



universität
wien

MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

„The Various Influences Private Equity Firms have on their
Target Firms IPO Underpricing “

verfasst von / submitted by

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angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of
Master of Science (MSc)

Wien, 2023 / Vienna 2023

Studienkennzahl lt. Studienblatt /
degree programme code as it appears on
the student record sheet:

UA 066 974

Studienrichtung lt. Studienblatt /
degree programme as it appears on
the student record sheet:

Masterstudium Banking and Finance

Betreut von / Supervisor:

Univ.-Prof. Dr. Gyöngyi Lóranth

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Abstract

This paper examines initial public offering (IPO) data from S&P Capital IQ Pro on United States (US) companies that had an IPO date from 1/1/2013 till 1/1/2018 in order to evaluate the underpricing experienced by private equity backed IPOs and non-private equity backed IPOs after the passage of the JOBS Act. This evaluation is brought further by testing a variety of different characteristics regarding private equity investments and their effects on underpricing. A dataset of 184 companies, consisting of 129 private equity backed companies and 55 non-private equity backed companies was used when calculating the average underpricing after the passage of the JOBS Act along with the implementation of the two-stage least squares regression to find the various effects private equity firms have on their target firm's IPO underpricing. With the removal of an outlier, the data shows an average underpricing of 19.05% and a median of 8.06%. When the dataset was compared between private equity backed and non-private equity backed IPOs, it was found that there was a statistically significant difference between the average underpricing for non-private equity backed entities compared to private equity backed entities. The results regarding this contradicted most previous research because private equity backed firms had a higher average underpricing of 24.49% while non-private equity backed firms had a lower average underpricing of 6.05% (Megginson & Weiss, 1991; Cai et al., 2011; Lee & Wahal, 2004). To get a better understanding of the effects private equity companies have on a firm's IPO underpricing, five variables regarding private equity investments were tested. The empirical analysis found that the variable log days of private equity involvement had a statistically significant influence on reducing a firm's IPO underpricing.

Keywords: Private equity, PE, Initial Public Offering, IPO, Underpricing, JOBS Act

Abstract (German)

In dieser Arbeit werden die Daten von S&P Capital IQ Pro zu Börsengängen (IPOs) von US-amerikanischen Unternehmen mit einem IPO-Datum zwischen dem 1.1.2013 und dem 1.1.2018 untersucht, um das Underpricing von Unternehmen mit privatem Beteiligungskapital finanzierten IPOs und von nicht mit privatem Beteiligungskapital finanzierten IPOs bewertet, nach der Verabschiedung des JOBS-Act. Dieses Papier bringt diese Bewertung auch weiter, indem es eine Reihe verschiedener Merkmale von Private-Equity-Investitionen und deren Auswirkungen auf das Underpricing testet. Ein Datensatz von 184 Unternehmen, 129 mit Private-Equity-Beteiligung und 55 ohne Private-Equity-Beteiligung, wurde bei der Berechnung des durchschnittlichen Underpricing nach der Verabschiedung des JOBS-Act zusammen mit der Implementierung der zweistufigen Kleinst-Quadrat-Regression verwendet, um die verschiedenen Auswirkungen von Private-Equity-Firmen auf das Underpricing ihrer Zielunternehmen bei Börsengängen zu ermitteln. Nach dem Entfernen eines Ausreißers zeigen die Daten ein durchschnittliches Underpricing von 19,05 % und einen Median von 8,06 %. Beim Vergleich des Datensatzes zwischen mit privatem Beteiligungskapital unterstützten und nicht mit privatem Beteiligungskapital unterstützten Börsengängen wurde festgestellt, dass es einen statistisch signifikanten Unterschied zwischen dem durchschnittlichen Underpricing für nicht mit privatem Beteiligungskapital unterstützte Unternehmen und für mit privatem Beteiligungskapital unterstützte Unternehmen gibt. Die diesbezüglichen Ergebnisse stehen im Widerspruch zu den meisten früheren Untersuchungen, da mit privatem Beteiligungskapital finanzierte Unternehmen ein höheres durchschnittliches Underpricing von 24,49 % aufwiesen, während nicht mit privatem Beteiligungskapital finanzierte Unternehmen ein niedrigeres durchschnittliches Underpricing von 6,05 % hatten (Megginson & Weiss, 1991; Cai et al., 2011; Lee & Wahal, 2004). Um ein besseres Verständnis der Auswirkungen von Private-Equity-Firmen auf das IPO-Underpricing eines Unternehmens zu erhalten, wurden anschließend fünf Variablen zu Private-Equity-Investitionen getestet. Die empirische Analyse ergab, dass die Variable log Tage der Private-Equity-Beteiligung einen statistisch signifikanten Einfluss auf die Reduzierung des IPO-Underpricing eines Unternehmens hat.

Schlüsselwörter: Private equity, PE, Initial Public Offering, IPO, Underpricing, JOBS Act

Chapter 1: Introduction

1.1 Motivation and Problem Statement

Since its founding, the asset class known as private equity (PE) has played and continues to play a significant role in world economies, technology development, and funding for companies. Many of the market leading companies today have received some type of funding from the private equity industry. For example, companies like Alibaba, Facebook, Twitter, Google, and Cisco, all have received funding from private equity firms. With this said, private equity firms are an essential form of financing for many companies throughout the world, and they have a significant impact not only on the companies receiving financing themselves but also on global economies.

The importance of private equity (PE) financing for companies has been on the rise since its start. This is largely due to companies being increasingly dedicated to staying private longer and prolonging going public. In the last few decades, private equity firms, particularly in the US, have played a very significant role regarding companies going public. Currently a large proportion of companies going public are PE backed.

In the 1980's, the private equity industry started to become well known in the United States. Since then, this industry has experienced times of rapid growth to times of no activity, but its importance viewed by investors can be recognized in its overall growth over the last few decades. In recent history, this asset class has started to be seen as a great investment opportunity by all types of investors because of this asset class's unique ability to allow investors to diversify in a large scope of regions, countries, industries, and risk levels. Governments around the world, especially in the US, are realizing the benefits of this asset class and are starting to promote the growth of this asset class because of its positive impact on economies, firms, and technological advancements.

Due to the significant increase in companies getting backed by private equity financing, the demand for research in this area is rapidly increasing. Also, the demand for research is growing because of laws such as the JOBS Act in the US which has allowed more types of investors to invest in this asset class and has allowed higher

fundraising limits for private equity funds. The insufficient amount of research on this asset class is due to its private structure. The large majority of private equity firms are private which exempts them from many of the disclosures publicly traded companies have to release to the public which makes it difficult to study (Cumming & Walz, 2010; Johan & Zhang, 2021). In addition, most of the investments private equity companies make are in companies that are also private. Previous research has also mentioned reasons why there is a lack of research for this asset class. For example, one reason is because of the uneven disclosures in this sector and because timed cash flows in this asset class are normally not provided which makes it difficult to compare returns (Harris et al., 2020). With that said, the access to data on private equity companies and their investments is starting to become more transparent. Some governments like the United States (US) and the European Union (EU) are demanding more disclosures which is allowing more data and transparency in this asset class.

Past research has focused predominantly on private equity returns, private equity firms' effects on its target firms before and after initial public offering (IPO), and effects private equity companies have on their target firms underpricing. The research has also concentrated on how performance is affected by different variables such as capital commitments, fund size, previous fund performance, reputation, partnerships, and ownership concentration. This research has helped bring considerable insight into this asset class, but one key concept that still has mixed findings and needs to be further developed is variables related to private equity that affect a target firm's initial IPO underpricing. The objective of my master thesis is to help investors and governments have a better understanding of how private equity involvement in the United States affects a company's IPO underpricing after the passage of the US JOBS Act and before the Covid-19 pandemic. This will be done by testing some key variables from past research that have had mixed results along with new variables that have never been tested before to my knowledge. The variables from past research include days incorporated till IPO, underwriter reputation, if it is a high-tech industry, IPO price, and total shares offered. The new variables are the log number of days since first PE involvement, total number of days since first syndication, total number of PE sponsors before the target firms IPO, if first investment by a PE firm was a syndication, and the total number of PE investors involved in the first round of funding for the target firm.

This research is essential to gain a better understanding of the private equity industry because there has been a cultural shift towards firms staying private longer and their ability to access more funding than ever before. This has allowed firms to grow to sizes that would only have been possible some decades ago by going public. A prime example of laws that have further pushed this trend is the JOBS Act of 2012. This is an interesting development and could or already has changed the landscape for the private equity industry. For example, this shift could cause PE firms to not liquidate their investments through IPOs as fast and cause more buying and selling of companies between PE firms before these companies go public. This in turn will cause firms to have access to larger amounts of capital before their IPO and to have access to more expertise and resources for longer periods of time. Understanding these new variables after the passage of the JOBS Act will have various benefits such as helping investors identify important characteristics that lead to better investments, comprehending the effects on companies with a longer exposure to the PE industry, helping governments understand potential effects to the PE industry due to law changes, establishing a better understanding of the PE industry in general, effects PE firms' have on their target firms, and first day return expectations.

Previous research has been conducted on similar topics related to this paper. It has been shown that underpricing does exist on average (Ritter, 1984; Grinblatt & Hwang, 1989; Lee & Wahal, 2004; Boulton et al., 2010). Furthermore, many theories have explained why underpricing occurs (Baron, 1982; Grinblatt & Hwang, 1989; Jamaani & Alidarous, 2019). It has also been proven that venture capital backed and private placement backed IPOs have less underpricing than non-PE backed and non-private placement backed IPOs (Megginson & Weiss, 1991; Cai et al., 2011; Lee & Wahal, 2004). Moreover, one of the most prominent papers on PE, *The Grandstanding Hypothesis*, shows that less reputable Venture Capital (VC) firms rush their portfolio companies to IPO which in turn causes greater underpricing (Gompers, 1996). This could be due to the positive effects PE involvement has on a firm (Bernstein et al., 2019; Kaplan & Strömberg, 2009; Guo et al., 2011; Davis et al., 2014; Cohn, 2014). The time lag between private placement and IPO has only briefly been studied but the findings could have been misleading due to its incorporation of the internet bubble (Cai et al., 2011). Also, syndication and its positive effects have been proven for venture capital (VC) investments (Lerner, 1994; Brander et al., 2002; Tian, 2012). With that said, this paper will find the average underpricing within my time frame and then compare the average underpricing for PE backed firms and non-PE backed firms. With these

findings, which I assume will show that underpricing does exist, and that PE backed IPOs have less underpricing than non-PE backed IPOs, I will then conduct a two-stage least squares regression on five PE related variables that should reduce IPO underpricing.

Chapter 2: Literature Review and Hypotheses

2.1 Hypothesis 1

In recent history, companies have shifted towards a culture of staying private longer due to easier access to capital, legal changes, and a growing interest of investors wanting to invest in private companies. Another key factor that is allowing companies to stay private longer is the growing prominence of the private equity industry which continues to grow larger each decade. For example, the US private equity firms that focus on buyouts and venture capital raised \$148 billion between 1980 and 1995 while \$794 billion was raised from 2005 to 2008 (Harris et al., 2014). This rapid growth has led to a growing demand for more research to be conducted on this asset class since much is still unknown. Current research related to the private equity industry has predominantly focused on different ways to calculate returns for this industry, the different effects private equity firms have on their target firms, how performance is affected by different variables, and previous models such as the information asymmetry models explaining the important role of private equity firms. Another key topic that has been researched regarding the private equity industry is a concept called underpricing. Underpricing is a situation where the initial public offering share price is below the end of the first trading day share price. This concept is known as underpricing since the market views the stock price to be higher than what was originally offered. The general concept of underpricing has been thoroughly studied, but this concept specifically related to the various effects private equity companies have on their target firm's underpricing is still largely unknown or inconclusive. With that said, research on private equity is limited due to its private nature, but research in this field is growing as data is becoming easier to access. Until now, private equity is still one of the most difficult asset classes to research.

As previously mentioned, the concept of underpricing is the difference between the closing share price of the stock after the first day of trading and the initial share price of the stock at the initial public offering (IPO). Underpricing has been studied for many decades with most of the prominent research coming from the 1980's. The reason for the vast amount of research conducted on the concept of underpricing is because having a better understanding of this would help many parties such as underwriters, current shareholders, future shareholders, company founders, banks, and governments make more money. For example, if the closing share price of the

stock after the first day of trading is higher than the initial share price of the stock at the IPO then it means the stock was underpriced. In other words, the public views the stock to be worth more than the price it was originally issued at, so the parties involved in issuing the stock lost out on money. A better understanding of how to reduce this underpricing can help the many different parties make money.

