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Swedish Private Equity – A Reliable Source for IPO Pricing?

A Quantitative Analysis of Explanatory Factors for Differences in Underpricing Between Private Equity-Backed and Non-Private Equity-Backed IPOs in the Swedish Market

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Abstract

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Key words: Underpricing, Information Asymmetry, Private Equity, IPO, Sweden

Purpose: To explore if and why Private Equity-backed companies experience different levels of underpricing compared to its counterpart between 2009 and 2018

Methodology: Quantitative Research

Theoretical approach: Previous research suggests that firms going public experience, on average, abnormal first day returns. One of the theories explaining this phenomena argues that underpricing is a result of informational asymmetry between investors. However, certain procedures can be made in order to lower this informational gap. Hence, this study examines whether private equity lowers informational asymmetry by comparing a sample containing private equity-backed firms with a sample containing non-private equity-backed firms in Sweden during 2009-2018.

Empirical approach: 277 IPOs in Sweden between 2009-2018 were studied. 83 of the companies studied were backed by private equity and the remaining 194 companies were not backed by private equity. The data was collected from Bloomberg.

Conclusion: The study concludes that private equity backed firms experience less underpricing compared to non-private equity-backed firms due to the certification effect private equity provides. The variables *debt-to-capital ratio*, *market capitalization* and *IPO Year* proved significant results in explaining underpricing for non-private equity-backed firms. The decision for a private equity firm to sell off their shares, "exiting", in connection to IPOs was the most prominent variable explaining underpricing for private equity-backed firms.

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1.0 Background

This chapter establishes the relevant introductory information for the study. Initially, information about IPO underpricing and the PE industry is introduced. Secondly, previous research within the areas are discussed, which leads to the study's purpose and question. Lastly, the scope of the thesis is discussed, where choices in time frame, chosen markets and scope within domestic markets are established.

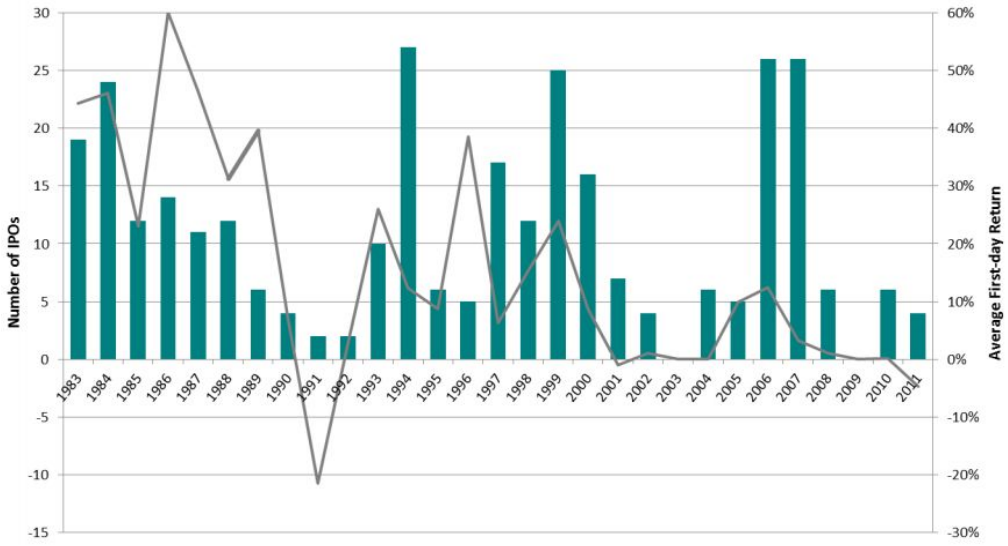
1.1 Introduction

A growing investment class in the financial markets is *private equity* (*PE*) funds, with funds from the class having increased from 30 billion dollars to 4 trillion dollars during the past twenty years (Mathis, 2017). PE is a collection of several investment strategies stretched over several asset classes, with two of the main strategies being *buy-outs* (*BO*), and *venture capital* (*VC*). VC focuses on investing in early-stage companies, typically to aid in the company's future growth and financial stability. BOs refers to a purchase of a company of a more mature character from its current owner through equity funds from one or several private equity actors and debt financing from financial institutions (Baker, Filbeck, Kiymaz, 2015). The PE fund then realizes returns (*exits*) through selling the company to a strategic buyer, a financial sponsor or through an IPO (Minardi, Bortoluzzo, Rosatelli, Ribeiro, 2019; Povaly, 2007).

One of these exit strategies, the IPO, has been the subject for a significant amount of academic research. From the company's perspective, going public is a significant milestone. An IPO, and taking a company public in general, comes with several perks, such as easier access to capital and exit opportunities, to name a few (Ibbotson, Sindelar and Ritter, 1994).

