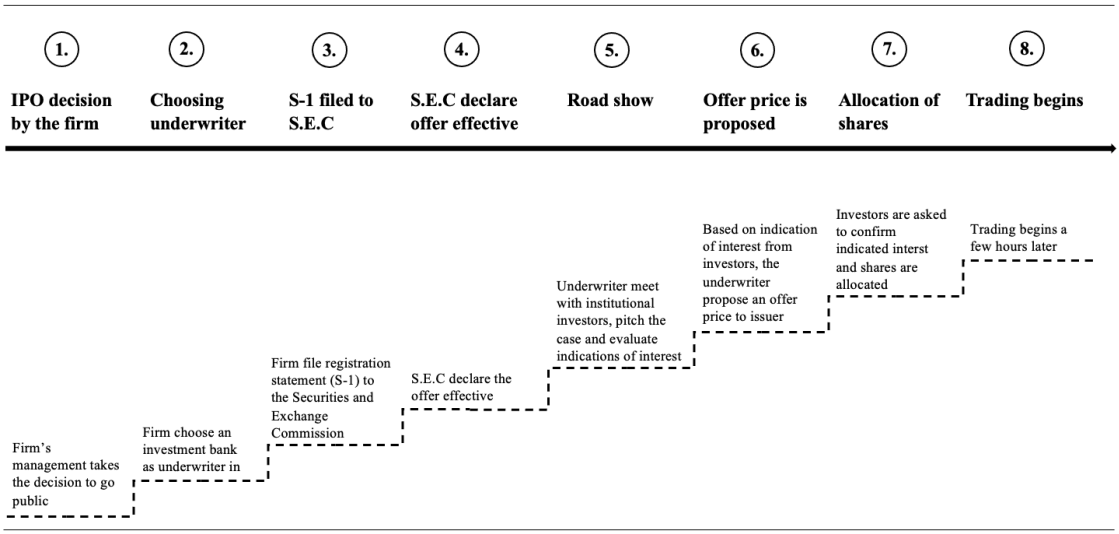
	1980-2021	1980-1989	1990-1998	1999-2000	2001-2010	2011-2021
R^2	0.15	0.22	0.06	0.19	0.08	0.10
Adj. R^2	0.14	0.20	0.05	0.13	0.04	0.09
Num. obs.	5990	1118	2452	218	621	1581
RMSE	28.25	6.62	21.55	79.81	20.17	33.78
N Clusters	42	10	9	2	10	11

* Null hypothesis value outside the confidence interval.

Appendix VI

Overview of the IPO Book Building Process in the US

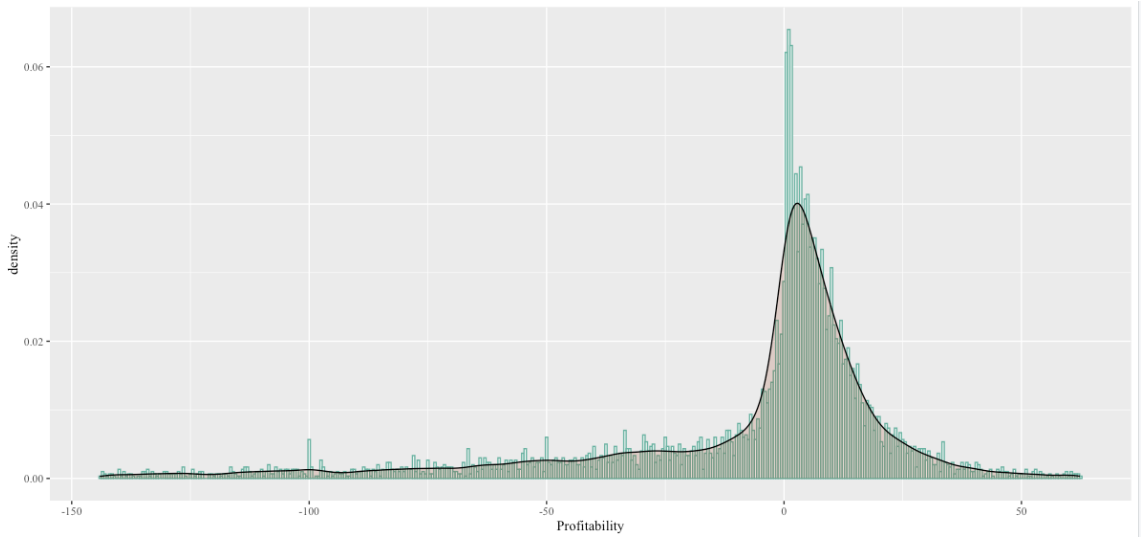
The figure reports an overview of the IPO process in the US according to Ljungqvist (2007). After the firm's management has taken the decision to go public, the firm chooses an investment bank to act as an underwriter. When the underwriter is chosen, the firm files a registration statement (S-1) to the S.E.C. If the S.E.C. declare the offer effective, the road show begins where the underwriter meets with institutional investors, pitches the case and collects indications of interest from investors. Based on the indication of interest, the underwriter proposes an offer price to the issuer. When the offer price is set, investors are asked to confirm their indicated interest and shares are allocated. A few hours later, trading begins.



Appendix VII

The Distribution of the ROA Measure Used in the Study

The graph reports the distribution of the ROA measure used in the study. According to the graph, the distribution is not symmetrical nor normally distributed. The distribution has a long-left tail and is thus skewed to the right. This is due to the inherent nature of the measure itself. A company reporting a negative net income considerably larger than the total assets in its balance sheet is more likely than a company reporting a considerably larger positive net income that the total assets in its balance sheet. Hence, the distribution gets skewed to the left. Therefore, we elect to use a higher and lower cut-off value to exclud SPAC-like companies biasing our dataset. We define the higher cut-off as the 99th quantile and the lower as the 5th quantile. All values below and above such cut-offs are excluded from the dataset.



Appendix VIII

Equation Variable Definitions

Below, all variables relating to the econometric equations are defined. The definitions are taken from the mathematical pamphlet relating to the specifications made by the statistical programming software R (Sonnet, 2023). All equations have been adjusted from the original sources to fit the same variable definitions.

$(X^T X)$: *The gram matrix*

X_y^T: *The moment matrix*

S: *The number of clusters*
X_s: *The rows of X that belongs to cluster s*

I_n: *an identity matrix of size* $n * n$

e_s: *the elements of the residual matrix e in cluster* s, *or* $e_s = y_s - X_s\hat{\beta}$

A_s:

$H = X(X^T X)^{-1} X^T$

$B_s = (I_N - H)_s (I_N - H)_S^T$

$A_s = B_S^{+\frac{1}{2}}$

x_i: *the* ith *row of* X

$e_i = y_i - x_i\hat{\beta}$

$h_{ii} = x_i (X^T X)^{-1} x_i^t$

$diag[.]$: *an operator that creates a diagonal matrix from a vector*