Previous research has shown that the concept of underpricing is not just a concept but happens in practice. Some of the first papers to show that IPOs on average are underpriced are Ibbotson (1975) and Ibbotson (1982) (Ritter, 1984). It was found that between 1977 and 1982 the average underpricing was 16.3% while between 1960 and 1982 the average underpricing was 18.8% (Ritter, 1984). Another paper found that the average underpricing was 16.37% (Ibbotson et al., 1988). In addition, from 1980 to 1998 the average underpricing was 11% (Lee & Wahal, 2004). Furthermore, research shows that the concept of underpricing also exists globally. From 2000 until 2004, a total of 29 countries were studied and it was concluded that the average underpricing was 28% (Boulton et al., 2010). These findings prompted research to be conducted into potential explanations for why the concept of underpricing exists in practice. Some of the key explanations for underpricing are information asymmetry, ownership and control, behavior, and institutional reasons (Jamaani & Alidarous, 2019). The most prominent explanation for the concept of underpricing is the theory known as information asymmetry which consists of moral hazard and adverse selection. Moral hazard is when one party changes their behavior after an agreement. Adverse selection is when one party has more information than the other party before the agreement. For the case of IPOs, research usually discusses the information asymmetry between three key parties which are the underwriter, investor, and the firm wanting to go public. As discussed by Jamaani and Alidarous (2019), the seven key information asymmetry models are described below:

1. The principal-agent model discusses the information asymmetry between the issuing firm and the investment bankers/ underwriters (Baron & Holmström, 1980; Baron, 1982). These papers argue that the underwriter has better information regarding the market than the firm issuing shares (Jamaani & Alidarous, 2019). The principal agent model concludes that the reason underpricing happens is because it is a way to compensate the investment bankers/ underwriters for their services such as underwriting the

transaction, advertising, and distribution. Due to the investment bankers/ underwriters being more informed on the market, they can conduct these services better than the issuing firm (Baron, 1982).

2. The ex-ante uncertainty theory discusses many different variables that can be observed before an IPO such as size, age, and IPO type to explain the concept of underpricing as explained by Jenkinson and Ljungqvist (2001) (Jamaani & Alidarous, 2019). The paper by Beatty and Ritter (1986) argues that as ex-ante uncertainty increases then underpricing should also increase (Jamaani & Alidarous, 2019). Rock (1986) also shows that as the age of the firm increases, the ex-ante uncertainty decreases (Jamaani & Alidarous, 2019).
3. The book building theory discusses that institutional investors have better information than any other party (Jamaani & Alidarous, 2019). For example, Benveniste and Spindt (1989), Benveniste and Wilhelm (1990), and Spatt and Srivastava (1991) focus specifically on the asymmetric information between the institutional investors and the issuing firm (Jamaani & Alidarous, 2019).
4. The signaling model discusses information asymmetry between the issuing firm and the investors (Grinblatt & Hwang, 1989; Welch, 1989; Jamaani & Alidarous, 2019). These two models discuss how underpricing signals the quality of the firm to investors on whether this firm is a good investment.
5. The winners curse model is one of the most prominent models regarding information asymmetry which was introduced by Rock (1986) (Pang, 1993; Jamaani & Alidarous, 2019). This model discusses the relationship between informed and uninformed investors with the informed investors having better information regarding the IPO than the uninformed investors (Pang, 1993). If underpricing did not exist, then only uninformed investors would invest in bad IPOs since informed investors knew they would lose money on these deals. So, this theory argues how underpricing must exist to ensure uninformed investors continue to take part in new IPOs which in turn helps drive up the price (Pang, 1993).

6. Certification discusses the relationship between shareholders and potential investors. It argues that reputable underwriters will ensure that the new IPO offering is fairly valued in order to protect their reputation which aligns with the firm's wants (Jamaani & Alidarous, 2019). Firms want this because their investors are concerned about the firm's reputation (Jamaani & Alidarous, 2019). This theory was developed by Booth and Smith (1986) (Jamaani & Alidarous, 2019).
7. Entrepreneurial Wealth Loss Theory is a combination of multiple models discussed above. It includes the winners' curse, certification, ex-ante uncertainty, and signaling models (Jamaani & Alidarous, 2019).

Information asymmetry models are not the only potential explanations for underpricing. There are also many institutional reasons for why underpricing exists such as lawsuit avoidance, tax advantages, and to prevent underwriters from losing money on deals that have a guaranteed price (Jamaani & Alidarous, 2019). These commonly known facts also help explain the concept of underpricing without having to understand any theoretical models.

With all the information asymmetry models, institutional reasoning, and past research findings, I hypothesize:

H1: On average, there is underpricing of IPOs between the years 2013 to 2018 for private equity backed and non-private equity backed firms in the United States

2.2 Hypothesis 2

The concept of underpricing has been researched extensively for many decades but research regarding the effects private equity has on IPO underpricing is a newer development. Much of the current research regarding this started in the early 2000's and has slowly continued to develop. Due to the research on this topic being new, it opens the door to many new possibilities. Current underpricing research generally focuses on certain factors that might help determine the underpricing of a firm's IPO, but this research has not looked very extensively

into specific factors related to private equity involvement in a company's IPO and its effect on underpricing to my knowledge. Most current research regarding private equity involvement is comparing the average underpricing of PE backed IPOs against non-PE backed IPOs. So current research has mostly focused on comparing certain factors that signal the quality of the firm such as firm size, firm age, retained equity, auditor reputation, underwriter reputation, number of risk factors, offer price, IPO gross proceeds, and if companies were venture capital backed (Daily et al., 2003). It is important to note that positive signals reduce the underpricing of a firm's IPO because positive signals indicate that the new IPO is a good investment. So, a better understanding of variables that reduce a firm's IPO underpricing helps reduce money that is left on the table to any parties related to the firm's IPO such as internal shareholders and underwriters. With that said, a positive signal found to reduce IPO underpricing is a "certifying" investor like a PE firm that can help signal the value of the issuing firm (Daily et al., 2003; Bruton et al., 2009). Previous research has shown that overall PE firms improve their target firms operating performance, productivity, innovation, incentives and monitoring, performance post investment, and resilience through recessions (Wilson et al., 2022). Regarding leverage buyouts which is one of the most prominent investment strategies for PE firms, research has shown that PE involvement has a positive long-term impact on their target firms by disciplining management, remedying value destroying diversification, improving productivity, improving performance, improving incentives and monitoring, and improving innovation (Kaul et al., 2018). Overall, past research shows that the private equity industry in general has a positive effect on their target firms. It also points to the idea that PE firms play a certification role to their target firms (Megginson & Weiss, 1991). This is because PE firms play a monitoring role for the target company by mitigating information asymmetry (Hertzel & Smith, 1993). This monitoring role is played by PE firms in their target firms in a variety of ways like requiring certain goals to be met before the firm receives their next round of funding. Also, the monitoring role is played by being active shareholders and on the board of directors (Daily et al., 2003). In turn, the target firms benefit by receiving advice and gaining access to key stakeholders like new suppliers, new options for financing, and new customers (Daily et al., 2003). Furthermore, there is strong data supporting that PE firms have a positive impact on the target firms accounting reporting due to the certification role that they play (Beuselinck & Manigart, 2007). Lastly, data has also shown that just the presence of a PE firm also helps reduce information asymmetry because there is a U-shaped relationship between the founder's retained equity and the IPO underpricing due to the tradeoff between adverse selection and moral hazard (Bruton et al., 2009).

Most of the current research on the effects PE firms have on their target firm's IPO underpricing has been limited to venture capital (VC). This is due to VC encompassing a large variety of stages of investments in target firms. For example, it was found that VC backed firms had an average underpricing of 7.1% compared to 11.9% for non-VC backed firms when matched by offer size and industry between the years 1983 and 1987 (Megginson & Weiss, 1991). It was also concluded in this paper that the costs of going public and the net proceeds are maximized when there is a presence of a VC (Megginson & Weiss, 1991). Furthermore, it was shown that private placement IPOs from 1981 till 2002 had an average underpricing of 14.2% compared to non-private placement IPOs with 22.24% on a matched basis (Cai et al., 2011). Also, between 1980 and 1989, the average matched underpricing for VC backed IPOs was 7.89% compared to 8.5% for non-VC backed while between 1990 till 1998 the average matched underpricing for VC firms was 16.17% compared to 16.7% for non-VC backed IPOs (Lee & Wahal, 2004). Similar findings have even been seen on recent data from Poland. Between 2000 and 2018 the Polish market had an average IPO underpricing of 9.99% compared to an average IPO underpricing of 9.12% for PE backed IPOs (Zasępa, 2019). With that said, all these papers conclude that firms that are PE backed will have less underpricing. However, from 1980 to 2000, it was found that VC backed IPOs had larger underpricing which in turn benefits VC funds since it leads to larger flows of capital (Lee & Wahal, 2004). The author of this paper does admit that these findings could be affected due to the data including the internet bubble. Moreover, it was found that when looking specifically at management buyouts (MBO) on an average value weighted return scale, VC backed firms had more underpricing than non-VC backed firms (Jelic et al., 2005). Based on most of my dataset consisting of VC firms and the conclusions of past data, I hypothesize the following:

H2: On average, private equity backed IPOs will have less underpricing compared to non-PE backed firms

2.3 Hypotheses 3&4

Even though most current research up to this point has focused on testing variables and their effects on IPO underpricing such as firm size, firm age, retained equity, auditor reputation, underwriter reputation, number of

risk factors, offer price, IPO gross proceeds, and venture capital equity, it does not mean that there are no other alternatives that reduce the level of uncertainty of an IPO (Daily et al., 2003). A meta-analysis conducted on the prominent variables currently used to explain underpricing concluded that current research on these variables is modest and that there is still much to learn (Daily et al., 2003). This is why it is so important to continue to discover new variables that could potentially reduce IPO underpricing. A largely undiscovered area regarding these new variables are ones detailed to the specifics of private equity involvement and not just testing if there was private equity involvement. An example of two key variables that have not been tested in the past to my knowledge are how the length of time of PE involvement and the total number of PE firms involved in a target company affect IPO underpricing.

Current research has shown that the age of a firm is an important factor in reducing information asymmetry. Research has shown that firms that are older are normally more established which makes them less risky (Carter et al., 1998; Ritter, 1991). Moreover, other studies have also concluded that returns of a firm are related to its age (Megginson & Weiss, 1991; Mikkelsen et al., 1997). More recent studies have also concluded that IPO underpricing is reduced the older the firm is before going public (Daily et al., 2003).

As previously mentioned, the length of time of PE involvement along with the total number of PE firms involved in the target firm before its IPO has not been researched extensively to my knowledge. One paper that briefly looked into the time lag between private placement (PP) and IPOs concluded that shorter time lags result in significantly larger underpricing (Cai et al., 2011). It was found that the above medium underpricing was 11.22% for PP backed and 19.09% for non-PP backed while for the below medium underpricing was 16.31% for PP backed and 25.47% non-PP backed (Cai et al., 2011). The author admitted the findings could be misleading since his study included the hot issue market of the internet bubble which in turn lead to the mean time lag to be 2.5 years and the medium time lag to be 1.5 years. Furthermore, one of the most prominent papers regarding private equity found that younger VC firms bring their target firms to IPO earlier which leads to greater underpricing (Gompers, 1996). As can be seen, the older the firm is before its IPO and the more time between private placement and IPO seem to reduce IPO underpricing. Due to PE firms having to generate returns for their investors they often need to exit their position, which is many times done through selling their

ownership to another PE firm. This in turn means that target companies are often bought and sold between PE firms before going public which could potentially indicate the target firm's age. As discussed previously, PE firms have many positive effects on their target firms including bringing new advice, suppliers, customers, and financing. Due to every PE firm having different stakeholders, knowledge, and new continuous monitoring techniques, it is reasonable to hypothesize that the more PE firms involved in a target firm will have a positive effect.

H3: The longer firms receive private equity investments before going public, the less underpricing that will be seen

H4: The larger the total number of private equity firms involved in a target firm before its IPO, the less underpricing that will be seen

2.4 Hypotheses 5-7

Another variable that is often studied in financial literature is syndication. Syndication is generally discussed when financial institutions join together to manage a large financial transaction like an investment that is too difficult for just one institution to handle. This is commonly seen in practice when a company wants to take out a large loan from a bank, but the bank needs to bring in other banks to fulfill the requested amount. Syndication also happens in the private equity industry, and it is very common practice to see multiple PE firms invest together into a target firm. Regarding PE, the concept of two or more VC firms involved in financing a certain target firm is known as syndication (Brander et al., 2002). Syndication can happen in the same round of financing, or it can be when other PE firms are brought into the target firm at later rounds of financing (Casamatta & Haritchabalet, 2007).

There are many reasons why PE firms like VCs would like to syndicate and why it is so common to see in practice. One of the most obvious reasons to conclude why VC firms syndicate is to reduce the risk of their investments (Brander et al., 2002). Syndication can not only help reduce investment risk, but it also helps VCs

pick better investments by getting confirmation from other VCs that this target company is a good investment (Lerner, 1994). Due to the lengthy and detailed nature of screening that goes into potential target companies, if multiple PE firms agree that this one firm is a good investment from the hundreds that they have screened, then it is probably a good investment due to improved screening. Not only does syndication combine screening resources, but it also allows collaboration of other resources from each PE firm at an operational level for the target firm. Each VC has different information, skills, and connections which gives the target firm access to a greater number of resources (Brander et al., 2002). For example, one of the most obvious ways multiple VCs can combine resources is the amount of funding they will give the target company. It was found that VC syndications put significantly larger amounts of capital into each round of funding for the target firm (Tian, 2012). Also, syndication increases the target firm's valuation in later rounds. It was found that when an established VC joins an investment of a target firm in a later round, the valuation of the target firm increases sharply (Lerner, 1994). Also, syndication can help reduce agency problems because by bringing in other VC investors it helps current VCs invested in the target firm to maintain a constant ownership share (Brander et al., 2002). As previously discussed in prior sections, reducing agency problems reduces IPO underpricing. Another example would be the networks that are built from syndication. It has been concluded that VC funds perform better when there is a larger network of influential relationships (Hochberg et al., 2007). Syndication has also created product market value, financial market value, focused innovation, and more successful exits (Tian, 2012). By increasing the focus of a firm's innovation, it allows the target firms to have better operational performance after their IPO (Tian, 2012). Moreover, more successful exits have been proven to increase IPO market value along with decreasing IPO underpricing (Tian, 2012). This is understandable since it has been concluded that VC syndication projects on average have higher returns than non-syndicated projects (Brander et al., 2002).