These perks are a few of the reasons as to why there are a rather significant amount of IPOs executed every year (Bloomberg, 2020). However, research has shown that IPOs are systematically underpriced. (Ibbotson *et. al*, 1994; Ritter, 1984). This can be discovered in the share performance of the first day of trading after a company's IPO, where IPOs tend to outperform the market as a whole. In Sweden, the average underpricing of IPOs between 2005-2015 has been 4.9% (Göthner & Ramsin, 2015) .

Chart 1. Number of offerings and average first-day returns on Swedish IPOs, 1983-2011



Line shows average first-day returns per year. Bars shows the number of IPOs per year.
Source: Ritter (2012)

1.2 Problem Discussion

The discovery of the underpricing phenomena by Logue (1973) and Ibbotson (1975) has prompted a significant amount of research on IPO Underpricing and its underlying explanations (for example, see Ritter, 1984; 2012; Beatty and Ritter, 1986; Habib and Ljungqvist, 2001). Studies have focused on various metrics in order to better explain the phenomena and different variables significance in relation to underpricing.

This extensive research gave offspring for theory suggesting that underpricing may be impacted on the level of ex-ante uncertainty surrounding the firm (Beatty and Ritter, 1986). The higher the uncertainty, the harder it is for investors to estimate the "true" value of the firm. As such, firms going public are forced to underprice their issues. As the underpricing represents a significant cost to the issuing firms however, companies going public are incentivized to take measures to certify

higher quality and therefore decrease the uncertainty (Habib and Ljungqvist, 2001). Being backed by a PE-firm might act as such a certification.

Bergström, Nilsson and Wahlberg (2006) argue that PE-backed firms are exposed to less uncertainty due to the support they gain from the private equity firm in terms of capital, industry experience and professional management. Private equity firms are also suggested to be less likely to float a poor quality firm, due to the importance of their reputation. Moreover, Megginson and Weiss (1991) claim that private equity fulfills the criteria to be seen as credible in certifying firm quality.

Despite these claims, there is still no consensus as to how much PE-backing actually influences underpricing, as little research has been made on the area – especially for recent time periods and in markets that are less of an object to regular research.

In their research, Bergström *et. al* (2006) studied the difference in underpricing between IPOs backed by private equity and the ones that are not, in the two markets UK and France. The results demonstrated a difference in the mean level of underpricing between the two groups, specifically looking at size, industry and IPO year to explain underpricing. Siow & Low (2018) has moreover studied several company-specific measures regarding underpricing of PE-backed companies in the US.

However, there seems to exist a lack of similar research looking at the Swedish markets only. Furthermore, while there is a significant amount of research done on underpricing and VC-backed underpricing, private equity backed issues have been overlooked in most previous studies. This can be seen as rather odd, because of the sheer size of the industry. In Sweden during 2017, the BO segment of the PE industry (VC and BO combined) corresponded for 35% of the companies and approximately 90% of the employees and revenues (SVCA, 2018). Given that Sweden is the third largest PE industry globally relative to the domestic GDP, this represents a research gap that needs to be addressed.

Consequently, this study addresses a relevant research area because of the analysis of differences in underpricing between PE-backed firms and non-PE-backed firms in Sweden, comparing the differentiating explanatory variables between the two groups.

1.3 Purpose and Question at Issue

The aim behind this study is to identify potential differences in IPO underpricing between IPOs performed by a company with PE ownership and a company that has not. Furthermore, whether or not this is found to be true, the authors will continue to study potential underlying reasons to explain the result of the main question.

Hence, the resulting research questions at issue are the following:

Question 1:
Do Private Equity-backed companies tend to see a lower level of underpricing than its counterpart in Sweden?

Question 2A:
Given the result in question 1, which are the factors explaining underpricing among PE-backed and non-PE-backed firms in Sweden?

Question 2B:
Are there differences in the factors explaining underpricing between PE-backed and non-PE-backed firms in Sweden?

1.4 Thesis Scope

Given the potential effect of external factors when comparing different countries, a single country has been chosen as the object of study. Bergström, Grubb and Jonsson (2007) stated that Sweden has the third largest PE industry in relation to domestic GDP in the world. Hence, the authors have chosen to limit the study to the domestic stock market in Sweden, as the industry's size makes the country highly relevant. The country has a developed private equity industry, with world-leading firms such as EQT, Nordic Capital, Altor and IK Investment Partners (Spliid, 2013). Given the established private equity industry in Sweden, we believe that, given the chosen timeframe, there

are a sufficient number of datapoints to reach statistically significant results to draw reliable conclusions. This also imitis the risk of overlapping research, which could be considered a risk in two relatively larger PE industries UK and the US.

