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# Underpricing and long-term performance of Private Equity backed IPOs

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**ABSTRACT**

This paper investigates underpricing and long-term performance of Private Equity backed (PE-backed) initial public offerings (IPOs) in the US. We investigate underpricing by using a sample of 443 PE-backed IPOs and 1550 non-sponsored IPOs listed on the New York Stock Exchange (NYSE) and Nasdaq between 2002-2021. The long-term performance analysis consists of 372 PE-backed IPOs and 965 non-sponsored IPOs listed on NYSE and Nasdaq between 2002-2016. We find that PE-backed IPOs, on average, outperform other non-sponsored IPOs and experience less underpricing. Our results reveal that PE-backed IPOs on average, are larger (in terms of market capitalization) and that the level of underpricing in these issues are less affected by the timing of the IPO compared to that of non-sponsored IPOs. In the three years following the listing the PE-backed IPOs significantly outperforms both other non-sponsored entities and the market (S&P500).

## Acknowledgements

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# 1 Introduction

When Private Equity (PE) funds exit their investments, it is often done through an initial public offering (IPO). This is a process which offers private shares to the public in a new stock issuance on a stock exchange. An IPO price is set by the issuing company (with help from investment banks, advisors etc.). By the end of the first trading day, investors decide on the "correct" market price, which determines if an IPO is underpriced or not. Former research shows that most IPOs are underpriced. Ritter (1984) documented an average underpricing of 16.3% in the period 1977-1982. Booth and Chua (1996) documented similar results with an average underpricing of 13.1% between 1977-1988. In addition, most IPOs underperform in the aftermarket compared to the market and matching companies (control sample of comparable stocks) on a three-year horizon (Ritter, 1992; Levis, 2011).

However, Private Equity backed (PE-backed) IPOs appear to defy these norms (Levis, 2011). IPOs backed by Private Equity have attracted more attention in recent years, due to both indications that Private Equity backed IPOs are priced and perform differently than non-sponsored (NS) entities, in addition to increasing numbers of Private Equity backed IPOs. Consequently, in this thesis we will investigate underpricing of PE-backed IPOs compared to that of non-sponsored IPOs, and PE-backed IPOs long-term performance compared to that of non-sponsored IPOs. We also study differences in underpricing for different issuing markets, industries, and firm sizes. This paper's main contribution to the literature is that PE-backed IPOs appear to be less affected by *when* the firms go public, in opposition to the large periodic differences we observe in non-sponsored IPOs. In addition, we investigate PE-backed IPOs performance compared to the market by using the S&P500 index as benchmark.

The final sample size for the underpricing analysis consists of 1993 IPOs listed on the New York Stock Exchange and Nasdaq from January 2002 until December 2021. A total of 443 IPOs are Private Equity backed and 1550 non-sponsored. In line with previous literature (Ritter, 1984; Booth and Chua, 1996) the total sample of 1993 IPOs experienced an average underpricing of 19.13%. However, in line with Levis (2011) our results reveal the Private Equity backed IPOs are less underpriced compared to that of non-sponsored IPOs. To investigate whether the timing of the IPO affects levels of underpricing and/or the IPO long-term performance, we classify each year as either high market activity- (HMA) or low market activity (LMA) periods, as suggested by Schöber (2008). Years that experience significantly higher numbers of IPOs (2004-2007, 2012-2015 & 2017-2021) are labeled HMA, whereas the remaining years are labeled LMA. Our results suggests that IPOs listed in high market activity (HMA) periods are more underpriced compared to listings in low market activity (LMA) periods.

However, we find no significant evidence for different levels of underpricing in Private Equity backed IPOs in regards to market activity levels (HMA/LMA). In opposition, our results suggest that in LMA periods, Private Equity backed IPOs are on average more underpriced compared to that of non-sponsored IPOs. We believe the main reason for this is that the Private Equity backed IPOs are less affected by timing issues compared to large periodic differences (between HMA & LMA) in non-sponsored IPOs. Further, we find that large companies on average are more underpriced than smaller companies in our total sample. However, this is not the case for Private Equity backed IPOs, as Mid cap companies are more underpriced than Large cap companies. We find vast differences in the level of underpricing between industries, where the Retail industry experiences the most underpricing for both subgroups (Private Equity backed and non-sponsored).

Moving to the long-term performance analysis, our final sample size was 1337 IPOs including 372 PE-backed and 965 non-sponsored IPOs, listed on the New York Stock Exchange and Nasdaq from January 2002 until December 2016. We find that Private Equity backed IPOs significantly outperform non-sponsored IPOs over the first 36 months in the aftermarket. We also find that Private Equity backed IPOs on average significantly outperform the market (S&P500) over both the first 36 months, and the entire event window of 60 months (five years). We obtain positive abnormal returns for the entire sample of IPOs in the event window in the aftermarket. This means that the total sample of IPOs on average outperform the market. We also find that IPOs issued in HMA periods significantly outperform IPOs issued in LMA periods in the 36-months aftermarket. In addition, we note that there are vast differences between the two sub-groups, in the sense that the performance of PE-backed IPOs is less affected by the current market activity level when issued (HMA/LMA), than non-sponsored IPOs.

In the following, we will provide our motivation for this research. In chapter 2, we present previous findings and relevant literature on both underpricing and long-term performance of IPOs, including PE-backed IPOs. Our two main research questions, in addition to our ten main hypotheses, are presented in chapter 3. Chapter 4 and 5 contains an overview of our data collection process, as well as the methodology used in this thesis. Results and discussions are presented in chapter 6, while our conclusion is presented in chapter 7.

## 1.1 Motivation

In the last couple of years, we have seen a boom in IPOs around the world. At the same time, we see more Private Equity funds as they gain more attention and have become more popular among investors. Given the gained attention and relevancy of the two topics we are curious to investigate a research question combining the two. Our research questions are whether Private Equity backed IPOs are less underpriced than non-sponsored IPOs and if they perform better in the long run. We also seek to provide empirical reasons that explain why Private Equity backed IPOs appear to be less underpriced compared to- and outperforms, non-sponsored IPOs in the long run. This could explain these entities' increased attention and why you would invest in a Private Equity fund instead of other types of funds. However, it is to be said that Private Equity investing is not as accessible as most other funds. We will be investigating this in the US market as the size of the market will give us a substantial sample size and therefore accurate results.

# 2 Literature review

In the following, we aim to provide a brief overview on the most recognized theories and articles related to our research. Firstly, we cover key concepts and theories on underpricing in IPOs, including Private Equity backed IPOs. Secondly, we will focus on previous studies and literature on post IPO company performance, including Private Equity backed IPOs.

## 2.1 Underpricing in IPOs

Underpricing in IPOs is a well-studied concept, and has been so over several decades. In the literature, it is rarely disputed whether or not underpricing exists through different periods of time. In the following, we will give an overview of some theoretical explanations for why "money is left at the table" at all.

### 2.1.1 Asymmetric information

Theories and models on asymmetric information is one of the most recognized explanations for underpricing in IPOs, and have been covered by several authors. In an IPO process, the issuing firm is often dependent on investing banking expertise. The investment banks are often better informed about the issuer's fair value, as well as better informed about investors' valuations. This phenomenon, where any of the key participants in an IPO are better informed than others, defines the term; asymmetric information. Baron (1982) focuses on asymmetric information in the case of issuer (issuing firm) and underwriter (investment bank). The article claims that underpricing occurs in part because the issuer rewards the investment bank for its insight and expertise. This is because the issuer often is unable to detect whether the recommended price is appropriate or not. Baron (1982) also argues that the greater the degree

of uncertainty among issuers around the IPO process, the more expensive the investment bank's services will be.

As mentioned, asymmetric information may also occur in the case of investors. Rock (1986) presented a model much in line with Loughran and Ritter's (2004) changing risk composition hypothesis. In the case of uninformed investors, the underwriters will compensate for the information bias by underpricing in the IPO (Rock, 1986). This concept is consistent with Ibbotson, Sindelar and Ritter's (1994) term; the winning curse. They argue that investment banks systematically underprice IPOs in order for investors to make money and keep buying IPOs in the future.