Overall, we know that VC firms cause value creation in their target firms for a variety of reasons such as reputation, intense monitoring, staged investment structure, professionalization of the management, network positions, industry experience, and market timing (Tian, 2012). With that said, it is reasonable to conclude that the more VC firms invested together, the more beneficial it would be for the target firm. It has even been proven that syndication reduces information asymmetry because of the certification role it plays which in turn reduces IPO underpricing (Chahine et al., 2007). Also, it is reasonable to conclude that being syndicated longer would

only benefit the target firm. This could also mean that if a target firm receives a syndicated investment from PE firms from the beginning, it will have access to more resources and financing earlier on. With that said, I would hypothesize:

H5: The longer the amount of time the target firm was first syndicated, the less underpricing that will be seen

H6: If the first private equity involvement was a syndication, then less underpricing will be seen

H7: The more investors involved in the syndication of the first funding of a firm, the less underpricing that will be seen

Chapter 3: Data and Methodology

3.1 Data

Private equity is one of the most understudied asset classes and a large reason for this is due to the private nature of this asset class. Most private equity firms and their target companies they invest in are private, so they are not subject to all the disclosures public companies are required by law to publish. This makes it difficult for researchers to gather and analyze the investments private equity companies make and how their investments are performing. Much of the data that is studied for this asset class is self-reported by the PE firms and target companies which means that the data accuracy depends on the reliability of the data provided. This also can bring bias due to missing data because it is up to each PE firm what and if they choose to disclose information. In order to mitigate issues related to the reliability and biasness of data regarding private equity, it is important to use a large, well maintained, and well-known database. For this paper, the database called S&P Capital IQ Pro, which is a division of S&P Global, was used. S&P Capital IQ Pro is one of the world's leading and largest databases for market research which was designed by Standard & Poor's (S&P). S&P Capital IQ Pro claims to have data on more than 62,000 public companies and 50 million private companies. Regarding private companies, they have a variety of providers such as Preqin, Crunchbase, Dun & Bradstreet, and CreditSafe. They can provide access to a more complete list of data since they compile data from many different sources, which is essential. Also, since Preqin is one of the data providers, this has given access to the world's largest private equity database. Lastly, S&P Capital IQ Pro regularly updates information on their platform, so it is as accurate as possible.

The sample set collected from S&P Capital IQ Pro was filtered to fit my research design. My sample only contains target companies that have the geography classification in the United States. This was done for two main reasons. First of all, companies in the United States provide the most data regarding private equity, and they are the largest market for private equity investing. This allowed access to a larger and more accurate data set. Secondly, limiting the dataset to the United States helps reduce variances seen in IPO underpricing between countries. Research has shown that IPO underpricing varies drastically between countries (Boulton et al., 2010). Furthermore, the time range for the IPO date for this sample was from 1/1/2013 to 1/1/2018. The reason for this

was because on April 5, 2012, the US passed the JOBS Act. The JOBS Act (see Appendix 1) made drastic changes regarding funding availability for companies. It changed the role and funding private equity companies could provide to their target firms compared to before the JOBS Act was passed. The sample only includes up to January 1, 2018, since it was important to exclude the volatile effects the COVID-19 pandemic had on the market due to the fears of a recession. It is important to note that it was found that higher GDP growth increases venture capital activity (Gompers et al., 1998). This means that including a period where there was a recession would affect the results since the pandemic influenced IPO issuances. This time frame allows me to remove other periods that would have had potential effects on my study's results and allowed a period of steady economic growth. A smaller time frame also helps keep consistency of the activity of the PE industry. It was even found that at the industry level PE fund performance and market entry are procyclical (Kaplan & Schoar, 2005).

Furthermore, when filtering the data, I removed companies where data was missing on the IPO price, IPO offer price, IPO price change after the first day of trading, and date of incorporation. After this filtering, the sample contained 231 companies that were prior sponsored backed. After this, hand collected data was found on days of PE involvement, total number of PE sponsors before IPO, days of syndication, if the first PE investment was a syndication, number of PE investors involved in the first round, and lead underwriter for the 231 companies. After removing companies that had missing data regarding this hand collected data points the sample for this study was left to a total of 184 companies. Of these 184 companies, 129 of them were PE backed while 55 of them were non-PE backed. It is important to note that normally in studies, complete case is applied which means that when variables are missing then this data is excluded (Meuleman et al., 2009).

3.2 Sample Size

It is well known that regarding research, larger samples will give a more accurate representation of the overall population and it will help limit the effects of outliers. With that said, a sample size of 183 companies might be alarming at first until one has a better understanding of the sample sizes in related research. For example, a study that looked at the underpricing effect of PE backed IPOs of the capital markets in Poland between 2000 till 2018 had a total sample size of 507 companies with 54 of them being supported with venture capital funds (Zasępa, 2019). Another paper that looked at the effects venture capitalist had regarding initial returns and gross spreads of IPOs between 1983 and 1987 used a sample of 320 VC backed firms and 320 non-VC backed firms (Megginson & Weiss, 1991). Lastly, another paper looked at the effects founders retained equity had on underpricing with a total sample size of 275 entrepreneurial IPOs from the London Stock Exchange (LSE) and Alternative Investment Market (AIM) from 2000 till 2003 (Bruton et al., 2009).

3.3 Methodology General Overview

This paper implemented two main methods that were commonly used in past research. Hypothesis 1 and 2 implemented the first methodology that will be discussed below while hypothesis 3-7 implemented the second methodology that will be discussed later. It was important to use methods most prominently seen in related research to insure more comparability between findings in this paper and past research.

3.4 Methodology 1

The first two hypotheses of this paper were to gain a better insight into the underpricing that existed between the data's time frame of 2013 to 2018 and to see if PE backed firms had lower IPO underpricing than non-PE backed firms. Testing these hypotheses would help give insight and comparability to past research on the dataset used since a time frame after the passage of the JOBS Act was used in this paper unlike previous research to my knowledge. The methodology implemented for hypotheses 1 and 2 was used in most past research that looked at IPO underpricing of firms.

Underpricing is a situation when the initial public offering's share price is below its real value. This in other terms means that the price that the company and underwriter agree to sell the newly publicly traded company at on its opening day is below the price of the shares at the end of the first day of trading. The share price at the end of the first day of trading indicates the real value of the company since a company's share price is an indication of how the market values the company. So, if the IPO issue price were \$10 and after the first day of trading the company's share price was \$12 it would indicate the following:

- 1.) The market believes the value of this new publicly traded company is higher than what it was issued at which in turn means that the company lost out on money from selling some of the ownership of their company
- 2.) That the company was issued \$2 under its end of day trading price which translates to an underpricing of 20%

With that said, the formula for underpricing used in this paper and many other papers can be given in absolute and/or relative terms. Most papers report underpricing in relative terms. Also, these formulas are commonly used in related literature (Bruton et al., 2009; Zasepa, 2019). The formula for underpricing is as follows:

$$UPA_{c,t} = CP_{c,t} - IP_{c,t}$$

Where:

$UPA_{c,t}$ = Absolute value of the underpricing of the company's share price after the first day of trading

$CP_{c,t}$ = Companies closing stock exchange share price after the first day of trading

$IP_{c,t}$ = Companies initial public offering issue share price

$$UPR_{c,t} = \frac{(CP_{c,t} - IP_{c,t})}{IP_{c,t}} \times 100$$

Where:

$UPR_{c,t}$ = Relative value, also known as the rate of return, of the underpricing of the company's share price after the first day of trading

$CP_{c,t}$ = Companies closing stock exchange share price after the first day of trading

$IP_{c,t}$ = Companies initial public offering issue share price

The potential varieties that can be seen in this formula pertain to the closing bid price. Some papers take the first recorded aftermarket bid price on the IPO offering date while others choose another closing bid date. Often, later closing bid dates are only chosen due to data limitations from older papers' time frames or due to certain securities having the first recorded trade many days after the first day of trading (Ritter, 1984). Most recent papers take the first recorded aftermarket bid price on the IPO offering date which is also referred in many papers as the "first day return" (Ritter, 1984; Lee & Wahal, 2004; Boulton et al., 2010; Zasepa, 2019; Megginson & Weiss, 1991; Bruton et al., 2009; Certo et al., 2001; Filatotchev & Bishop, 2002).

After the relative value, also known as the rate of return, was found for each company's share price after the first day of trading the mean and medians were taken from all the companies in the dataset. It is important to note that S&P Capital IQ Pro already automatically calculated the relative underpricing value as mentioned above. By using the relative underpricing value for each company, the means and medians of the relative underpricing value were found for the dataset, for just PE backed IPOs, and for just non-PE backed IPOs. It is important to note that some papers implemented a matching strategy. For example, one paper matched 320 VC backed firms with 320 non-VC backed firms based on industry and offer size (Megginson & Weiss, 1991). This was not possible for this paper due to the available sample size.

3.5 Methodology 2

Hypothesis 3-7 of this paper focuses on testing new variables that have not been tested up to this point to my knowledge. Previous research suggests that certain variables related to PE could reduce underpricing, but these variables have not been explicitly tested yet. Testing these new variables related to private equity could help give a clearer picture that could potentially indicate a decrease in underpricing and the effects private equity has on underpricing. The new variables that were tested which will later be referred to as my independent variables include:

- 1.) Log Days of Private Equity Involvement
- 2.) Total Number of Private Equity Sponsors Before the Target Firms IPO
- 3.) Days of Private Equity Syndication
- 4.) If the First Private Equity Investment was a Syndication (Dummy Variable)
- 5.) Total Number of Private Equity Investors Involved in the First Round of Funding for the Target Firm

To test these new variables, previous methodology used in past related research will be used. Previous research tested the effects of certain variables on underpricing through a variety of regression models. One commonly used regression model in past research was the Ordinary Least Squares (OLS) regression model (Cai et al., 2011; Loughran & Ritter, 2004; Megginson & Weiss, 1991). The other commonly used regression model in past research was the Two-Stage Least Squares Regression (2SLS) (Bruton et al., 2009; Lee & Wahal, 2004). For this paper, the Two-Stage Least Squares Regression (2SLS) Model will be used due to concerns over endogenous explanatory variables as expressed in past research. With that said, the Ordinary Least Squares (OLS) regression model was also run, but it yielded the exact same results as the 2SLS.

The Two-Stage Least Squares (2SLS) method is a statistical technique that can be used in estimating linear regression models when there is a concern of endogenous explanatory variables within the model. In other words, this means that there are certain variables within the model that are correlated to the error term. This can happen when the dependent variable relies on other variables that have not been included within the model.

When this happens, the error term incorporates these variables that have been excluded from the model. This in turn has an effect where certain variables in the model will correlate with the error term which creates endogeneity.

Due to the current lack of research regarding variables related to private equity that affect underpricing, it makes it very likely that important variables were omitted which in turn will cause endogeneity when testing new variables. Attempts to minimize endogeneity were done by using specific control variables that have been commonly proven and used in previous research related to testing variables in regard to IPO underpricing (Bruton et al., 2009; Megginson & Weiss, 1991; Lee & Wahal, 2004; Cai et al., 2011, Loughran & Ritter, 2004; Cai et al., 2011). The control variables used in this paper include:

- 1.) Days Incorporated till IPO
- 2.) Underwriter Reputation (Dummy Variable)
- 3.) High-Tech Industry Classification (Dummy Variable)
- 4.) IPO Price
- 5.) Log Total Shares Offered at IPO

Even with attempts to reduce endogeneity through careful selection of control variables that there was data on, Two-Stage Least Squares (2SLS) was used to ensure endogeneity was not a concern since this method removes this potential problem. As the name suggests, 2SLS uses a two-stage process to remove variables that are correlated to the error term. In the first stage, the endogenous variables are located and are tested with other variables that correlate with the endogenous variables but are not correlated with the error term. This is done by regressing the endogenous variables on the new correlated variables and the other variables in the previous model. This OLS regression will let me know if the new correlated variables are exogenous. In summary, the first stage finds variables that are not correlated to the error term. The second stage now uses these new variables that are uncorrelated with the error term in an OLS regression to estimate the regression model for the dependent variable. It is important to note that R-Studio has a function called “ivreg” that does the Two-Stage Least

Squares (2SLS) method for the user which is what was done in this paper. The underlying regression model that was used in this paper is as follows:

$$\begin{aligned} \text{Underpricing} = & \alpha + \theta(\text{Tested Independent Variable}) + \beta_1(\text{Days Incorporated till IPO}) \\ & + \beta_2(\text{Underwriter Reputation}) + \beta_3(\text{High – Tech Industry Classification}) \\ & + \beta_4(\text{IPO Price}) + \beta_5(\text{Log Total Shares Offered at IPO}) \end{aligned}$$

It is important to note that each of the five independent variables (Days of Private Equity Involvement, Total Number of Private Equity Sponsors Before the Target Firms IPO, Days of Private Equity Syndication, If the First Private Equity Investment was a Syndication, and Total Number of Private Equity Investors Involved in the First Round of Funding for the Target Firm) will be individually tested within the model. The reason all the independent variables were not together in the model is due to correlation concerns (see Appendix 2).