Furthermore, actions have been taken to reduce the effect of external factors. The IPO climate is highly dependent on the economic cycle (Bergström *et. al*, 2006). To limit the effect of economic cycles, the authors have therefore chosen the ten year period 2009-2018. This fits the scope of declining PE returns as well as a period of relatively non volatile market indices. Furthermore, as the research of Ritter (2020) suggests, the level of IPO underpricing differs significantly between countries. To limit the risk of this being a deciding factor in the data set, a one-country study has been deemed to be the most effective approach in the given study. Additionally, all of the Stock exchanges in Sweden have been included. Even though there is a risk for legal differences between exchanges, the data set would run the risk of not being large enough. Additionally, this contributes with results for a larger variety of company characteristics, which adds a more universal angle to the results, as some countries' indexes can have more exposure in some industries than other countries. For instance, Sweden's OMXS30 index has a heavy exposure to financials and industrials.

2.0 Literature Review and Hypothesis Development

This chapter establishes the relevant literature framework for this study. To begin with, general theories relevant to IPO underpricing are introduced, with focus on theories regarding information asymmetry. Secondly, Private Equity and its effect on firms' operational performance will be discussed before reviewing theories on Private Equity's effect on IPO underpricing. Lastly, relevant hypotheses concluded from the literature findings are formalized.

2.1 Theoretical Reasons for Underpricing

Various theories for IPO underpricing have been developed ever since the discovery of the phenomenon. These include behavioral reasons, institutional explanations as well as theories regarding ownership and control. However, the most prominent and, according to Ljungqvist's (2004) survey, best explanatory theory suggests that underpricing is a consequence of pre-IPO information asymmetry among investors. This theory is explained below and will be used as the theoretical foundation for the rest of this paper.

2.1.1 Information Asymmetry: The Winner's Curse

The prominent parts of an IPO are the issuing firm, the bank underwriting the IPO and the investors of the stocks. Asymmetric information models regarding underpricing assume that one of these parties are better informed than the other (Ljungqvist, 2007). One of the most well-known asymmetric information models is Rock's (1986) "*Winner's curse*", which is an application of "*The Market for Lemons*"-problem presented by Akerlof (1970). Rock assumes that some investors are better informed of the "true" value of the firm than the general investor. Hence, the better informed investor only bids on attractively priced IPOs, whereas the uninformed investor bids blindly. This "adverse selection problem" imposes a "winner's curse" on the uninformed investor, as they recieve all shares they have bid for in unattractively priced offerings, while only receiving a fraction of their bid in attractively priced (thus oversubscribed) offerings.

For the uninformed investor, this results in a lower average return as compared to the average underpricing return. In extreme cases, the uninformed investor *only* receives the shares of the bids they have placed on unattractive offerings, resulting in negative returns. When these conditions

apply, the uninformed investor will be unwilling to participate in bidding for IPOs, resulting in an IPO market only consisting of informed investors. Rock (1986) assumes that the primary market is dependent on the participation of uninformed investors in order for the demand to take up all the shares offered, even in attractively priced offerings. Thus, it is conditionally required that the expected returns are non-negative in order for the uninformed investors to be willing to participate. Hence, all IPOs have to be underpriced in expectation. Even though there is an allocation bias against the uninformed investor, they will no longer have negative returns on average, even adjusted for rationing. (Ljungqvist, 2007)

2.1.1.1 Ex-ante Uncertainty Explaining Underpricing

Beatty and Ritter (1986), argues that underpricing should increase in line with the ex ante uncertainty about the value of the IPO firm. Beatty and Ritter suggest the following: Investors who decide to participate in information research essentially invest in a call option on the IPO, which will be exercised should the "true" price exceed the strike price, which in this case equals the offer price for the IPO. The call option's value increases the greater the valuation uncertainty. Consequently, more investors will participate in information research the greater the valuation uncertainty for the issue. As a result, the required underpricing is raised, since an increase in the number of informed investors aggravates the winner's curse problem by creating a larger information asymmetry between informed and uninformed investors. This theory has received a great amount of empirical evidence. As a cause, studies that test new theories within IPO underpricing have to control for uncertainty before any convincing conclusions can be made.

2.1.2 Information Asymmetry: Signaling Theory

The signaling theory assumes that investors are unable to evaluate the quality of firms. Allen and Faulhaber (1989) argue that high quality firms consequently are incentivized to underprice their issues in order to signal high quality. The costs implied as a result of a lower issuing price can be compensated by seasoned equity in the future. Low quality firms are however not able to utilize the same strategy, as the risk of being exposed is high, which would significantly affect the prospects of raising new capital through seasoned equity. As such, poor quality firms are not incentivized to mimic high quality firms in their issue pricing as they may not be able to recoup the costs implied with the signal at a later financing stage.