Booth and Smith (1986) presents what is known as the *certification hypothesis*. This relates to the fact that asymmetric information between insiders and outside investors incentivizes the management to hide bad information and disclose only what increases the firm value. Meggison and Weiss (1991) study third-party specialists' (e.g. Private Equity) ability to certify the value of issuing securities to outside investors. Firstly, third-party specialists have *"...very strong incentives to establish a trustworthy reputation in order to retain access to the IPO market on favorable terms"* (Meggison & Weiss, 1991, p. 881). This is because the greater perceived access a Private Equity fund has to the IPO market, the more attractive it will be for take-over firms, which in turn ensure a continuing deal flow. In addition, a solid reputation including competence and honesty, will allow PE funds to establish vitally important relationships with large institutional investors (e.g. pension funds), both as investors in the fund as well as buyers in future IPOs (Meggison & Weiss, 1991). Consequently, it may be reasonable to assume that PE firms have greater intensities and ability to minimize the information asymmetry compared to that of non-sponsored entities, and thus, certify the IPO value to a greater extent.

### 2.1.2 "Hot issue" markets

Earlier studies done by Ibbotson and Jaffe (1975) and Ritter (1984) suggest that underpricing occurs in time-specific periods, as well as in certain industries. "Hot issue" markets are defined as periods in which new issues, on average, yield abnormally high first month returns in the aftermarket (Ibbotson & Jaffe, 1975). "Cold issue" markets define the opposite, when new issues perform negatively relative to the average in the aftermarket. The authors argue that new issues' first month series are predictable, and thus, that investors should be able to concentrate investments in "hot issue" markets as returns are expected to be high. In addition, since market series seem to be predictable, this will also be useful information for the issuers going public. Ibbotson and Jaffe (1975) findings suggest that issuers tend to obtain a higher offering price relative to the efficient price in "cold issue" markets. Ritter (1984) documented an average underpricing of 48.4% in the "hot issue" market of 1980. In sharp contrast, the average underpricing was 16.3% in the remaining analyzing period from 1977-1982. Ljungqvist and Wilhelm (2003) conducted a review on IPOs during the Dot-com bubble, which concludes that at the bubble's peak in 1999 and 2000, internet companies were underpriced by a staggering average of 89%.

### 2.1.3 Market capitalization

Boubaker and Mezhoud (2011) conducted research containing 143 IPOs listed on the Paris Stock Exchange between 2006-2010. The authors argue that a company deliberately underprice their IPO in order to demonstrate its quality and financial strength to market participants. This signaling effect is much in line with Allen and Faulhaber (1989), as well as the model developed by Welch in 1989. In the model by Welch (1989) large companies try to distance them-

selves from smaller companies by voluntarily incurring a cost (underpricing) that smaller companies cannot bear. Bundoo (2007) obtained similar results, as the biggest companies are most underpriced.

### 2.1.4 Other theories on underpricing in IPOs

Loughran and Ritter (2004) indicated that underpricing has changed over time, and that the change is due to three, non-mutually exclusive hypotheses; The changing risk composition, which refers to the assumption that risky IPOs will be "compensated" by being more underpriced, compared to less risky IPOs. The realignment of incentives, which argues that issuing firms have increasingly acquiesced in leaving money on the table. And the changing issuer objective function, which claims that issuing companies to a greater extent accept underpricing, in order to maintain the level of management ownership and other characteristics (Loughran & Ritter, 2004).

Drake and Vetsuypens (1993) argue that underpricing in IPOs reduces the possibility of a lawsuit after the listing. This is justified by the fact that investors in principle have less incentives to sue companies that later underperform if they were offered underpriced shares to begin with. In addition, there are several other explanations in the literature, such as Ljungqvist's (2007) arguments on IPO underpricing's possible tax benefits.

### 2.1.5 Underpricing in Private Equity backed IPOs

Bergström, Nilsson and Wahlberg (2006) studied a sample of 1,370 non-sponsored and 152 Private Equity backed IPOs listed on the London- and Paris Stock Exchange between 1994-2004. The authors conclude that Private Equity backed IPOs tend to experience lower degrees of underpricing compared to other non-sponsored IPOs (Bergström et al., 2006). The same

results were observed by Van der Geest and Van Frederikslust (2001) when studying a sample of 68 non-sponsored IPOs and 38 Private Equity backed IPOs listed on the Amsterdam Stock Exchange from 1985 to 1998.

## 2.2 Long-run performance of IPOs

Jay Ritter (1992) examined the long-run performance of 1,526 IPOs in the US between 1975 and 1984. The issuing firms in this period substantially underperformed compared to matching firms (control sample of 1,526 comparable listed stocks) from the first day's closing price to their three-year trading anniversaries (Ritter, 1992). Over a three-year holding period, Ritter found the average return of the IPO sample to be 34.47%, whereas the matching firms outperformed by generating a return of 61.86% over the same period. According to Ritter, the well documented concept of underpricing in IPOs appears to be a short-run phenomenon.

Ritter (1992) also provides several reasons for why long-run performances are of interest. Firstly, from the investor's point of view, the existence of price patterns may offer superior return possibilities. Secondly, a nonzero aftermarket performance calls into Shiller's (1990) hypothesis that the IPO market particularly is subject to fads that affect market prices. Hence, the informational efficiency of the IPO market is being questioned (Ritter, 1992). A third reason is that the volume of IPOs varies over time. Ritter argues that if poor long-run performances occur in high volume periods, then a "window of opportunity" is presented regarding the timing of new issues (Ritter, 1992). This phenomenon is what Ibbotson and Jaffe (1975) and Ritter (1984) refers to as the "hot issue" market. Lastly, it is not only incurred transaction costs, but also investor's returns which affects the cost of external equity for issuing companies (Ritter, 1992).

### 2.2.1 Possible explanations for IPO underperformance

Ritter (1992) highlights three possible explanations for IPO underperformance. First, risk mismeasurement, which refers to an investor's typical measurement of risk as being the probability of a given loss at the end of their investment horizon. Hence, a risk mismeasuring investor excludes the exposure to losses throughout the investment horizon. Ritter's (1992) second and third explanations are bad luck and fads and overoptimism.

Ibbotson, Sindelar and Ritter (1994) suggest the following reasons for IPO underperformance. Firstly, the authors point out that the valuation of a new IPO may be uncertain. Some investors will be highly optimistic about an IPO's value and others will be pessimistic. On this basis, they describe a scenario called excessive optimism. As time goes by and more performance-related information becomes available, the divergence between the valuation of optimistic and pessimistic investors will narrow down. This will consequently force the market price to drop (Ibbotson, Sindelar and Ritter, 1994). Secondly, a second explanation called impresarios. Since most IPOs are underpriced by an investment bank, it will apparently create "excess demand". Hence, the impresario hypothesis predicts that the short-run underpricing phenomenon negatively affects the long-run performance of an IPO (Ibbotson, Sindelar and Ritter, 1994).

### 2.2.2 The performance of Private Equity-backed IPOs

Levis (2011) conducted a review on aftermarket performance of Private Equity-backed IPOs listed on the London Stock Exchange in the period 1992-2005. This article uses a sample of 1,595 IPOs which are identified into one of three categories; Private Equity-backed (PE-backed), Venture Capital-backed (VC-backed) or other non-backed (NB). Levis (2011) found that PE-backed IPOs

on average are larger in terms of market capitalization, amount raised, sales and assets, compared to the two other categories. Additionally, PE-backed IPOs significantly outperformed VC-backed and non-backed IPOs throughout the entire three-year period in the aftermarket (Levis, 2011). Levis (2011) finds abnormal (positive) buy-and-hold returns for PE-backed IPOs over the whole three-year period. Poorer or negative returns are consistently observed in the two other IPO categories (VC-backed and NB). Levis (2011) reports significant positive intercepts in the Fama and French (1993) regressions, which confirms that the outperformance of PE-backed IPOs is not due to size or book-to-market effects.