3.6 Measures - Dependent Variable

The dependent variable for hypothesis 3-7 is IPO underpricing which is in relative terms and not absolute terms. Since this value is in relative terms, it is a percentage. As previously mentioned, underpricing is the difference between the stock's price after the first day of trading and the initial public offering share price. This formula and definition of underpricing has been used by numerous papers (Ritter, 1984; Lee & Wahal, 2004; Boulton et al., 2010; Zasepa, 2019; Megginson & Weiss, 1991; Bruton et al., 2009; Certo et al., 2001; and Filatotchev & Bishop, 2002).

3.7 Measures - Independent Variables

Days of Private Equity Involvement: Days of private equity involvement were measured by counting the days between the first documented private equity investment until the firm went to IPO. It is important to note that it did not appear that any of the firms in this data sample repurchased their ownership shares from the private equity firms before IPO to make them non-PE backed again. It appears that when PE firms wanted to exit their position without taking the company to IPO, they sold their ownership shares to other PE firms which kept PE

involvement in the firm up until IPO. It is very common in the PE industry that they exit their positions by selling their ownership shares to another PE firm. Often more than one PE firm is invested into a company which makes it even harder for the target firm to go back to being non-PE backed. Lastly, it is important to note that this variable does not consider change in ownership which in this case would mean when PE firms sell their ownership shares to another PE firm.

Total Number of Private Equity Sponsors Before the Target Firms IPO: The total number of private equity sponsors before IPO had to be manually calculated by looking at the firms' past rounds of financing before IPO. By looking at the firms' past rounds of financing, it was possible to count the number of PE firms that had given financing to the target firm before their IPO. It is important to note that in most cases PE firms participate in multiple rounds of financing for a firm. As previously mentioned, this is done to incentivize the firm to reach certain goals. I did not double count a PE firm if it made multiple rounds of financing to the target firm. The total number of private equity sponsors also included minority and majority stakeholders. This variable should allow me to indirectly calculate how much the target firm had access to PE resources such as advice and connections to grow.

Days of Private Equity Syndication: Days of private equity syndication measures the first recorded point of when there were two or more PE firms invested into the target firm till IPO. The first recorded point of syndication could take place in two situations. The first being that the first PE investment that the target firm receives has two or more PE firms involved. The second being where the target firm currently has received financing from one PE firm and then in a later round another PE firm invests with the original PE firm. In some rare cases, a firm would have one finance firm involved and then when they exited their position, two new PE firms would enter. When these two new firms entered, it would then be classified as syndication.

If the First Private Equity Investment was a Syndication: The variable, if the first private equity investment was a syndication, was a dummy variable meaning it is either a one or a zero. This variable simply measured if the first investment that the target firm received from a PE firm had two or more PE firms involved.

Total Number of Private Equity Investors Involved in the First Round of Funding for the Target Firm: This variable measured the total number of PE investors who have given financing in the first documented PE funding of the target firm. This variable indirectly measures the risk of the target firm since a riskier investment is more likely to have multiple PE investors. This variable also indirectly measured the size of the investment since it is likely that the more PE firms involved, the larger the investment total will be in the target firm.

3.8 Measures- Control Variables

Days Incorporated till IPO: This variable measured the age of the target firm by calculating the days from incorporation till IPO. Due to data availability, the starting point for the firms' age was based on the incorporation date instead of the date of establishment. Other papers have also used the incorporation date as the starting point for a firms' age when data on the firms' date of establishment is missing (Carter et al., 1998; Cai et al., 2011). It is also important to note that many times the date of incorporation and the date of establishment were the same in S&P Capital IQ Pro for companies that had data available for both parameters. With that said, previous research has shown that age is an important factor determining the target firm's organizational performance (Bruton et al., 2009). Moreover, older firms have been proven to be less risky in prior research (Daily et al., 2003; Carter et al., 1998; Ritter, 1984). This in turn has led researchers to find that the older a firm is, IPO underpricing decreases (Daily et al., 2003). Lastly, research has also shown that the age of a VC is positively correlated with the target firm's age which means that older VCs take older target companies to IPO (Lee & Wahal, 2004).

Underwriter Reputation: Underwriter reputation measured the prestige of the underwriter for the target firm's IPO. The process used to classify the prestige of the underwriter in this paper mimics a similar process that was performed in previous research (Bruton et al., 2009). The first step was to find the underwriters for the target company's IPO and list the underwriters with the title book manager since this indicates that they are the lead underwriters for the IPO. This was performed for all companies in the dataset. Next, through S&P Capital IQ Pro a list of book runners with their number of offerings and deal credits from 1/1/2013 to 1/1/2018 in the United States was compiled. From this list, I was able to calculate the cumulative market share for each underwriter as

was performed in previous research (Bruton et al., 2009). The top ten underwriters based on cumulative market share from deal credit was then taken as the basis for my classification as a prestigious underwriter. If the target firm had at least one of their book runners listed in the top ten underwriters list, then its underwriter reputation was given a one. If not, then it was given a zero. It is important to note that some past research did use a 9-point grading scale or a previously created underwriter reputation list. In this paper, I did not use past lists of underwriter reputation since after the top 10 underwriters in my list, the market share drops below 2.6% with the majority having a market share of less than 1%. Due to these findings, it suggests that past lists of underwriter reputation were very outdated. Also, the 9-point grading system was not implemented since its overall purpose is to see how frequent an underwriter is the lead bookrunner. Using deal credit as an indicator of the frequency was possible due to the large differences normally seen in the shares underwritten by book managers compared to co-managers. With that said, underwriter reputation is an important variable to consider since previous research has shown that the better an underwriter reputation is for the target firm's IPO, the less underwriting that will be seen (Carter & Manaster, 1990; Carter et al., 1998). Also, many papers on related research have included underwriter reputation as an important variable in determining underpricing (Lee & Wahal, 2004; Cai et al., 2011; Bruton et al., 2009; Megginson & Weiss, 1991).

High-Tech Industry Classification: Classifying companies by their industry is an important variable to consider since each industry has a different risk and underlying operational foundation. Many papers on IPO underpricing or private equity consider industry classification as an important variable (Meuleman et al., 2009; Lee & Wahal, 2004; Cai et al., 2011; Bruton et al., 2009; Megginson & Weiss, 1991). Industry classification is an important variable since future investors assess the industry the company is in and the risk associated with this industry when they go public (Bruton et al., 2009). Due to the sample sizes being small, it is not very common to find papers classifying companies by each of their industries. What was commonly done in past research was to classify each target firm's company as high-tech or non-high tech through a dummy variable of 1 or 0 (Cai et al., 2011; Meuleman et al., 2009; Bruton et al., 2009). The reason for this is because companies in the high-tech industry require more monitoring because they have more specific assets due to higher R&D which increases losses in the case of bankruptcy (Meuleman et al., 2009). For this paper, the list of high-tech industries provided by the US Bureau of Labor Statistics (BLS) was used in classifying what was considered a high-tech industry.

It is important to note that Capital IQ Pros industry classifications did not align exactly with the US Bureau of Labor Statistics (BLS) which means that if certain industries had similar industry titles as the BLS classification it was considered a high-tech industry.

IPO Price: The IPO offer price is simply the price the shares of the new company being offered. Previous research has shown that the IPO offer price can be an indicator of underpricing (Daily et al., 2003). The reason for this is because the IPO price can signal the estimated value of the firm which the underwriter was able to obtain from potential investors (Jain & Kini, 1999). It has been mentioned in Ibbotson, Sindelar, and Ritter 1988 that low offer prices have higher underpricing (Daily et al., 2003). In short, lower IPO offer prices can indicate a greater uncertainty of the target firm's IPO prospectus (Daily et al., 2003). Many papers have used IPO price as an essential variable (Bruton et al., 2009; Daily et al., 2003). Within this study the IPO price was provided by Capital IQ Pro.

Log Total Shares Offered at IPO: The shares offered at IPO are the total number of shares being offered for sale in the offering by the issuer and the selling shareholder but excluding overallotment options. The overallotment options like the greenshoe option were excluded because these are the shares that are allowed to be offered in a follow-up offering. Many times, these options do not have to be exercised on the same day of the IPO. To ensure that only shares that were available on the same day as the IPO were considered, the overallotment options were excluded. Excluding overallotment has also been performed in past research (Megginson & Weiss, 1991; Dunbar, 2000). Ritter (1984) has shown that a significant relationship exists between IPO offer size and the initial returns (Megginson & Weiss, 1991). Previous research has also pointed out the importance of controlling systematic influence caused from the offering size (Carter et al., 1998). Furthermore, literature regarding IPOs have proven that the size of the offering explains initial returns and long run investment and operating performance of the firm which means it is a good proxy to measure the extent of information asymmetry regarding the success of the IPO (Jain & Kini, 1999). This is why previous research has used the size of the offering as a control variable (Jain & Kini, 1999). It is important to note that issue size can be given as a share amount as in this paper or as a value term. When given as a value term which is seen in past research, it is the total number of shares multiplied with the final offer price of the IPO (Cai et al., 2011; Bruton et al., 2009). For the purpose of

this paper, the reason issue size was not given in value terms is because it would make this variable include the IPO price which has already been proven in past research to be an important variable on its own. To prevent having two variables that account for the IPO price, the size of the offering was given in the share amount.

Chapter 4: Sample Description

4.1 Whole Dataset

The following section will do a descriptive analysis of the data that was used in this paper. The first part is a descriptive analysis of the whole sample data. Then, a descriptive analysis will be performed on only non-private equity backed firms. Following this, a descriptive analysis will then be performed on only the private equity backed firms within the data sample used in this paper.

The data sample used in this paper is composed of 184 entities which have an IPO date between 1/1/2013 and 1/1/2018 and are headquartered in the United States. It is important to note that this sample data was compiled by using data from S&P Capital IQ Pro. Table 1 provides an overview of five essential characteristics for the whole data sample consisting of private equity backed and non-private equity backed firms.

WHOLE DATASET OVERVIEW					
	DATE INCORPORATED	IPO DATE	IPO YEAR	IPO PRICE	UNDER-PRICING
MEAN	21/04/2008	30/05/2015	2015	15.75	23.84%
MEDIAN	02/07/2008	14/04/2015	2015	15.00	8.20%
MIN	07/03/1972	07/02/2013	2013	0.01	-28.71%
MAX	31/08/2017	15/12/2017	2017	128.90	900.00%
NUMBER OF ENTITIES	184				

Table 1: Descriptive Statistics on Whole Dataset

It appears that the mean and median incorporation date for companies within the sample is in the year 2008 with the mean incorporation date being 21/04/2008 and the median incorporation date being 02/07/2008. With the mean and median incorporation date being so close to each other, it means the date incorporated is not very skewed. With that said, the earliest incorporation year within the sample was 1972 and the latest was 2017. When comparing the range of 45 years between the earliest and latest incorporation date to the mean and median, it appears that the majority of firms within the dataset were not recently incorporated.

Another important variable to look at within the data sample is when firms had their IPO date. It also appears that the mean and median IPO date for firms did not vary much within the sample. The mean IPO date was 30/05/2015 while the median was 14/04/2015. When comparing the mean and median year for the date of incorporation and IPO date for the firm, we see that it took firms around seven years to go public after incorporating.

When firms within this dataset decided to go public, it appears that their IPO price was \$15.75 for the mean and \$15.00 for the median. It is interesting to see that within this sample the range for the IPO price is extremely large but not very skewed. The lowest IPO price was around \$0.01 while the highest was around \$128.90. It is important to note that the second highest IPO price within the sample was \$30.89 while the second lowest was \$0.59.

The underpricing seen within the sample data had large differences between the mean and median which implies that the data is right skewed. The mean underpricing is 23.84% while the median is 8.2%. It is also important to note the large difference between the minimum and maximum of the data set with the minimum being -28.71% and the maximum being 900%. The second largest underpricing seen in the data is only at 185.56%. After further research, it can be seen that the entity called First Foods Group, Inc is causing the large maximum seen in the underpricing. The exclusion of First Foods Group, Inc can be seen in Table 2.