### 2.2.3 Possible explanations for PE-backed IPOs outperformance

The literature generally associates PE-backed IPOs with positive excess returns compared to other non-backed IPOs. Kaplan (1989) suggests that the outperformance is related to improvements in operating performance, closer monitoring, and higher levels of leverage in PE-backed IPOs. However, the literature's extant evidence for this outperformance is somewhat limited and inconclusive (Levis, 2011).

# 3 Research questions and hypotheses

Now, we present our two main research questions and hypotheses for the two. Further on we present our ten main hypotheses linked to our research questions to provide more depth and explanation.

## 3.1 Research questions

Our two main research questions are:

- Is Private Equity backed IPOs less underpriced than non-sponsored IPOs in the US?

- Do Private Equity backed IPOs in the US perform better than non-sponsored IPOs short- and long-term?

Our main hypothesis is that Private Equity backed IPOs are less underpriced than non-sponsored IPOs and that Private Equity backed entities perform better in the long run compared to non-sponsored entities. This is in line with former research by Ritter (1982), Kaplan (1989), Ritter and Welch (2002) and Levis (2011). Our contribution is to study the timing issue, in regards to whether underpricing and long-term performance of PE-backed IPOs are affected by *when* (HMA/LMA) the listing was issued.

## 3.2 Hypotheses

To further explain what effect these results imply, we have the following hypotheses.

### 3.2.1 Underpricing hypotheses

As mentioned in chapther 2, previous research generally finds significant levels of underpricing for all IPOs. Hence, our first hypothesis is:

**Hypothesis 1**: All IPOs will on average be underpriced in the US.

Accorcing to Levis (2011) and Kaplan (1989) Private Equity backed IPOs are less underpriced compared to that of non-sponsored IPOs. Hence, our second hypothesis is:

**Hypothesis 2**: Private Equity backed IPOs will be less underpriced compared to non-sponsored IPOs in the US.

Based on Ibbotson and Jaffe (1975) we investigate whether IPOs listed in Hot Issue Markets will be more underpriced than listings in Cold Issue Markets. Hence, our third hypothesis is:

**Hypothesis 3**: Listings during periods with high market activity (HMA) will be more underpriced than listings during low market activity (LMA).

In line with Allen and Faulhaber (1989), as well as Welch (1989), we investigate how the size of the company, in terms of their market capitalization, affects the level of underpricing.

**Hypothesis 4**: Bigger companies will be more underpriced.

We will also investigate if there are the different levels of underpricing across industries. According to Loughran and Ritter (2004), riskier IPOs will be more underpriced in order to compensate investors for the risk. Earlier studies (Ljungqvist & Wilhelm, 2003; Loughran & Ritter, 2004) associate the technology industry as more risky than others, but that the general level of underpricing change over time, as well as in different industries. Hence, our fifth hypothesis follows:

**Hypothesis 5**: Different industries will experience different levels of underpricing.

According to Meggison and Weiss (1991), third-pary specialists (e.g. Private Equity funds) tend to lower the information asymmetry between insiders and outside investors. If PE-backed companies to greater extent display correct pricing and information to investors, we expect to observe more steady levels of underpricing in these issues. Therefore, our last hypothesis on underpricing is the following:

**Hypothesis 6**: Private Equity backed IPOs will be less affected by the differences in market activity, market capitalization and industry.

### 3.2.2 Long-term performance hypotheses

Our first hypothesis on the subject is that our Private Equity backed IPOs will perform better than non-sponsored listings, in line with Kaplan (1989).

**Hypothesis 7**: Private Equity backed IPOs will perform better than non-sponsored IPOs over the first 36 months after the listing.

Further on we suggest that Private Equity backed IPOs will beat the market over the first 36 months, in line with Lewis (2011), but that IPOs in general will underperform compared to the market in line with Ritter (1992). Hence, our next two hypotheses are as follows:

**Hypothesis 8**: Private Equity backed IPOs will perform better than the market over the first 36 months after the listing.

**Hypothesis 9**: The total IPOs in our sample will perform negatively compared the market over the first 36 months after the listing.

Lastly, we will check whether listings during different market activity periods perform differently. There is no former research on the topic in the US market,

but we suggest that listings during high market activity will perform better than listings during low market activity. Hence, our last hypothesis is:

**Hypothesis 10**: Listings during high market activity periods will perform better than listings during low market activity over the first 36 months after the listings.

# 4 Data collection

## 4.1 Initial sample generation

We use SDC Platinum to get the list of IPOs from the New York Stock Exchange and Nasdaq from January 2002 until December 2021. We exclude the minor stock exchanges in the US because of their listing criterions and overall importance on the total US market. The initial sample size in the underpricing analysis is 5134, including 818 Private Equity backed and 4316 non-sponsored IPOs. Further, because we also want to study up to five years of performance for the second part of the research question, we include IPOs from January 2002 until December 2016, and collect monthly returns for these listings from CRSP database. The initial sample size for long term performance consists of 2891 IPOs, including 641 Private Equity backed and 2250 non-sponsored IPOs.

## 4.2 Data cleaning process

From our initial sample of 5134, we exclude IPOs with an offer price below 5 dollars because of the restrictions placed on such issues by the Penny Stock Reform Act of 1990 in the same way as Hahn, Ligon and Rhodes (2013). We also exclude financial and utility offerings (SIC codes 4000-4999 & 6000-6999) because of the unique features of such issues.

Further on, some of the first day closing prices are missing in SDC Platinum, so these IPOs are removed from our sample. Lastly, we remove the 1st and 99th percentiles of first day trading returns to drop the outliers. This leaves us with our final sample of 1993 IPOs, including 443 Private Equity backed and 1550 non-sponsored.

For the second part of our research, we exclude IPOs listed after the end of 2016 so that we can study the 5-year return for the listings. We include 60

months (5 years) to see if we observe major differences on 60 months performance compared to the usual 36 month time-frame. If there are no significant differences, we will focus our analysis on 36 months to be able to compare our results to previous research. When retrieving the returns, some tickers are not recognized by CRSP. Others are removed due to delisting within 5 years or other issues that can cause wrongful measuring of the listing's performance. Our final sample size for long term performance are 1337 IPOs, including 372 Private Equity backed and 965 was non-sponsored IPOs.

## 4.3 IPO classification process

When classifying whether an IPO is Private Equity backed or non-sponsored, we use SDC Platinum's "Private Equity Backed IPO Flag" filter. Their definition of the filter is:

*"Private Equity Backed IPO Issue Flag (Y/N): Set to Y where the issuer was private equity-backed at the time of the initial public offering"* (SDC Platinum, 2022).

SDC Platinum does not go further in depth on what they categorize as "private equity-backed" but given the magnitude and reputation of SDC Platinum as a database we choose to rely on this filter.