SAMPLE OVERVIEW EXCLUDING OUTLIER					
	DATE INCORPORATED	IPO DATE	IPO YEAR	IPO PRICE	UNDER-PRICING
MEAN	07/04/2008	29/05/2015	2015	15.84	19.05%
MEDIAN	26/06/2008	14/04/2015	2015	15.00	8.06%
MIN	07/03/1972	07/02/2013	2013	0.59	-28.71%
MAX	31/08/2017	15/12/2017	2017	128.90	185.56%
NUMBER OF ENTITIES	183				

Table 2: Descriptive Statistics on Whole Dataset excluding First Foods Group, Inc

As can be seen with the exclusion of First Foods Group, Inc, the new maximum underpricing is 185.56%. This changes the mean underpricing from 23.84% to 19.05%. The rest of the variables either do not change or change very little.

When the data sample is broken out by industry as shown in Table 3, it shows that 52.17% of the dataset consists of biotechnology, asset management, internet software and services, and the pharmaceutical industries. It is interesting to note, the average IPO year was 2015 for all of these industries, but the average underpricing varied dramatically between these industries. For example, the second most prominent industry, asset management, had an average underpricing of 3.63% while the most prominent industry, biotechnology, had an average underpricing of 22.12%. Of the four main industries in this dataset, internet software and services had the highest underpricing at 36.59%. Of these four main industries, the asset management industry had the lowest average underpricing, and it had the highest average IPO price. With that said, when the medians are calculated for these four industries regarding underpricing and the IPO price, it shows that they are similar to the overall sample median shown above. For example, biotechnology had a median underpricing of 8.33% and a median IPO price of \$15.00. Asset management had a median underpricing of 8.64% and a median IPO price of \$16.00. Internet software and services had a median underpricing of 8.5% and a median IPO price of \$15.00. Pharmaceuticals had a median underpricing of 7.36% and a median IPO price of \$14.00. This shows that these industry's averages regarding underpricing and IPO price might vary but on a median basis they are very similar and close to the whole sample median.

INDUSTRY	Count of INDUSTRY	Min of IPO YEAR	Average of IPO YEAR	Max of IPO YEAR	Min of IPO PRICE	Average of IPO PRICE	Max of IPO PRICE	Min of UNDERPRICING	Average of UNDERPRICING	Max of UNDERPRICING
Biotechnology	40	2013	2015	2017	6.00	14.16	22.00	-28.71%	22.12%	185.56%
Asset Management	26	2013	2015	2017	10.00	24.34	128.90	-26.80%	3.63%	122.08%
Internet Software and Services	15	2013	2015	2017	7.00	15.23	25.00	-22.56%	36.59%	131.25%
Pharmaceuticals	15	2013	2015	2017	6.00	12.03	20.50	-7.67%	8.84%	37.50%
Bank	5	2014	2016	2017	10.75	15.35	27.00	1.33%	9.12%	14.54%
Healthcare Equipment	5	2014	2015	2016	4.00	13.40	18.00	4.25%	36.33%	73.44%
Life and Health	4	2013	2013	2014	10.00	17.13	19.50	6.87%	8.65%	14.00%
Mortgage REIT	4	2014	2016	2017	5.00	15.38	20.00	-2.56%	-0.98%	0.80%
Restaurants	4	2013	2014	2015	14.00	17.00	21.00	60.20%	100.68%	119.79%

Life Sciences Tools and Services	3	2013	2015	2017	10.00	14.50	18.50	-19.40%	2.61%	16.47%
Trading Companies and Distributors	3	2015	2016	2016	21.00	21.33	22.00	4.33%	15.60%	27.00%
Advertising	2	2014	2015	2016	15.00	16.50	18.00	33.93%	50.58%	67.22%
Application Software	2	2013	2014	2015	14.00	14.75	15.50	12.64%	20.77%	28.90%
Building Products	2	2016	2017	2017	2.50	12.75	23.00	13.57%	17.62%	21.67%
Communications Equipment	2	2013	2015	2017	13.00	14.00	15.00	-0.07%	5.35%	10.77%
Education Services	2	2014	2016	2017	13.00	13.50	14.00	-5.36%	1.09%	7.54%
Electrical Components and Equipment: Light	2	2013	2015	2016	5.00	10.50	16.00	0.00%	3.50%	7.00%
Homebuilding Producers	2	2013	2014	2014	11.00	11.00	11.00	16.36%	16.82%	17.27%
Industrial REIT	2	2013	2015	2016	14.00	17.00	20.00	-4.25%	-1.98%	0.29%
Oil and Gas Equipment and Services	2	2017	2017	2017	14.00	14.00	14.00	0.14%	1.86%	3.57%
Packaged Foods and Meats Producers	2	2014	2015	2015	0.01	7.51	15.00	27.40%	463.70%	900.00%

Real Estate Services	2	2013	2015	2017	12.00	13.00	14.00	-0.36%	7.78%	15.92%
Semiconductors	2	2016	2016	2016	8.00	11.00	14.00	0.25%	14.30%	28.36%
Auto Parts and Equipment	1	2015	2015	2015	9.50	9.50	9.50	42.00%	42.00%	42.00%
Banking Technology	1	2014	2014	2014	13.00	13.00	13.00	16.69%	16.69%	16.69%
Biotechnology	1	2015	2015	2015	19.00	19.00	19.00	19.53%	19.53%	19.53%
Digital Lending	1	2014	2014	2014	15.00	15.00	15.00	56.20%	56.20%	56.20%
Electrical Components and Equipment: Heavy	1	2016	2016	2016	11.00	11.00	11.00	23.27%	23.27%	23.27%
Food Retail	1	2013	2013	2013	18.00	18.00	18.00	122.11%	122.11%	122.11%
Healthcare Facilities	1	2015	2015	2015	19.00	19.00	19.00	-3.00%	-3.00%	-3.00%
Healthcare Services	1	2016	2016	2016	9.00	9.00	9.00	2.00%	2.00%	2.00%
Healthcare Supplies	1	2017	2017	2017	13.00	13.00	13.00	47.85%	47.85%	47.85%
Healthcare Technology	1	2013	2013	2013	20.00	20.00	20.00	85.80%	85.80%	85.80%

Home Improvement Retail	1	2017	2017	2017	21.00	21.00	21.00	52.62%	52.62%	52.62%
Integrated Telecommunication Services	1	2015	2015	2015	13.00	13.00	13.00	-15.77%	-15.77%	-15.77%
Internet and Direct Marketing Retail	1	2017	2017	2017	15.00	15.00	15.00	1.00%	1.00%	1.00%
Investment and Business Development Companies	1	2014	2014	2014	16.00	16.00	16.00	0.00%	0.00%	0.00%
Investment Banks, Brokers and Capital Markets	1	2015	2015	2015	21.00	21.00	21.00	6.67%	6.67%	6.67%
IT Consulting and Other Services	1	2014	2014	2014	14.00	14.00	14.00	33.93%	33.93%	33.93%
Leisure Facilities	1	2015	2015	2015	16.00	16.00	16.00	0.00%	0.00%	0.00%
Leisure Products Producers	1	2014	2014	2014	14.00	14.00	14.00	26.79%	26.79%	26.79%
Machinery: Construction and Heavy Trucks	1	2017	2017	2017	22.00	22.00	22.00	13.64%	13.64%	13.64%
Managed Care	1	2014	2014	2014	14.00	14.00	14.00	25.71%	25.71%	25.71%
Mortgage Banks and Brokers	1	2017	2017	2017	10.00	10.00	10.00	22.20%	22.20%	22.20%
Movies and Entertainment	1	2013	2013	2013	18.00	18.00	18.00	5.00%	5.00%	5.00%

Oil and Gas Drilling	1	2014	2014	2014	11.00	11.00	11.00	0.55%	0.55%	0.55%
Oil and Gas Storage and Transportation	1	2014	2014	2014	17.00	17.00	17.00	-1.76%	-1.76%	-1.76%
Payment Processors	1	2015	2015	2015	9.00	9.00	9.00	45.22%	45.22%	45.22%
Payment Service Providers and Gateways	1	2017	2017	2017	0.59	0.59	0.59	24.58%	24.58%	24.58%
Payments Infrastructure	1	2015	2015	2015	10.00	10.00	10.00	21.70%	21.70%	21.70%
Property and Casualty	1	2015	2015	2015	10.50	10.50	10.50	0.95%	0.95%	0.95%
Specialty Chemicals	1	2014	2014	2014	11.00	11.00	11.00	-2.27%	-2.27%	-2.27%
Specialty Finance: Commercial Focused	1	2014	2014	2014	12.50	12.50	12.50	5.20%	5.20%	5.20%
Specialty Finance: Consumer Focused	1	2014	2014	2014	23.00	23.00	23.00	0.00%	0.00%	0.00%
Specialty Stores	1	2017	2017	2017	22.00	22.00	22.00	26.50%	26.50%	26.50%
Systems Software	1	2014	2014	2014	22.00	22.00	22.00	100.00%	100.00%	100.00%
Technology Distributors	1	2013	2013	2013	17.00	17.00	17.00	8.06%	8.06%	8.06%

Technology Hardware, Storage and Peripherals	1	2015	2015	2015	17.00	17.00	17.00	-5.82%	-5.82%	-5.82%
Water Utilities	1	2016	2016	2016	6.25	6.25	6.25	0.00%	0.00%	0.00%
Grand Total	184	2013	2015	2017	0.01	15.75	128.90	-28.71%	23.84%	900.00%

Table 3: Descriptive Statistics on Whole Dataset by Industry

4.2 Non-Private Equity Backed Entities

This next section will focus on a descriptive analysis of only the entities that were non-private equity backed. Of the 184 companies that are in the dataset, 55 of them were never private equity backed. Table 4 provides some key characteristics of the non-private equity backed entities.

SAMPLE OVERVIEW FOR NON-PE BACKED					
	DATE INCORPORATED	IPO DATE	IPO YEAR	IPO PRICE	UNDERPRICING
MEAN	08/12/2009	20/06/2015	2015	18.89	22.31%
MEDIAN	09/07/2013	30/04/2015	2015	19.50	0.29%
MIN	07/03/1972	07/02/2013	2013	0.01	-26.80%
MAX	31/08/2017	15/12/2017	2017	128.90	900.00%
NUMBER OF ENTITIES	55				

Table 4: Descriptive Statistics for All Non-Private Equity Backed Entities

When looking at the date incorporated, it appears that the data is left skewed since the mean incorporation year is 2009 while the median incorporation year is 2013. Also, when comparing the median date incorporated to the IPO date, it appears that the non-PE firms within this dataset go public about two years after incorporating. Moreover, what really stands out is the difference between the mean and median underpricing. The mean underpricing is 22.31% while the median underpricing is around 0.29%. This would indicate that non-PE backed firms are almost perfectly priced when looking at the median. Another metric that stands out is the maximum

underpricing value. With further analysis of the data, it is found that the second largest underpricing found within the dataset for non-PE backed firms is 122.08% which is much smaller than the maximum underpricing value. When the entity First Foods Group, Inc is removed, which contains this maximum underpricing value, the only large difference seen in the sample overview for non-PE backed firms is the mean underpricing. This can be seen in Table 5. As Table 5 shows, the new mean underpricing would be 6.05% compared to 22.31% as previously shown.

SAMPLE OVERVIEW FOR NON-PE BACKED EXCLUDING OUTLIER					
	DATE IN-CORPORATED	IPO DATE	IPO YEAR	IPO PRICE	UNDERPRICING
MEAN	01/11/2009	17/06/2015	2015	19.24	6.05%
MEDIAN	15/06/2013	22/04/2015	2015	19.75	0.27%
MIN	07/03/1972	07/02/2013	2013	2.50	-26.80%
MAX	31/08/2017	15/12/2017	2017	128.90	122.08%
NUMBER OF ENTITIES	54				

Table 5: Descriptive Statistics for All Non-Private Equity Backed Entities Excluding First Foods Group, Inc.

Now, when I break down the non-PE backed firms by industry as can be found in Table 6, I find that 47.27% of the dataset is dominated by Asset Management alone.