Table 1: **IPO classification**

We study underpricing by using a sample of 1993 IPOs, including 443 PE-backed IPOs and 1550 non-sponsored IPOs listed on the New York Stock Exchange (NYSE) and Nasdaq between 2002-2021. The sample used in the long-term performance analysis consists of 1337 IPOs, including 372 PE-backed IPOs and 965 non-sponsored IPOs listed on NYSE and Nasdaq between 2002-2016.

| **Sample type** | **Period** | **No. of IPOs** | **PE-backed** | **NS** |
|---|---|---|---|---|
| Underpricing | 2002-2021 | 1993 | 443 | 1550 |
| LT performance | 2002-2016 | 1337 | 372 | 965 |

## 4.4 Market activity levels: Underpricing

We allocate the IPOs in sub-groups based on market activity at the time of the listing to examine if the underpricing and performance is affected by *when* the companies go public. We labele each year as either high market activity (HMA) or low market activity (LMA) as suggested by Schöber (2008). As highlighted by Ritter & Welch (2002, p. 1800);

*"...high IPO activity may follow high underpricing because underwriters encourage more firms to go public when public valuations turn out to be higher than expected and because underwriters discourage firms from filing or proceeding with an offering when public valuations turn out to be lower than expected".*

To check whether there is any difference among the ownership groups, their respective allocation is presented below in table 2:

Table 2: **Market activity & Ownership**

To investigate whether the *timing* of the IPO affects the level of underpricing, we separate IPOs listed in high market activity (HMA) and low market activity (LMA) periods and place them into their respective ownership subgroup (PE-backed/NS).

| **Market** | **Sample size** | **PE-backed** | **NS** |
|---|---|---|---|
| LMA | 246 | 60 | 186 |
| HMA | 1747 | 383 | 1364 |
| Total | 1993 | 443 | 1550 |

Following the same procedure as Schöber (2008), we classify the IPOs into market activity periods (HMA/LMA) based on the total number of listings in the respective periods. Years that experience significantly higher numbers of IPOs (2004-2007, 2012-2015 & 2017-2021) are labeled HMA, whereas the remaining years are labeled LMA. The classification is presented in table 3 below:

Table 3: **Market activity levels**

We classify the IPOs into market activity periods (HMA/LMA) based on the total number of listings in the respective periods. Years that experience significantly higher numbers of IPOs (2004-2007, 2012-2015 & 2017-2021) are labeled HMA, whereas the remaining years are labeled LMA.

| **Year** | **No. of IPOs** | **Classification** |
|---|---|---|
| 2002 | 5 | LMA |
| 2003 | 28 | LMA |
| 2004 | 99 | HMA |
| 2005 | 85 | HMA |
| 2006 | 119 | HMA |
| 2007 | 127 | HMA |
| 2008 | 17 | LMA |
| 2009 | 14 | LMA |
| 2010 | 35 | LMA |
| 2011 | 31 | LMA |
| 2012 | 57 | HMA |
| 2013 | 146 | HMA |
| 2014 | 218 | HMA |
| 2015 | 135 | HMA |
| 2016 | 59 | LMA |
| 2017 | 107 | HMA |
| 2018 | 133 | HMA |
| 2019 | 126 | HMA |
| 2020 | 183 | HMA |
| 2021 | 269 | HMA |

## 4.5 Market Capitalization

We create sub-groups to check whether the size of the company being listed have any effect on underpricing/performance. To simplify and reduce the number of subgroups we categorize Small Cap as everything up to $2 billion market capitalization, Mid Cap from $2 billion to $10 billion and Large Cap as everything above $10 billions in market capitalization. The threshold is taken from Ross (2021). This is summarized in table 4 below.

Table 4: **Market capitalization**

Following the threshold suggested by Ross(2021) we classify the IPOs into three subgroups depending on their market capitalization when issued; *small cap* (up to $2 billion), *mid cap* (between $2 billion and $10 billion) & *lagre cap* (above $10 billion), and allocate them into their respective ownership subgroup (PE-backed/NS).

| **Firm size** | **No. of IPOs** | **PE-backed** | **NS** |
|---|---|---|---|
| Small cap | 1391 | 235 | 1156 |
| Mid cap | 471 | 174 | 297 |
| Large cap | 131 | 34 | 97 |
| Total | 1993 | 443 | 1550 |

## 4.6 Industries

We create subgroups to examine whether the different industries affect the underpricing/performance. We do this by using SDC Platinum's industry classification. As mentioned, we exclude financial and utility offerings (SIC codes 4000-4999 & 6000-6999) because of the unique features of such issues.

Table 5: **Industry overview**

The IPOs are allocated into different industries by using SDC Platinum's industry classification, excluding financial and utility offerings (SIC codes 4000-4999 & 6000-6999).

| Industry | No. of IPOs | PE-backed | Non-sponsored |
|---|---|---|---|
| Agriculture | 8 | 2 | 6 |
| Construction | 18 | 8 | 10 |
| Healthcare | 55 | 17 | 38 |
| Leisure | 24 | 11 | 13 |
| Manufacturing | 842 | 150 | 692 |
| Natural Resources | 97 | 34 | 63 |
| Other services | 34 | 8 | 26 |
| Pers/Bus/Rep Svc | 733 | 127 | 606 |
| Restaurant/Hotel | 39 | 20 | 19 |
| Retail | 92 | 45 | 47 |
| Wholesale | 46 | 20 | 26 |

## 4.7 Market activity levels: Long-term performance

We also separate the listings in HMA/LMA for our analysis on long-term performance in the aftermarket. After cleaning the data we are left with the following number of stocks in the different periods:

Table 6: **Market activity: Long-term performance**

To investigate whether the *timing* of the IPO affects the long-term performance, we separate IPOs listed in high market activity (HMA) and low market activity (LMA) periods and place them into their respective ownership subgroup (PE-backed/NS).

| Market | No. of IPOs | PE-backed | NS |
|---|---|---|---|
| LMA | 369 | 89 | 280 |
| HMA | 968 | 283 | 685 |
| Total | 1337 | 372 | 965 |

## 4.8 Data collecting criticism

Our main criticism in regards to our data collecting process is SDC Platinum's definition of "Private Equity-backed". This definition does not distinguish between the different levels of ownership. Some of the companies included in our sample may have 10% Private Equity ownership that may not be involved in the everyday business. Others may have 90% ownership, and be more controlled and monitored by the Private Equity firms. Also, we believe our industry categorization could be more specific, as SDC Platinum organize many different industries together based on SIC codes. We would for example preferred to see "Technology" categorized as its own industry, instead of including it in "Pers/Bus/Rep Svc". We would also point out that we may have removed some relevant listings in our data cleaning because of the missing first day returns in the SDC Platinum database. This may cause minor discrepancies or errors in our results. Nevertheless, given the number of observations in the sample, we believe that this will not significantly affect our results.

# 5 Methodology

## 5.1 Underpricing

### 5.1.1 Initial returns

In former literature, several different methods and time periods for measuring the initial returns of an IPO. Most recent literature defines the initial return as the percentage difference between the offer price and the first day of trading closing price (Westerholm, 2006). Therefore, we will use the following formula to calculate our initial returns[1]:

$$R_i = \frac{P_{t+1,i} - P_{t,i}}{P_{t,i}} \tag{1}$$

In line with most recent research, we have chosen to not adjust for daily market movements. We see this as unnecessary since the daily return of the market is usually much smaller than the average initial return of an IPO and will have minimal effect on the pricing of the firm.

As mentioned in the chapter 4, the IPOs are divided into listings within high and low market activity periods, industries, and size to further investigate effects on the under-/overpricing.

### 5.1.2 Statistical tests for hypothesis testing

We will test if our sample shows evidence of underpricing by using a two-sided t-test to test whether the first day returns for the different groups and sub-groups are different from zero. To check our second hypothesis, whether the private equity backed IPOs are less underpriced than the non-sponsored IPOs,

[1]Where $R_i$ is the first-day return of IPO firm $i$, $P_{t+1,i}$ is the first day closing pricing of IPO firm $i$, and $P_{t,i}$ is the offer price of IPO firm $i$.

we will test if the difference between the two are statistically different from zero. We will also test whether the listings within the different market activity periods are significantly different from zero.

## 5.2 Long-term performance

### 5.2.1 Event study time-span

Since Fama, Fisher, Jensen and Roll (1969) introduced the event study methodology, it has become one of the most recognized methods for measuring security prices reaction to announcements and events (Binder, 1998). According to Scböber (2008), the most common time-span for measurement of long-run performance in the aftermarket is between one and five years. Therefore, a 60 months (five years) event window is set in our study. However, in previous studies on the topic (Ritter, 1991; Bergström et al., 2006; Levis, 2011) a 36 months (three years) event window has been used. Hence, because there seems to be an academic consensus to use a time-span of 36 months to measure IPO long-term performance, and in order to compare our results with previous literature, we will focus our analysis on a 36 months (three years) event window.