INDUSTRY	Count of INDUSTRY	Min of IPO YEAR	Average of IPO YEAR	Max of IPO YEAR	Min of IPO PRICE	Average of IPO PRICE	Max of IPO PRICE	Min of UNDERPRICING	Average of UNDERPRICING	Max of UNDERPRICING
Asset Management	26	2013	2015	2017	10.00	24.34	128.90	-26.80%	3.63%	122.08%
Bank	3	2017	2017	2017	10.75	16.58	27.00	1.33%	7.37%	11.48%
Life and Health	3	2013	2013	2013	19.50	19.50	19.50	6.87%	6.87%	6.87%
Mortgage REIT	3	2017	2017	2017	5.00	14.83	20.00	-2.56%	-1.29%	0.80%
Industrial REIT	2	2013	2015	2016	14.00	17.00	20.00	-4.25%	-1.98%	0.29%

Real Estate Services	2	2013	2015	2017	12.00	13.00	14.00	-0.36%	7.78%	15.92%
Biotechnology	1	2015	2015	2015	19.00	19.00	19.00	19.53%	19.53%	19.53%
Building Products	1	2016	2016	2016	2.50	2.50	2.50	21.67%	21.67%	21.67%
Healthcare Equipment	1	2016	2016	2016	4.00	4.00	4.00	4.25%	4.25%	4.25%
Healthcare Services	1	2016	2016	2016	9.00	9.00	9.00	2.00%	2.00%	2.00%
Homebuilding Producers	1	2013	2013	2013	11.00	11.00	11.00	17.27%	17.27%	17.27%

Investment and Business Development Companies	1	2014	2014	2014	16.00	16.00	16.00	0.00%	0.00%	0.00%
Investment Banks, Brokers and Capital Markets	1	2015	2015	2015	21.00	21.00	21.00	6.67%	6.67%	6.67%
IT Consulting and Other Services	1	2014	2014	2014	14.00	14.00	14.00	33.93%	33.93%	33.93%
Machinery: Construction and Heavy Trucks	1	2017	2017	2017	22.00	22.00	22.00	13.64%	13.64%	13.64%
Mortgage Banks and Brokers	1	2017	2017	2017	10.00	10.00	10.00	22.20%	22.20%	22.20%
Oil and Gas Storage and Transportation	1	2014	2014	2014	17.00	17.00	17.00	-1.76%	-1.76%	-1.76%
Packaged Foods and Meats Producers	1	2015	2015	2015	0.01	0.01	0.01	900.00%	900.00%	900.00%
Pharmaceuticals	1	2017	2017	2017	6.00	6.00	6.00	37.50%	37.50%	37.50%

Specialty Finance: Commercial Focused	1	2014	2014	2014	12.50	12.50	12.50	5.20%	5.20%	5.20%
Specialty Finance: Consumer Focused	1	2014	2014	2014	23.00	23.00	23.00	0.00%	0.00%	0.00%
Water Utilities	1	2016	2016	2016	6.25	6.25	6.25	0.00%	0.00%	0.00%
Grand Total	55	2013	2015	2017	0.01	18.89	128.90	-26.80%	22.31%	900.00%

Table 6: Descriptive Statistics on All Non-Private Equity Backed Entities by Industry

It can be seen in Table 6, the average IPO year for the asset management industry was 2015 with an average IPO price of \$24.34 and an average underpricing of 3.63%. When the medians are observed, the median IPO price is \$20.00 while the median underpricing is 0%. The medians for the asset management industry are very similar to the medians for all the non-PE backed entities. Due to the very low underpricing seen in the asset management industry and the fact that it consists of almost half of the entities for non-PE backed entities, it has a large effect on the overall samples average underpricing. To get a better understanding of the average underpricing for the non-private equity backed entities, it is important to look at the non-PE entities without the asset class asset management and without the entity First Foods Group, Inc. which is shown in Table 7. It is important to note that generally financial firms are excluded from studies due to their differences in financing structure and operational methods (Al-Issa et al., 2022).

SAMPLE OVERVIEW EXCLUDING OUTLIER AND ASSET MANAGMENT					
	DATE IN-CORPORATED	IPO DATE	IPO YEAR	IPO PRICE	UNDERPRICING
MEAN	24/12/2005	21/10/2015	2015	14.50	8.31%
MEDIAN	14/07/2009	28/04/2016	2016	14.00	5.93%
MIN	07/03/1972	01/05/2013	2013	2.50	-4.25%
MAX	07/04/2017	15/12/2017	2017	27.00	37.50%
NUMBER OF ENTITIES	28				

Table 7: Descriptive Statistics for Non-Private Equity Backed Entities Excluding the Asset Management Industry and First Foods Group, Inc.

With the removal of entities in the asset management industry and the removal of the outlier First Foods Group, Inc., the data shows a lower mean and median regarding the IPO price but a higher underpricing. When comparing the data for non-PE backed firms excluding First Foods Group, Inc., the mean underpricing goes from 6.05% to 8.31% while the median underpricing goes from 0.27% to 5.93%. Interestingly, the mean and median IPO prices go from being in the \$19.00 range to the \$14.00 range. This shows that due to a large portion of the data consisting of the asset management industry, which has a very low underpricing influences the overall underpricing.

4.3 Private Equity Backed Entities

The last section will do a descriptive analysis of only entities that were private equity backed. It is important to note that of the overall sample containing PE backed and non-PE backed IPOs there were a total of 129 entities of the 184 that were PE-backed. The tables that follow will take a deeper dive into the key characteristics of the PE-backed entities within this dataset.

Some of the key dates of this dataset are the incorporation date, IPO date, the date of the first PE investment, and the date of the first syndication for each entity which can be seen in Table 8.

KEY DATES FOR PE ENTITIES				
	DATE INCORPORATED	IPO DATE	DATE OF FIRST PE INVESTMENT	DATE OF FIRST SYNDICATION
Mean	11/08/2007	21/05/2015	22/05/2008	04/10/2008
Median	07/08/2007	29/01/2015	01/05/2008	15/05/2008
Min	05/10/1985	20/03/2013	25/10/1998	28/06/2000
Max	21/11/2016	14/12/2017	13/08/2015	13/10/2015
Number of Entities		129		

Table 8: Descriptive Statistics on Key Dates for Private Equity Backed Entities

As can be seen, the mean and median incorporation year was 2007 while the mean and median IPO date was 2015. This implies that for this dataset, companies took about 8 years to go public since their incorporation. For more detailed specifics on the exact days between these two dates, please refer to Table 9 below. It is important to note that this shows that PE backed firms had a larger amount of time from incorporation till IPO than non-

PE backed firms. This makes sense because PE-backed firms are already gaining access to large amounts of funding from the PE firms and because PE firms normally hold onto their target firms for many years. Another important point to mention is that the year of the first PE investment and the year for the target firm's first syndicated investment is the same.

TIME FRAME OVERVIEW FOR PE ENTITIES			
	DAYS FROM IN-CORPORATION TILL IPO	DAYS OF PE INVOLVEMENT	DAYS OF SYNDICATION
Mean	2839	2555	1797
Median	2564	2491	1812
Min	90	288	0
Max	11714	6092	5780
Number of Entities		129	

Table 9: Descriptive Statistics for Private Equity Backed Entities Regarding Key Number of Days

With further analysis, as shown in Table 9, it shows that target firms had a higher mean and median days of PE involvement than days of syndication. This is interesting because the mean and median dates discussed above paint a different picture. When analyzed even further, we see that 48.06% of the target firms had their first investment as a syndication as shown in Table 10. Table 10 also shows that over 75% of the entities had a syndicated investment before their IPO and a reputable underwriter.

KEY PERCENTAGES FOR PE ENTITIES			
	FIRST INVESTMENT WAS SYNDICATION	SYNDICATION BEFORE IPO	REPUTABLE UNDERWRITER
Yes	62	97	98
No	67	32	31
Total	129	129	129
Percentage Yes	48.06%	75.19%	75.97%

Table 10: Descriptive Statistics for Private Equity Backed Entities Regarding Key Percentages

Moreover, it is also important to take a deeper dive into the specifics of PE sponsors, PE investors in the first round, and key IPO statistics as shown in Table 11. The sample data for only PE backed entities have a mean and median of around 5 for the number of PE sponsors before the target firms IPO. With that said, it seems that the mean number of PE investors in the first funding round of the firm is around 2 while the median is 1. So, it

appears that for the first round of funding firms have either 1 or 2 PE firms involved. Moreover, the mean and median IPO price is around \$14 which is about \$4 less than for non-PE backed firms even when excluding the outlier. Interesting enough, the IPO price for PE backed entities is similar to the IPO price for non-PE backed entities when excluding entities in the asset management industry and the outlier. Next, when looking at the underpricing, it appears that the mean is around 24.5% while the median is 13.75%. When comparing these figures to the underpricing for non-PE backed firms, even when excluding outliers and the asset management industry, PE backed firms have greater underpricing than non-PE firms.

KEY STATISTICS FOR PE ENTITIES						
	PE SPON- SORS BE- FORE IPO	PE INVES- TORS IN FIRST FUNDING OF FIRM	SHARES OFFERED AT IPO	GROSS PRO- CEEDS FROM IPO	IPO PRICE	UNDER- PRICING
Mean	5.11	2.03	9,640,042	138,793,116	14.41	24.49%
Median	5.00	1.00	6,740,000	100,000,012	14.00	13.75%
Min	1.00	1.00	2,100,000	15,000,000	0.59	-28.71%
Max	20.00	7.00	76,271,186	871,250,000	25.00	185.56%
Number of Entities			129			

Table 11: Descriptive Statistics for Private Equity Backed Entities

Last of all, it is important to look at the industry breakout for just the PE backed entities which is shown in Table 12. It is important to note that 69 of the 129 PE backed companies are in biotechnology, internet and software services, and pharmaceutical industries with the largest being biotechnology which is 40. Past research has also shown that VCs tend to provide more financing to industries that are technology intensive like biological research and software research (Lee & Wahal, 2004). With around 31% of the sample data for PE-backed companies being from biotechnology, it is important to note that they had a mean underpricing of 22.12% and a median underpricing of 9.28%. Internet and software services had a mean underpricing of 36.59% and a median underpricing of 27.08%. Pharmaceuticals had a mean underpricing of 6.79% with a median of 2.36%.

INDUSTRY	Count of ENTITIES	Average of DAYS FROM INCORPORATION TILL IPO	Average of DAYS OF PE INVOLVEMENT	Average of DAYS OF SYNDICATION	Average of IPO PRICE	Average of UNDERPRICING	Average of PE SPONSORS BEFORE IPO	Average of PE INVESTORS IN FIRST FUNDING OF FIRM	Average of SHARES OFFERED AT IPO	Average of GROSS PROCEEDS FROM IPO
Biotechnology	40	2,806	2,162	1,944	14.16	22.12%	7.10	3.03	6,004,649	86,453,318
Internet Software and Services	15	3,861	2,972	1,944	15.23	36.59%	6.07	1.20	8,436,077	123,689,923
Pharmaceuticals	14	3,032	2,746	2,240	12.46	6.79%	5.86	1.86	8,302,976	123,139,286
Healthcare Equipment	4	5,222	3,475	3,024	15.75	44.36%	7.25	2.75	5,823,530	95,250,002
Restaurants	4	2,928	2,109	1,104	17.00	100.68%	2.00	1.25	6,250,000	103,392,857
Life Sciences Tools and Services	3	3,027	2,679	2,210	14.50	2.61%	3.33	2.00	5,927,769	89,375,999
Trading Companies and Distributors	3	1,607	3,208	1,199	21.33	15.60%	2.67	2.00	17,333,333	375,666,667
Advertising	2	2,521	2,373	2,314	16.50	50.58%	4.00	1.50	5,718,831	92,782,466
Application Software	2	3,593	3,492	3,463	14.75	20.77%	2.50	1.50	6,870,000	101,235,000
Bank	2	1,310	2,742	-	13.50	11.73%	1.00	1.00	2,531,937	34,097,111
Communications Equipment	2	3,251	1,900	-	14.00	5.35%	1.00	1.00	22,230,769	327,461,528
Education Services	2	1,337	3,897	2,612	13.50	1.09%	9.00	2.00	22,087,500	304,637,500
Electrical Components and Equipment: Light	2	2,212	1,531	-	10.50	3.50%	1.00	1.00	7,500,000	103,500,000
Oil and Gas Equipment and Services	2	1,887	2,004	-	14.00	1.86%	1.00	1.00	16,850,000	235,900,000
Semiconductors	2	4,508	4,411	4,411	11.00	14.30%	9.00	3.50	4,900,000	53,600,000
Auto Parts and Equipment	1	897	6,092	823	9.50	42.00%	4.00	1.00	2,350,000	22,325,000
Banking Technology	1	3,275	811	-	13.00	16.69%	1.00	1.00	7,760,870	100,891,310
Building Products	1	240	1,942	-	23.00	13.57%	1.00	1.00	25,000,000	575,000,000
Digital Lending	1	2,991	2,512	2,512	15.00	56.20%	7.00	2.00	58,000,000	870,000,000
Electrical Components and Equipment: Heavy	1	4,339	4,299	4,299	11.00	23.27%	8.00	2.00	6,250,000	68,750,000
Food Retail	1	916	835	-	18.00	122.11%	1.00	1.00	18,500,000	333,000,000
Healthcare Facilities	1	181	2,106	-	19.00	-3.00%	1.00	1.00	14,285,000	271,415,000
Healthcare Supplies	1	3,603	1,227	-	13.00	47.85%	1.00	1.00	4,000,000	52,000,000
Healthcare Technology	1	2,468	2,115	-	20.00	85.80%	1.00	1.00	13,045,000	260,900,000
Home Improvement Retail	1	2,385	2,308	-	21.00	52.62%	1.00	1.00	8,823,500	185,293,500
Homebuilding Producers	1	838	3,606	3,606	11.00	16.36%	3.00	2.00	7,450,000	81,950,000
Integrated Telecommunication Services	1	4,257	3,723	3,723	13.00	-15.77%	6.00	3.00	5,000,000	65,000,000
Internet and Direct Marketing Retail	1	2,470	1,722	1,722	15.00	1.00%	4.00	3.00	8,000,000	120,000,000
Leisure Facilities	1	142	1,000	-	16.00	0.00%	1.00	1.00	13,500,000	216,000,000
Leisure Products Producers	1	90	2,679	2,679	14.00	26.79%	2.00	2.00	7,142,858	100,000,012
Life and Health	1	3,026	2,390	-	10.00	14.00%	1.00	1.00	7,125,000	71,250,000
Managed Care	1	4,333	2,801	-	14.00	25.71%	1.00	1.00	9,100,000	127,400,000
Mortgage REIT	1	260	951	-	17.00	-0.06%	1.00	1.00	13,250,000	225,250,000
Movies and Entertainment	1	2,386	3,426	1,873	18.00	5.00%	7.00	1.00	18,421,053	331,578,954
Oil and Gas Drilling	1	1,007	871	871	11.00	0.55%	2.00	2.00	10,000,000	110,000,000
Packaged Foods and Meats Producers	1	3,646	1,400	-	15.00	27.40%	1.00	1.00	10,416,667	156,250,005
Payment Processors	1	2,345	2,179	2,179	9.00	45.22%	4.00	2.00	27,000,000	243,000,000

Payment Service Providers and Gateways	1	3,311	3,150	3,150	0.59	24.58%	7.00	2.00	76,271,186	45,000,000
Payments Infrastructure	1	3,048	3,024	3,024	10.00	21.70%	2.00	2.00	15,000,000	150,000,000
Property and Casualty	1	2,115	1,777	-	10.50	0.95%	1.00	1.00	3,100,000	32,550,000
Specialty Chemicals	1	2,218	4,774	3,816	11.00	-2.27%	7.00	1.00	7,500,000	82,500,000
Specialty Stores	1	1,349	4,425	-	22.00	26.50%	1.00	1.00	15,800,000	347,600,000
Systems Software	1	3,403	3,346	3,346	22.00	100.00%	3.00	2.00	4,800,000	105,600,000
Technology Distributors	1	2,224	2,084	2,084	17.00	8.06%	3.00	2.00	23,250,000	395,250,000
Technology Hardware, Storage and Peripherals	1	2,195	1,775	1,505	17.00	-5.82%	7.00	1.00	25,000,000	425,000,000
Grand Total	129	2,839	2,555	1,797	14.41	24.49%	5.11	2.03	9,640,042	138,793,116

Table 12: Descriptive Statistics on All Private Equity Backed Entities by Industry

Chapter 5: Results

5.1 Results Section Description

In the following section, the results for the seven hypotheses for this paper will be presented. This section will be split into two parts due to the two different methodologies used within this paper. The first will discuss the results for hypothesis 1 and 2 since it compares the underpricing found within the data sample. The second section will discuss the results for hypothesis 3-7 since it uses regression to find if the new variables are statistically significant.

5.2 Comparing Underpricing

The results regarding the mean and median underpricing found in the dataset can be found in Table 13. Table 13 compares the underpricing which contains the whole dataset, only private equity backed entities, non-private equity backed entities, and cases where certain outliers and industries are removed. The first hypothesis in this paper was that on average there was underpricing between the years 2013 and 2018 for private equity backed and non-private equity backed firms. As Table 13 shows, underpricing does exist between these years for PE backed and non-PE backed entities meaning we can reject the null hypothesis. As can be seen, the mean for the whole dataset even when excluding the one outlier is 19.05% while the median is 8.06%. Even when looking at just non-PE backed firms or just PE-backed firms, we see that the means and medians are greater than 0% which shows that underpricing does exist. These results are in line with past research which also shows that underpricing existed in their datasets time frames (Ritter, 1984; Grinblatt & Hwang, 1989; Lee & Wahal, 2004; Boulton et al., 2010). It is also important to note that that underpricing found in this dataset, when excluding the outlier, is very similar to the underpricing percent found in Ritter (1984) dataset between 1960 and 1982 and Lee & Wahal (2004) dataset between 1980 and 2000.

Underpricing Table			
Data Type	Number of Entities	Mean	Median
Whole Dataset	184	23.84%	8.20%
Whole Dataset but Excluding First Foods Group, Inc	183	19.05%	8.06%
Non-Private Equity Backed	55	22.31%	0.29%
Non-Private Equity Backed but Excluding First Foods Group, Inc	54	6.05%	0.27%
Non-Private Equity Backed but Excluding First Foods Group, Inc and Asset Management Industry	28	8.31%	5.93%
Private Equity Backed	129	24.49%	13.75%

Table 13: Underpricing Comparison Table

Table 13 also shows the results to the second hypothesis of this paper which states that on average private equity backed IPOs will have less underpricing compared to non-private equity backed firms. Interestingly, the results show that the non-private equity backed firms are less underpriced than the private equity backed firms. The non-PE backed firms had an average underpricing of 22.31% while the private equity backed firms had an average underpricing of 24.49%. Also, Table 14 shows that the variances comparing the underpricing of the non-PE backed to the PE backed which indicate that the variances of the two are unequal, therefore we reject the null at the 5% significance level. Knowing this, a T-test assuming unequal variances was run, as shown in Table 15, which shows that we cannot reject the null hypothesis at the 5% significance level. This means that the difference between the means is not statistically significant.

F-Test Two-Sample for Variances		
	<i>Non-PE Backed</i>	<i>PE Backed</i>
Mean	22.30741109	24.48750006
Variance	14879.4667	1230.885862
Observations	55	129
df	54	128
F	12.08842115	
P(F<=f) one-tail	1.64504E-30	
F Critical one-tail	1.437889545	

Table 14: F-Test for Comparing Underpricing

T-Test: Two-Sample Assuming Unequal Variances		
	<i>Non-PE Backed</i>	<i>PE Backed</i>
Mean	22.30741109	24.48750006
Variance	14879.4667	1230.885862
Observations	55	129
Hypothesized Mean Difference	0	
df	58	
t Stat	-0.130267206	
P(T<=t) one-tail	0.448402891	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	0.896805781	
t Critical two-tail	2.001717484	

Table 15: T-Test for Comparing Underpricing

Now, when the medians are observed, the results show that non-PE backed firms had an underpricing of 0.29% while PE-backed firms had an underpricing of 13.75% which is a large difference.

Due to there being one large outlier for the non-sponsored backed dataset, the T-test shows a different story when this outlier is removed. The tests for when the outlier is removed are shown in Table 16 and Table 17. Table 16 shows that the variances are not equal at the 5% significance level while Table 17 shows that the means are statistically different, so we can reject the null hypothesis at the 5% significance level. In other words, the difference in means for underpricing is statistically significant. The result is the same when the outlier and entities in the asset management industry are removed as shown in Table 18 and Table 19.

F-Test Two-Sample for Variances		
	<i>PE Backed</i>	<i>Non-PE Backed</i>
Mean	24.48750006	6.053844632
Variance	1230.885862	356.2506829
Observations	129	54
df	128	53
F	3.455111587	
P(F<=f) one-tail	7.90099E-07	
F Critical one-tail	1.492201556	

Table 16: F-Test for Comparing Underpricing Not Including Outlier

T-Test: Two-Sample Assuming Unequal Variances		
	<i>PE Backed</i>	<i>Non-PE Backed</i>
Mean	24.48750006	6.053844632
Variance	1230.885862	356.2506829
Observations	129	54
Hypothesized Mean Difference	0	
df	170	
t Stat	4.588527577	
P(T<=t) one-tail	4.31807E-06	
t Critical one-tail	1.653866317	
P(T<=t) two-tail	8.63614E-06	
t Critical two-tail	1.974016708	

Table 17: T-Test for Comparing Underpricing Not Including Outlier

F-Test: Two-Sample for Variances		
	<i>PE Backed</i>	<i>Non-PE Backed</i>
Mean	24.48750006	8.305375263
Variance	1230.885862	118.3598238
Observations	129	28
df	128	27
F	10.39952429	
P(F<=f) one-tail	1.19197E-09	
F Critical one-tail	1.72710738	

Table 18: F-Test for Comparing Underpricing Not Including Outlier or Asset Management Industry

T-Test: Two-Sample Assuming Unequal Variances		
	<i>PE Backed</i>	<i>Non-PE Backed</i>
Mean	24.48750006	8.305375263
Variance	1230.885862	118.3598238
Observations	129	28
Hypothesized Mean Difference	0	
df	138	
t Stat	4.361000348	
P(T<=t) one-tail	1.25742E-05	
t Critical one-tail	1.655970382	
P(T<=t) two-tail	2.51484E-05	
t Critical two-tail	1.977303542	

Table 19: T-Test for Comparing Underpricing Not Including Outlier or Asset Management Industry

When the outlier First Food Group, Inc and the entities part of the asset management industry are removed, we must reject my hypothesis that PE backed firms have lower underpricing than non-PE backed firms on average.

These findings are surprising since most of the past research has shown that PE-backed firms had less underpricing (Megginson & Weiss, 1991; Cai et al., 2011; Lee & Wahal, 2004). It is also important to note that the non-PE backed average is very similar to the average found in Cai et al. (2011) dataset from 1981 to 2002. Furthermore, the non-PE backed average, excluding the outlier and the asset management industry, is very similar to the average found in Lee & Wahal (2004) findings from 1980 to 1989. Regarding PE-backed firms, the average underpricing found in this paper is similar to the average found in Lee & Wahal (2004) for the 1980 till 2000 dataset which was 24.49% vs. 26.82%. With that said, even though the findings for this hypothesis were shocking, it is not uncommon. For example, it was found that IPOs backed by VC firms had larger returns than non-VC backed IPOs which implies that VC-backed firms had larger underpricing (Lee & Wahal, 2004). It was also found that when looking at just management buyouts (MBOs), venture capitalists backed companies had higher underpricing than ones not backed by VCs on a value-weighted basis (Jelic et al., 2005).

There are many possible explanations on why the findings in this paper show that non-PE backed firms have significantly less underpricing than PE backed firms on average. One potential explanation could be due to the industries that are dominating the dataset during the studies time frame which would naturally have a large effect on the results. Another explanation is the JOBS Act and/or the growing economy during this time allowed PE firms to take on more R&D intensive investments which in nature are riskier. Moreover, the combination of investors starting to invest more than ever before in US history and with the JOBS Act opening investment opportunities could have changed the PE landscape. When thinking about the structure of the PE industry, PE firms need to build up a reputation of quality by being able to take companies public, so their limited partners invest in future funds which many times overlap (Lee & Wahal, 2004). An easy way for PE firms to take their companies public is by underpricing them. Due to so much money going into investments during this time, it is possible that many PE firms were using this easy access to capital to build their reputations.

5.3 Regression Results

The next methodology used in this paper was to use regression to test new variables that could potentially help explain underpricing. The Two-Stage Least Squares (2SLS) regression method was used due to concerns regarding endogenous explanatory variables. The results from the 2SLS regression method can be seen in Table 20 below.

Regression Results Using Two-Stage Least Squares												
Regression Hypothesis	Independent Variable Tested	Intercept	Independent Variable	Days from Incorporation till IPO	Reputable Underwriter	High Tech	IPO Price	Log (Shares Offered at IPO)	Multiple R-Squared	Adjusted R-Squared	Wald Test	P-Value
H3	Log (Days of PE Involvement)	51.354	-10.137	0.004	-0.943	-0.734	3.192	-0.401	0.186	0.146	4.636	0.000281
Pr(> t)		0.539	0.0842	0.030 *	0.901	0.905	1.9e-05 ***	0.934				
H4	PE Sponsors Before IPO	-4.942	-0.315	0.003	0.740	-2.558	3.252	-1.491	0.167	0.126	4.061	0.000953
Pr(> t)		0.949	0.699	0.116	0.923	0.679	1.66e-05 ***	0.761				
H5	Days of Syndication	-6.665	-0.001	0.003	0.535	-2.384	3.232	-1.404	0.166	0.125	4.044	0.000988
Pr(> t)		0.931	0.796	0.133	0.944	0.700	2.39e-05 ***	0.774				
H6	First Investment was Syndication	-13.936	4.084	0.003	-0.153	-1.602	3.355	-1.171	0.169	0.128	4.122	0.000837
Pr(> t)		0.857	0.500	0.150	0.984	0.799	1.22e-05 ***	0.811				
H7	PE Investors in First Round of Firm	-6.505	-0.295	0.003	0.327	-2.704	3.257	-1.419	0.166	0.125	4.035	0.001009
Pr(> t)		0.934	0.895	0.128	0.966	0.673	1.71e-05 ***	0.773				

Table 20: Regression Results (Significant Codes: ***, **, *, , represent significance at the 0.1%, 1%, 5%, and 10% levels respectively)

The five variables that were tested above were log days of private equity involvement, total number of private equity sponsors before the target firms IPO, days of private equity syndication, if the first private equity investment was a syndication (dummy variable), and total number of private equity investors involved in the first round of funding for the target firm. Of these five variables, the only one where we reject the null hypothesis was the independent variable log days of private equity involvement. This independent variable was significant at the 10% level. This finding shows supporting evidence that the longer the number of days a firm receives funding from private equity firms the less underpricing that will be seen, which in other words means that its IPO price is closer to its real value. Even though this variable has not been studied in much detail, one paper did make a comment on it in their study which supported what was found in this paper. In summary, the shorter time lags between the first private placement and the IPO date resulted in significantly larger underpricing when compared to longer time lags (Cai et al., 2011). Cai et al. (2011) did admit that this finding could be misleading due to the fact that their sample contained the internet bubble, so the mean time lag found in their paper was 2.5 years while the median was 1.5 years (Cai et al., 2011). It is important to note that in my sample data for this paper, the time lag from the first private placement till IPO was around 7 years for the mean and median. It is also important to note that the control variables that showed significance within the model testing log days of private equity involvement were the days from incorporation till IPO at the 5% level and the IPO price at the 0.1% level.