### 5.2.2 Aftermarket performance measurement

In previous studies, there are two main frameworks used to measure long-term performance; BHARs and CARs. Each method has its advantages and disadvantages which are extensively discussed in the literature (Barber Lyon, 1997; Fama, 1998; Mitchell Stafford, 2000). In this study we will focus on BHARs, as this method is considered to be a more appropriate measurement

of investor returns. Buy-and-hold abnormal returns (BHARs) are computed as[2]:

$$BHAR_i = \frac{1}{n}\sum_{i=1}^{n}[(\prod_{t=1}^{T}(1+r_{i,t})) - (\prod_{t=1}^{T}(1+r_{b,t}))] \quad (2)$$

Hence, the BHAR is the difference between the compounded returns of the IPO stock and the compounded return of the benchmark. Following Levis (2011), this measures an investor's total return from a buy and hold strategy where the IPO is held from the end of the first trading day until its fifth-year anniversary. We differentiate BHARs between averages in Private Equity backed- and non-sponsored IPOs. We use a F-test in order to determine whether the sub-group's returns are significantly different from zero.

### 5.2.3 Benchmark

In empirical studies on post IPO performance, it is common to adjust the IPO returns with the returns of a benchmark. Different methods and techniques have been used in previous studies, but two types of benchmarks dominate; broad equity indices and matching/comparable firms (Schöber, 2008). In this study we will use Standard & Poor's 500 (S&P500) index to capture abnormal market returns for IPOs following Bergström et al. (2006) and Levis (2011). We argue that S&P 500 as a benchmark is more applicable for our research question.

[2]Where $r_{i,t}$ is the raw return for company $i$ in the event month $t$, and $r_{b,t}$ is the simple return of the benchmark in month $t$ and holding period $T$.

### 5.2.4 Market activity periods

As discussed in chapter 4.7 we also measure the performance of IPOs according to which market activity level the company was listed in (e.g. HMA og LMA). In addition, we separate PE-backed IPOs and non-sponsored IPOs into sub-groups in order to determine whether or not there are significant differences between returns of PE-backed and non-sponsored IPOs in HMA/LMA periods.

# 6 Results and discussion

## 6.1 Underpricing results

### 6.1.1 First day returns

Figure 1 is the distribution of the first day returns. The first day is right skewed with a skewness of 4.75 and kurtosis of 49.54. A Jarque-Bera confirms that the first day returns are not-normal on a 1% significance level.

Figure 1: First day returns

The sample consists of 1993 IPOs, including 443 PE-backed IPOs and 1550 non-sponsored IPOs listed on the New York Stock Exchange (NYSE) and Nasdaq between 2002-2021. The returns are measured from the closing price after the first day of trading (see formula 1).

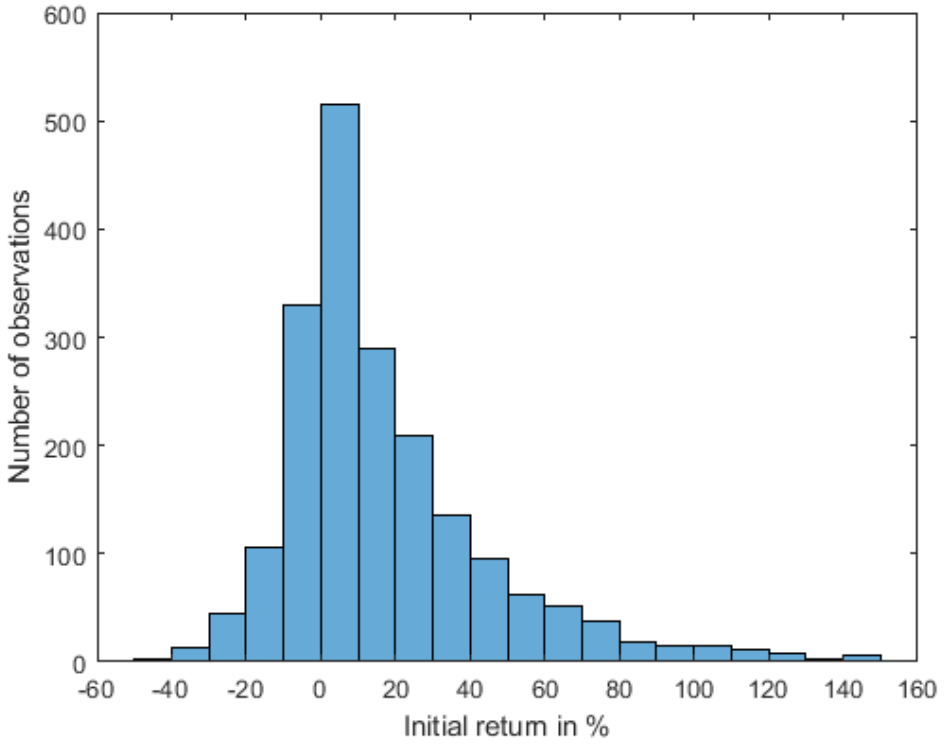



Table 7 summarizes the first day returns in our initial sub-groups. All results are statistically significant at the 1% level. As we can see from table 7 we find that our entire sample is on average underpriced by 19.13%. This is as expected and strongly supports Hypothesis 1, we expected all IPOs to be underpriced

on average, as previous studies concluded with different, but substantial levels of underpricing in IPOs (Ritter, 1984; Booth & Chua, 1996; Levis, 2011). We also find strong support for Hypothesis 2 as Private Equity backed IPOs are on average less underpriced (14.53%) compared to that of non-sponsored IPOs (20.44%).

Table 7: **First day returns**

The sample consists of 1993 IPOs, including 443 PE-backed IPOs and 1550 non-sponsored IPOs listed on the New York Stock Exchange (NYSE) and Nasdaq between 2002-2021. The total sample reports an average underpricing of 19.13% and a median of 9.33%. The distribution of first day returns in the two subgroups (PE-backed/NS) is tested under the hypothesis that the returns does not differ by using a two-sided t-test, and reports a p-value of 0.0052.

| **First day returns** | **All IPOs** | **PE-backed IPOs** | **NS IPOs** |
|---|---|---|---|
| Average | 19.13% | 14.52% | 20.44% |
| Median | 9.33% | 8.8% | 9.5% |
| Number of observations | 1993 | 443 | 1550 |
| P-value | | 0.0052 | |

There could be several empirical reasons that explain these results. First, we believe the main reason for lower degrees of underpricing in PE-backed IPOs is due to the operational characteristics of these firms. PE funds often improve efficiency and divert a lot of expertise into the firms, which improves performance, as shown by Levis (2011). Further, the certification of PE-backed firms may reduce the asymmetric information between the issuing company and the investors (Meggison & Weiss, 1991). In addition, because the IPO often marks the exit of the Private Equity fund's investment, this incentivizes a higher offering price. Levis (2011) emphasize this, as he argues that PE-backed IPOs experience lower degrees of underpricing because PE-backed firms aim for a more aggressive pricing compared to that of non-sponsored IPOs.

Accordingly, better and more efficient companies would suggest a lower degree of underpricing. On the other hand, PE-backed firms will often be more leveraged, which would imply more risk and therefore, a higher degree of underpricing. Consequently, underpricing of PE-backed IPOs is subject to multiple conflicting forces.

However, in line with Levis (2011), our results suggest that improved operational characteristics exceed the increased risk associated with these firms, which results in lower degrees of underpricing in PE-backed IPOs. Levis (2011) also argues that the average of PE-backed IPOs levels of net sales, total assets, turnover ratio and operating margin somewhat explain the lower levels of underpricing in these issues. We find no statistical evidence for this, but all these factors may provide empirical explanations for our results.

### 6.1.2 Issuing market

Table 8 summarizes our findings for the difference between underpricing in high- vs. low market activity periods.

Table 8: **Issuing market**

Years that experience significantly higher numbers of IPOs (2004-2007, 2012-2015 & 2017-2021) are labeled HMA, whereas the remaining years are labeled LMA, as suggested by Schöber (2008). The total sample reports an average underpricing of 19.74% in HMA periods, as opposed to 12.62% in LMA periods. The distribution of first day returns in HMA/LMA are tested in both ownership subgroups (PE-backed/NS) as well as the total sample (All IPOs), under the hypothesis that the returns does not differ by using a two-sided t-test, and reports the corresponding p-values.

| **Market activity** | **All IPOs** | **PE-backed IPOs** | **NS IPOs** |
|---|---|---|---|
| HMA | 19.74% | 14.5% | 21.22% |
| LMA | 12.62% | 13.78% | 12.25% |
| P-value | 0.0118 | 0.7192 | 0.0126 |

As we can see from table 8 we find evidence that supports Hypothesis 3 as IPOs listed during high market activity are more underpriced than IPOs listed

during low market activity (19.74% vs. 12.62%). This is significant at the 5% level. First, we observe that our findings are in line with previous research (Ibbotson & Jaffe, 1975; Loughran & Ritter, 2004; Bergström et al., 2006; Levis, 2011). The difference (21.22% HMA vs. 12.25% LMA) between non-sponsored IPOs in the different periods is also significant at the 5% level. However, the difference (14.50% HMA vs. 13.78% LMA) for Private Equity backed IPOs is not significant at the 10% level. We also note that Private Equity backed IPOs on average are more underpriced compared to that of non-sponsored IPOs in low activity markets. We believe the main reason for this is that the Private Equity backed IPOs are less affected by timing issues compared to large periodic differences (between HMA  LMA) in non-sponsored IPOs. Put differently, that the pricing of PE-backed IPOs appear to follow their own, and perhaps more stable cycles compared to the seemingly more fluctuating cycles in other non-sponsored IPOs.

Ritter and Welch (2002, p. 1800) argues that IPO activity and underpricing are highly related by saying; *"high IPO activity may follow high underpricing because underwriters encourage more firms to go public when public valuations turn out to be higher than expected".* Financial intuition suggests that in periods with high numbers of IPOs (HMA), issuers are trying to attract investors by offering discounts (i.e. underpricing) in the IPO. Therefore, one could argue that underpricing in HMA periods occurs more or less naturally.

Furthermore, as highlighted by Ritter (1984), it is presumably easier to value (and correctly price) more established firms. On average, the PE-backed IPOs in our sample consists of significantly larger firms (in terms of market capitalization) compared to that of non-sponsored IPOs. This may be an explanatory factor on why we observe much smaller differences in underpricing between HMA and LMA periods in the PE-backed IPOs compared to the large periodic differences in non-sponsored IPOs.

### 6.1.3 Market capitalization

Table 9 summarizes underpricing in our sample in regards to the firms' market capitalization:

Table 9: **Market capitalization**

Following the threshold suggested by Ross(2021) the IPOs are classified into three subgroups depending on their market capitalization when going public; small cap (up to $2 billion), mid cap (between $2 billion and $10 billion) lagre cap (above $10 billion). Our results indicate that larger firms are more underpriced on average. However, PE-backed IPOs appear to defy this norm.

| **Size of firm when listed** | **All IPOs** | **PE-backed IPOs** | **NS IPOs** |
|---|---|---|---|
| Small cap | 16.04% | 11.85% | 16.87% |
| Mid cap | 25.5% | 17.67% | 30.01% |
| Large cap | 26.79% | 14.67% | 31.9% |

Hypothesis 4 is supported as we can see from table 9, that larger companies are more underpriced than smaller companies. However, this is not the case for the Private Equity backed IPOs as "Large Cap" firms are less underpriced than "Mid Cap" firms (14.67% Large Cap vs. 17.67% Mid Cap).

One of the reasons that could explain these findings may be that large companies deliberately underprice their IPOs in order to demonstrate their strength and quality to the investors. In line with the model by Welch (1989), larger firms are capable of bearing "an additional cost" by offering shares at a lower price compared to smaller firms. However, as mentioned, Ritter (1984) argues that more established firms presumably are easier to value. One could argue that normal financial intuition would suggest that larger companies are more established (i.e. earnings, operations etc.) and should therefore experience less underpricing, not only because these companies presumably should be easier to value, but also because of lower amounts of risk.

### 6.1.4 Industries

Table 10 summarizes the underpricing in subgroups based on the industry the firms operate in. We have not included industries with less than 90 observations as these would have no statistical significance at the 5% level:

Table 10: **Industries**

The IPOs are allocated into different industries by using SDC Platinum's industry classification. However we exclude financial and utility offerings (SIC codes 4000-4999 & 6000-6999) because of the unique features of such issues. The industry "Pers/bus/rep services" represents all SIC codes between 7000 and 8999, which means that this industry classification mostly consists of software and technology companies.

| **Industry** | **SIC** | **All IPOs** | **PE-backed** | **NS** |
|---|---|---|---|---|
| Manufacturing | 2000-3999 | 15.64% | 8.94% | 17.09% |
| Natural resources | 1000-1999 | 4.93% | 7.15% | 3.77% |
| Pers/bus/rep services | 7000-8999 | 23.7% | 16.8% | 25.17% |
| Retail | 5000-5999 | 27.08% | 26.7% | 27.43% |

Table 10 shows vast differences for the level of underpricing in different industries, which supports Hypothesis 5. We find that the highest levels of underpricing occurs in the retail industry. This applies to both the total sample, as well as both subgroups. According to Loughran & Ritter's (2004) hypothesis on the *changing risk composition*, more risky IPOs will be more underpriced in order to compasate investors for higher risk. Earlier studies (Ljungqvist & Wilhelm, 2003; Loughran & Ritter, 2004) associate the technology industry with both high risk and hereby great levels of underpricing. This may be an explanation for why we observe second most underpricing in the "Pers/bus/rep services" industry in our sample, which includes technology and software companies.

Loughran & Ritter (2004) suggests that underpricing has changed over time, as well as in different industries. If the level of risk in different industries evolves in cycles, it is not given that the technology industry experience the

highest level of underpricing at all times, nor in our sample. Since most of the IPOs in our sample was listed after the "Dot-com-bubble" in 1999-2000, our results indicates that technology companies have become less risky than retail companies over the last two decades. The *changing risk composition* (i.e. high risk associated with a industry) may therefore explain why the highest levels of underpricing is observed in the retail industry.

### 6.1.5 Underpricing: PE-backed vs. Non-sponsored IPOs

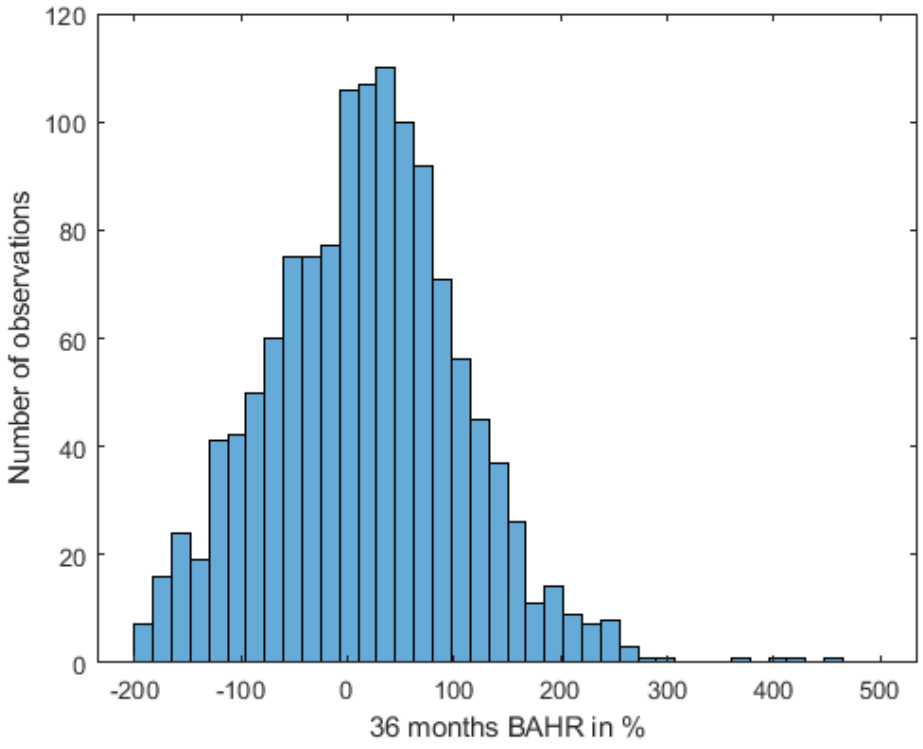
As we can see from chapter 6.1.1 - 6.1.4, we find evidence for Private Equity backed IPOs to be less underpriced than non-sponsored IPOs. We find that the only times our main hypothesis does not hold is for IPOs in low market activity periods and for IPOs within the "Natural resources" industry. For all our sub-categories (market, size and industry) we see smaller differences for Private Equity backed IPOs compared to that of non-sponsored IPOs, which provides evidence for 6th Hypothesis.