Furthermore, for the independent variables total number of private equity sponsors before the target firms IPO, days of private equity syndication, if the first private equity investment was a syndication (dummy variable), and total number of private equity investors involved in the first round of funding for the target firm we fail to reject the null hypothesis. It appears these variables have no significant effect on underpricing, so it is by random chance. It is also important to note that for hypotheses 4-7, the only variable that showed significance was IPO price at the 0.01% level. There are many potential explanations why these tested independent variables did not show themselves to be statistically significant. First of all, there is a large lack of research in this field and the current research up to this point is fairly new which makes it not as concrete. Due to this, it makes it difficult to understand fully what variables are essential for a study such as this one. Another explanation could be that these new variables have no correlation with underpricing, and these variables are more correlated with risk. It

is possible these variables could potentially help explain the risk for the company more than the underpricing effect. Furthermore, due to regression assuming a linear relationship between the variables which is violated for these variables, this can cause issues with the results. This could potentially suggest that maybe a new methodology needs to be created to test these variables. Also, due to this being the first study to look at a time frame after the JOBS Act to my knowledge, these findings could suggest that these changes in the industry have had a large effect on the results from past research. A final reason for the lack of significance for these variables could be due to the sample size. Even though past research has also dealt with similar sizes of data, testing these variables might need larger sample sizes to show significance.

Chapter 6: Robustness

6.1 Robustness of this Research

As previously mentioned, steps to ensure the model in this paper were robust were considered by implementing the Two Stage Least Squares (2SLS) method over using Ordinary Least Squares (OLS). The reason 2SLS was implemented was due to concerns for endogenous explanatory variables within the model. With that said, to further test the robustness of the 2SLS test performed in this study, the five assumptions for linear regression were tested. Not only were the assumptions for linear regression tested but OLS was also implemented on the data to see if there were any differences found in the results, but no differences were found. It is important to note that for this research it is difficult to test robustness by adding other control variables or using another subset of data due to the focus of the study and the data availability.

The five assumptions that needed to be tested regarding linear regression are as follows:

- 1.) A linear relationship exists between the predictor variable and the response variable
- 2.) The observations are independent from each other
- 3.) Multicollinearity does not exist meaning that the predictor variables are not highly correlated with each other
- 4.) Homoscedasticity exists meaning that there is a constant variance of residuals
- 5.) The variables are multivariate normal

The first assumption that was tested was if there was a linear relationship between the independent variables tested and underpricing. The test revealed that the variables are not very linear, which will reduce the precision of the model. It is important to note that transformations of the variables were performed which still did not correct this potential issue. As data becomes more available it will be better understood if the lack of a linear relationship was due to the sample size being too small or if the relationship between the variables used in this model were not linear. If it is due to the variables in this study not having a linear relationship, then other models should be used in future research. Independence was tested using the Durbin-Watson test which detects

autocorrelation among residuals (see Appendix 5). As can be seen, there is not enough evidence to reject the null hypothesis at the 5% level which suggests that there is not enough evidence that the residuals are autocorrelated. Next, multicollinearity was checked by using the Variance Inflation Factor (VIF). VIF showed that some variables such as days of syndication, PE investors in the first round of funding, and if the first investment was a syndication had moderate correlation, but it was not high enough to be of concern (see Appendix 3). This was further investigated by comparing the correlation between each variable (see Appendix 2). It is important to note that correlation between variables was reduced by testing each independent variable separately which minimizes concern for this assumption being violated. Furthermore, to test if heteroscedasticity exists the Breusch-Pagan Test was used. For each model in this paper, we would fail to reject the null hypothesis at the 5% level. This means that we cannot say that heteroscedasticity is present in the models for this paper (see Appendix 4). Last of all, normality was tested by using QQ plots. The QQ plots show that normality is violated but if the sample size for the study is large enough, which should be the case here, then Central Limit Theorem applies. The Central Limit Theorem states that if the sample size is large enough then the sample mean should be approximately normal.

Chapter 7: Concluding Remarks

7.1 Conclusion

Using data from S&P Capital IQ Pro, a unique dataset regarding companies IPO data was compiled for companies headquartered in the United States that had an IPO date between 1/1/2013 and 1/1/2018. This created a dataset of 184 companies in total of which 129 of them were PE backed while the remaining 55 were non-PE backed. A key element of this research paper is that it looks specifically at IPOs that happened after the passage of the JOBS Act which had drastic effects on the funding accessible to private companies and the funding limits for private equity companies. With that said, there are two main goals for this research paper. The first goal was to research if underpricing existed after the passing of the JOBS Act and to further determine if private equity backed entities had lower underpricing compared to non-private equity backed entities. The second goal of my research was to test a variety of different variables regarding PE investments and their effects on a firm's underpricing using the two-stage least squares regression. It is important to note that these characteristics regarding PE investments are new variables that have not been tested in literature up to this point in time to my knowledge.

The results for the first part of this paper which investigated underpricing found that underpricing did exist after the passage of the JOBS Act and in contrast to most past research that non-PE backed firms on average had lower underpricing than PE backed firms. The average underpricing found in the whole dataset was 23.84% while the median was 8.20%. When one outlier was removed from the dataset, the average was then 19.05% while the median was 8.06%. Furthermore, the mean underpricing for the 129 PE backed firms was 24.49% while the mean was 13.75%. When compared to the non-PE backed firms including the exclusion of the one outlier, the mean was 6.05% while the median was 0.27%. My results show that the difference between the mean underpricing between the PE backed and non-PE backed excluding the one outlier is statistically significant at the 5% level. Finding that non-PE backed firms have lower underpricing on average than PE backed firms is contrary to most previous research but is not abnormal.

The results for the second part of the paper which looked at a variety of characteristics that could potentially have an influence on a firm's IPO underpricing tested the variables log days of private equity involvement, total

number of private equity sponsors before the target firms IPO, days of private equity syndication, if the first private equity investment was a syndication, and the total number of private equity investors involved in the first round of funding for the target firm with a set of control variables. Of these newly tested variables, only log days of private equity involvement showed themselves to be statistically significant at the 10% level.

Overall, the findings in this paper support that the concept of underpricing exists in practice and that there is a significant difference in the average underpricing effect on PE backed and non-PE backed entities. Moreover, the findings in this paper also support how private equity involvement have a positive effect in reducing the underpricing of a firm's IPO. Interesting enough, this paper brought to light how there is a relationship between the length of time PE firms are involved in a firm and the decrease in the underpricing seen.

With that said, the results of this paper should be regarded with caution since data on private companies and the investments private equity firms make is very limited due to its private nature. As do most papers regarding research in private equity, there is a large concern for data accuracy and availability. For example, the results of this paper rely heavily on the data that S&P Capital IQ Pro collected and its accuracy. The results also rely heavily on the group of firms that reported this information and its accuracy. Last of all, the results of the regressions in this paper also rely heavily on the control variables with available data.

7.2 Further Research

The research performed in this paper has brought to light many possible ideas for future research. First, the regression models in this study used to discover significant variables related to private equity that can reduce underpricing could be enhanced by including more variables. This would also further test if the results and models built in this paper were robust. It would also give a clearer picture of the important control variables when conducting similar tests for new variables. As previously mentioned, this paper used commonly used control variables that appeared frequently in related literature and that S&P Capital IQ Pro had data on. With that said, past research sometimes included a combination of variables such as consideration of hot issue periods,

investor sentiment, auditor reputation, market volatility, lock up periods, offer risk, retained equity, percent of company held by founders, percent of company held by private equity firms, if the founder was the CEO at the time of the IPO, founders experience, number of risk factors, VC reputation, and VC age outside from the usual variables seen frequently in past research. Also, incorporating more entities by including other databases or performing this test on previous literature time periods would help test the robustness of this study and perhaps uncover new findings. Furthermore, another interesting research idea would be to compare comparable companies before and after the JOBS Act to see the effects the JOBS Act had on various variables. The JOBS Act changed the investing landscape in the United States by opening new avenues for private companies to raise funding and increased the funding limits for the private equity industry. One interesting insight this research might bring is if the role and importance PE firms play in their target firms have changed after the passing of this act. Lastly, all the different types of PE were analyzed together in this paper, but it would be beneficial to gain a better understanding of how the different PE segments like angel investing, seed investing, venture capital, and leverage buyouts all separately affect underpricing which would help give a better understanding of the effects each has on their target companies.

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Appendix

Appendix 1: The JOBS Act

The JOBS Act also known as the Jumpstart Our Business Startups Act was signed into law on April 5, 2012, and had the goal of encouraging funding for small businesses, under \$1 billion in revenue, in the United States by changing some of the security regulations. Titles I, V, and VI went into effect immediately while the other four titles went into effect at later dates. The passage of the JOBS Act had a large impact on private companies' funding possibilities. For example, it loosened reporting regulations, oversight, and advertising regarding raising capital from investors. It also allowed small businesses to disclose less to investors. Another key element of this Act was that these small companies could raise money from non-accredited investors through mini-IPOs and crowdfunding efforts. With that said, the passage of this Act also had an impact on the private equity industry. First, there was no need to register for crowdfunding which included the ability to raise \$1 million through restricted securities in 12 months. This also included the removal of the prohibition and solicitation of selling securities to investors that have an accredited status. Furthermore, offerings could now be \$50 million compared to the previous \$5 million. Additionally, firms had the ability to have 2,000 record holders compared to the previous 1,000 before having to register with the SEC. It also helped streamline the IPO process for private companies which is very important to private equity companies.

Appendix 2: Correlation of Regression Variables

	Log Days of PE Involvement	PE Sponsors before IPO	Days of Syndication	First Investment was Syndication
Log Days of PE Involvement	100.00%	29.72%	64.30%	2.92%
PE Sponsors before IPO	29.72%	100.00%	61.29%	34.44%
Days of Syndication	64.30%	61.29%	100.00%	51.78%
First Investment was Syndication	2.92%	34.44%	51.78%	100.00%
PE Investors in First Funding of Firm	3.96%	47.84%	41.08%	76.82%
Days from Incorporation till IPO	49.68%	24.08%	46.12%	11.11%
Reputable Underwriter	-1.85%	14.86%	9.93%	3.27%
High Tech	24.29%	3.25%	17.75%	-16.02%
IPO Price	-12.24%	-3.68%	-20.03%	-16.82%
log(Shares Offered at IPO)	-1.77%	-5.93%	-7.61%	-5.51%

	PE Inves- tors in First Funding of Firm	Days from Incorpor- ation till IPO	Reputable Under- writer	High Tech	IPO Price	log(Shares Offered at IPO)
Log Days of PE In- volvement	3.96%	49.68%	-1.85%	24.29%	-12.24%	-1.77%
PE Spon- sors before IPO	47.84%	24.08%	14.86%	3.25%	-3.68%	-5.93%
Days of Syndication	41.08%	46.12%	9.93%	17.75%	-20.03%	-7.61%
First In- vestment was Syнди- cation	76.82%	11.11%	3.27%	-16.02%	-16.82%	-5.51%
PE Inves- tors in First Funding of Firm	100.00%	15.31%	-1.37%	-20.31%	-10.63%	-13.01%
Days from Incorpor- ation till IPO	15.31%	100.00%	12.82%	26.47%	-15.43%	-9.27%
Reputable Under- writer	-1.37%	12.82%	100.00%	0.06%	33.18%	28.47%
High Tech	-20.31%	26.47%	0.06%	100.00%	-8.11%	-4.56%
IPO Price	-10.63%	-15.43%	33.18%	-8.11%	100.00%	14.85%
log(Shares Offered at IPO)	-13.01%	-9.27%	28.47%	-4.56%	14.85%	100.00%

Appendix 3: Variance Inflation Factor (VIF) Table

Variance Inflation Factor (VIF) Table	
Variable	VIF
Log Days of PE Involvement	2.487789
PE Sponsors before IPO	2.027129
Days of Syndication	4.245541
First Investment was Syndication	3.637615
PE Investors in First Funding of Firm	3.156375
Days from Incorporation till IPO	1.570964
Reputable Underwriter	1.350525
High Tech	1.206528
IPO Price	1.237277
log(Shares Offered at IPO)	1.158747

Appendix 4: Bresch-Pagan Test for 2SLS Models

Breusch-Pagan Test			
Hypothesis Regression Model	BP	df	P-Value
H3	12.471	6	0.05225
H4	7.9008	6	0.2455
H5	8.0146	6	0.237
H6	8.5922	6	0.1978
H7	8.1856	6	0.2248

Appendix 5: Durbin Watson Test for OLS Models

Durbin-Watson Test		
Hypothesis Regression Model	DW	P-Value
H3	1.872	0.2338
H4	1.917	0.3167
H5	1.913	0.3083
H6	1.902	0.2869
H7	1.912	0.3059