## 6.2 Long-term performance results

The 36-months BHARs[3] are plotted in figure 2. A Jarque-Bera test confirms that the distribution of the 36-months BHARs are not-normal on a 1% significance level.

Figure 2: 36 months BHAR

The sample consists of 1337 IPOs, including 372 PE-backed IPOs and 965 non-sponsored IPOs listed on NYSE and Nasdaq between 2002-2016. The Buy-and-hold abnormal returns (BHARs) over the first 36 months in the aftermarket are plotted below. The BHARs captures the difference between the compounded returns of the IPOs and the compounded return of the benchmark, which in this paper is the S&P500 index (see formula 2).




### 6.2.1 Performance of PE-backed IPOs

As presented in table 11, Private Equity backed IPOs significantly outperform non-sponsored IPOs over the first 36 months after the listings on the 1% level. This provides evidence for our 7th hypothesis. Table 11 also confirms our

[3]The abnormal returns are calculated by using S&P500 as benchmark.

8th hypothesis as PE backed IPOs yields extensive positive abnormal returns. Hence, Private Equity backed IPOs perform better than the market over the event window of 36 months.

Table 11: **BAHRs IPOs**

The sample consists of 1337 IPOs, including 372 PE-backed IPOs and 965 non-sponsored IPOs listed on NYSE and Nasdaq between 2002-2016. Below, we present the Buy-and-hold abnormal returns (BHARs) over the first 6, 12, 36 and 60 months in the aftermarket. The BHARs captures the difference between the compounded returns of the IPOs and the compounded return of the S&P500 index (see formula 2).

| **Holding period** | **Private Equity BHAR** | **Non-sponsored BHAR** |
|---|---|---|
| 6 months | 3.1692% | 3.1125% |
| 12 months | 8.4650% | 1.4552% |
| 36 months | 12.3106% | 8.2856% |
| 60 months | 28.5655% | 21.6549% |

### 6.2.2 IPO performance in general

We reject our 9th hypothesis as we expected the total IPO sample to perform negatively compared to the market. As presented in table 11, both PE-backed and non-sponsored IPOs report positive abnormal returns. Hence, the total IPOs in our sample outperform the market statistically significant at the 1% level.

### 6.2.3 Market activity

Table 12 provides evidence for our 10th hypothesis, as IPOs issued in HMA outperform IPOs issued in LMA. This is also statistically significant on the 1% level.

Table 12: **Market activity BAHRs**

The sample consists of 1337 IPOs, including 372 PE-backed IPOs and 965 non-sponsored IPOs listed on NYSE and Nasdaq between 2002-2016. Below, we present the average Buy-and-hold abnormal returns (BHARs) over the first 36 months in the aftermarket depending on whether the listing was done in a HMA or LMA period. Years that experience significantly higher numbers of IPOs (2004-2007, 2012-2015 & 2017-2021) are labeled HMA, whereas the remaining years are labeled LMA, as suggested by Schöber (2008).

| **Market activity** | **No. of IPOs** | **BHAR** |
|---|---|---|
| HMA | 968 | 11.279% |
| LMA | 369 | 4.4908% |

In addition, we note that the results show a large difference between the two sub-groups (PE/NS), in the sense that the performance of PE-backed IPOs is less affected by market activity than non-sponsored issues.The results are presented in table 13:

Table 13: **Market activity BAHRs & ownership**

The sample consists of 1337 IPOs, including 372 PE-backed IPOs and 965 non-sponsored IPOs listed on NYSE and Nasdaq between 2002-2016. Below, we present the average Buy-and-hold abnormal returns (BHARs) over the first 36 months in the aftermarket depending on whether the listing was done in a HMA or LMA period for each ownership subgroup (PE/NS).

| **Market activity** | **Ownership** | **No. of IPOs** | **BHAR** |
|---|---|---|---|
| HMA | PE | 283 | 12.384% |
| HMA | NS | 685 | 10.822% |
| LMA | PE | 89 | 12.076% |
| LMA | NS | 280 | 2.0798% |

### 6.2.4 Long-term performance: PE-backed vs. Non-sponsored IPOs

As presented in chapters 6.2.1 - 6.2.3, we find strong evidence for our second research question. Private Equity backed IPOs outperforms non-sponsored

IPOs both short- and long-term. PE-backed IPOs perform better than non-sponsored IPOs for all holding periods (6 months, 12 months, 36 months and 60 months). However, we note that the difference after 6 months is small, but that the distance constantly increases with time.

Levis (2011) suggests that *"the positive aftermarket performance of PE-backed IPOs may be related to either the nature and characteristics of PE-backed IPOs or their initial valuation in relation to the investors' expectations about their future prospects"* (Levis, 2011, p. 271).

In addition, according to Meggison and Weiss (1991), third-pary specialists (e.g. Private Equity funds) tend to lower the information asymmetry between insiders and outside investors. If the PE firms are considered to be more trustworthy and well-run than other non-sponsored entities, then this may explain some of the observed differences between the subgroups. We find no statistical evidence for this, but these factors are possibly empirical explanations for PE-backed IPOs' outperformance.

# 7 Conclusion

This thesis finds that Private Equity backed IPOs, on average, experience less underpricing compared to that of non-sponsored IPOs in the US, consequently answering our first research question. Further, Private Equity backed IPOs outperform other non-sponsored IPOs both short- and longer term, as well as the market (S&P500) as a whole. This is answering our second research question.

The final sample used to analyze underpricing in this thesis consists of 1993 IPOs listed on the New York Stock Exchange (NYSE) and Nasdaq between 2002-2021. In line with previous research we find that US entities, on average, experience an underpricing of 19.13%. However, our results reveal that Private Equity backed IPOs are less underpriced (14.52%) compared to that of non-sponsored IPOs (20.44%). We also find that Private Equity backed IPOs, on average, are larger in terms of market capitalization and less affected by market timing issues. With that said, we find that Private Equity backed IPOs are more underpriced compared to that of non-sponsored IPOs in low market activity (LMA) periods. Looking at IPOs as a whole, large firms appear to experience more underpricing. In addition, IPOs listed in high market activity (HMA) periods are more underpriced than listings during LMA periods. We also find that the retail industry experiences the most underpricing in both subgruops (PE & NS) in our sample, which reports an average underpricing of 27.08% for all IPOs in the retail industry.

Next, looking at the long-term performance analysis, the sample used consists of 1337 IPOs listed on the NYSE and Nasdaq between 2002-2016. Private Equity backed IPOs outperform other non-sponsored IPOs and report a Buy-and-Hold Abnormal Return (BHAR) of 12.31% over the first 36 months post IPO event window. In general, we obtain positive BHARs for all holding peri-

ods (6, 12, 36 & 60 months) for all IPOs, which contradicts both the literature and our expectations. We also find that IPOs listed in HMA periods significantly outperform IPOs listed in LMA periods over the first 36 months in the aftermarket. However, Private Equity backed IPOs are less affected by timing issues (i.e. the market activity periods) -both in terms of the level of underpricing and long-term performance. The observed returns of PE-backed IPOs are somewhat stable, in contrast to non-sponsored entities that report highly fluctuating returns depending on whether the listing was issued in HMA or LMA. We emphasize these findings as our main contribution to the literature.

Although a large proportion of our findings are consistent with previous research and literature, the paper does not investigate potential explanations for Private Equity backed IPOs' outperformance in the aftermarket, in depth. Hence, it remains to be studied, as suggested in this paper, whether the improvements in operational performance and characteristics by Private Equity funds may explain the reported differences in IPO performance. We believe a better understanding of these operational improvements may explain both the PE-backed IPOs outperformance, as well as the lower degrees of underpricing observed in these listings.

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# A Appendix

## A.1 Abbreviations

Below is a list of abbreviations used in this thesis and their definition:

IPO : Initial Public Offering

HMA : High market activity

LMA : Low market activity

PE : Private Equity

NS : Non-Sponsored

NYSE : New York Stock Exchange

## A.2 Matlab code: Underpricing

```
clear all;
close all;
clc;

opts = spreadsheetImportOptions("NumVariables", 9);

opts.Sheet = "Ark1";
opts.DataRange = "A1:I2706";

opts.VariableNames = ["IssueDate", "Issuer", "Var3", "Var4", "Industry",
"OfferPrice", "Close", "MarketCap", "Ownership"];
opts.SelectedVariableNames = ["IssueDate", "Issuer", "Industry",
"OfferPrice", "Close", "MarketCap", "Ownership"];
opts.VariableTypes = ["datetime", "string", "char", "char",
"categorical", "double", "double", "double", "categorical"];

opts = setvaropts(opts, ["Issuer", "Var3", "Var4"],
"WhitespaceRule", "preserve");
opts = setvaropts(opts, ["Issuer", "Var3", "Var4",
```

```
"Industry", "Ownership"], "EmptyFieldRule", "auto");
opts = setvaropts(opts, "IssueDate", "InputFormat", "");

underpricing =
readtable("C:\Users\Ulrik\OneDrive\Documents\Underpricing.xlsx", opts,
"UseExcel", false);

clear opts

underpricing = rmmissing(underpricing);
head(underpricing)

%% Avg returns

underpricing.Return =
((underpricing.Close./underpricing.OfferPrice)-1)*100;
underpricing1 = rmoutliers(underpricing(:,6),'percentiles',[1 99]);
%removed percintiles on all returns, not on both
ix = ismember(underpricing(:,6),underpricing1(:,1));
underpricing = underpricing(ix,:);
avgReturnAll = mean(underpricing.Return)
medReturnAll = median(underpricing.Return)
avgret = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", "Ownership");
avgret
medret = varfun(@median, underpricing, "InputVariables", "Return",
"GroupingVariables", "Ownership");
medret

%%
edges = linspace(-50, 150, 20+1);
hist = histogram(underpricing.Return,50)
hist.BinEdges = edges;
xlabel('Initial return in %')
ylabel('Number of observations')

s = skewness(underpricing.Return)
k = kurtosis(underpricing.Return)

%% T-test & Jarque-Bera

x = underpricing.Return(underpricing.Ownership =="PE");
y = underpricing.Return(underpricing.Ownership =="NS");
[h,p] = ttest2(x,y)

[JB_h,JB_p] = jbtest(underpricing.Return)

%% By industry
```

```
avgind = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", "Industry")
avgind2 = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", {'Industry','Ownership'})
%x2 = underpricing.Return(underpricing.Ownership == "PE" & underpricing
.Industry == "Leisure");
%y2 = underpricing.Return(underpricing.Ownership == "NS" & underpricing
.Industry == "Leisure");
%[leisure_h,leisure_p] = ttest2(x2,y2)

%% By year

[Y,E] = discretize(underpricing.IssueDate,'year');
underpricing.Year = Y;
avgyear = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", "Year")
avgyear2 = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", {'Year','Ownership'})
edges = [1 3 7 12 15 16 21];
[Y2,E2] = discretize(underpricing.Year,edges,'categorical',{'LMA',
'HMA', 'LMA','HMA','LMA','HMA'});
underpricing.Activity = Y2;
avgyear = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", "Activity")
avgyear2 = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", {'Activity','Ownership'})
x2 = underpricing.Return(underpricing.Activity == "HMA");
y2 = underpricing.Return(underpricing.Activity == "LMA");
[ActivityAll_h,ActivityAll_p] = ttest2(x2,y2)
x3 = underpricing.Return(underpricing.Activity == "HMA" & underpricing
.Ownership == "PE");
y3 = underpricing.Return(underpricing.Activity == "LMA" & underpricing
.Ownership == "PE");
[ActivityPE_h,ActivityPE_p] = ttest2(x3,y3)
x4 = underpricing.Return(underpricing.Activity == "HMA" & underpricing
.Ownership == "NS");
y4 = underpricing.Return(underpricing.Activity == "LMA" & underpricing
.Ownership == "NS");
[ActivityNS_h,ActivityNS_p] = ttest2(x4,y4)

%% By size

edges2 = [0 2000000 10000000 100000000000000];
[Y3,E] = discretize(underpricing.MarketCap,edges2, 'categorical'
,{'SmallCap', 'MidCap', 'LargeCap'});
underpricing.Size = Y3;
avgsize = varfun(@mean, underpricing, "InputVariables", "Return",
```

```
"GroupingVariables", "Size")
avgsize2 = varfun(@mean, underpricing, "InputVariables", "Return",
"GroupingVariables", {'Size','Ownership'})
```

## A.3 Matlab code: Long-term performance

```
clear all;
close all;
clc;

opts = spreadsheetImportOptions("NumVariables", 6);

opts.Sheet = "Ark1";
opts.DataRange = "A1:F1338";

opts.VariableNames =
["Market", "Ownership", "Ticker", "m", "y", "y1"];
opts.VariableTypes =
["categorical", "categorical", "string",
"double", "double", "double"];

opts = setvaropts(opts, "Ticker",
"WhitespaceRule", "preserve");
opts = setvaropts(opts, ["Market",
"Ownership", "Ticker"], "EmptyFieldRule", "auto");

performance =
readtable("C:\MATLAB\MatlabPerformance.xlsx", opts,
"UseExcel", false);

performance(1,:) = [];

clear opts

head(performance)

%%

performance.SixM = performance.m*100;
performance.OneY = performance.y*100;
performance.ThreeY = performance.y1*100;

perf = removevars(performance,{'m','y','y1'});
```

```
head(perf)

%%
hist = histogram(perf.ThreeY)
edges = linspace(-200, 500, 40+1);
hist.BinEdges = edges;
xlabel('36 months BAHR in %')
ylabel('Number of observations')
s = skewness(perf.ThreeY)
k = kurtosis(perf.ThreeY)

[JB_h,JB_p] = jbtest(perf.ThreeY)

%%
ret = varfun(@mean, perf, "InputVariables", "ThreeY",
"GroupingVariables", "Market")
ret2 = varfun(@mean, perf, "InputVariables", "ThreeY",
"GroupingVariables", {'Market','Ownership'})

%%
x2 = perf.ThreeY(perf.Market == "HMA");
y2 = perf.ThreeY(perf.Market == "LMA");
[MarketAll_h,MarketAll_p] = ttest2(x2,y2)
x3 = perf.ThreeY(perf.Market == "HMA"
& perf.Ownership == "PE");
y3 = perf.ThreeY(perf.Market == "LMA"
& perf.Ownership == "PE");
[MarketPE_h,MarketPE_p] = ttest2(x3,y3)
x4 = perf.ThreeY(perf.Market == "HMA"
& perf.Ownership == "NS");
y4 = perf.ThreeY(perf.Market == "LMA"
& perf.Ownership == "NS");
[MarketNS_h,MarketNS_p] = ttest2(x4,y4)
```