As underpricing represents a significant cost to the issuer, firms are highly incentivised to reduce the information asymmetry between informed and uninformed investors. Lowering the offer price when going public is not the only way to signal high quality, however. Habib and Ljungqvist (2001) argue that if issuers can take actions to reduce underpricing, they will do so up to the point where the marginal cost of reducing underpricing equals the marginal benefit, measured by the reduction in the issuer's total wealth loss as a result of underpricing. Specific procedures to reduce informational asymmetry historically include hiring a prestigious underwriter (Carter and Manaster, 1990) or a reputable auditor (Titman and Trueman, 1986; Beatty, 1989). Another method for firms to signal their quality is also to raise capital from private equity. This is discussed in depth in chapter 2.2.3.

2.1.3 "Hot issue" Markets

The IPO market has historically seen dramatic swings in issuance, referred to by Ritter (1984) as "hot" and "cold" markets and earlier discussed in Ibbotson and Jaffe (1975). Hot markets are described by periods of unusually high volume of IPOs, serious underpricing, frequent oversubscription of offerings and at times high concentration to certain industries. Cold markets, on the other hand, have a lower volume of issuing firms, less underpricing and less cases of oversubscriptions.

Previous literature finds no unanimous explanation for the existence of hot and cold periods. Signaling models, refer the hot markets as periods when a large volume of high-quality chose to go public (Allen and Faulhaber, 1989), while long-term performance researchers in contrast argue that these periods are characterized by a high volume issuance of low-quality firms, whose managers choose to take advantage of a "window of opportunity" by going public in a period of irrationally bullish investors (Loughran and Ritter, 1995). On a similar argumentative basis, Loughran, Ritter and Rydqvist (1994) suggest that firms "time" their IPOs to coincide with periods of high investor optimism. Although there are clear differences in the explanations, there seems to be a consensus regarding the existence of "hot issue" markets and their effect on IPO underpricing.

2.2 Private Equity

In the beginning of this chapter, the definition of private equity and previous research on its operational value-adding is explained. Exit strategies for private equity firms are also presented. The chapter ends with an in-depth walkthrough of signaling and certification effects of private equity, connected to the theories explained in part 2.1.

2.2.1 Definition of Private Equity and Private Equity-Backed IPOs

According to Baker *et. al* (2015), private equity firms are defined as a collection of several investment strategies stretched over several asset classes with two of the main strategies being buy-outs (traditional private equity) and venture capital. While buy-outs often involve more mature companies that are in a later stage of the company life-cycle, venture capital focuses on early-stage companies that do not have a business that is as well-established as the companies within the buy-out strategies. Hence, according to Baker *et. al*, the term private equity should be seen as the umbrella term with several different niche areas beneath it. This definition of private equity will be used throughout this paper and is further explained in part 3.3. Further, Levis (2011) defines venture capital-backed initial public offerings as IPOs where a venture capital firm is the largest shareholder in terms of number of shares owned at the point of the IPO. The same definition will be applied for private equity (with venture capital included) in this paper.

The characteristics that set private equity firms apart includes their knowledge and expertise, their investment horizon and risk profile as well as their work with incentives and corporate governance (Næss-Schmidt, Heebøll and Karlsson, 2017). Private equity firms aim to use their knowledge to increase productivity, profitability and competitiveness during the holding period that could range from 3 to 6 years on average . These acquisitions are enabled through the use of a relatively high amount of leverage to acquire a significant stake in the company which increases the risk, but also the potential return. When the company has been acquired, the private equity firms typically implement corporate governance tools such as management incentive plants, change the board and management and use other types of governance tools to align incentives and improve business operations.

The role of private equity and its effect on operational performance has been widely discussed ever since the publication of Jensen's (1989) report. Looking at the role of active investors and leverage buyouts, Jensen concluded that buyouts create powerful incentives that increase performance and

value. Since buyouts often involve a large amount of debt, managers need to find ways to effectivize resource management and operational improvements to generate cash flows in order to pay off the debt. This has led to an extensive research made to evaluate whether Private Equity involvement has a direct link to operational performance.

For example, Kaplan (1989) researched 76 large management buyouts of public companies between 1980 and 1986. The study showed increases in market value by 96 % and 77 % from two months before the announcement of the buyout to the post-buyout.

Although most of the studies on the subject have targeted the U.S. market, research has also been made on smaller domestic markets. For example, Bergström, Grub and Jonsson (2007) have studied the value creation of buyouts in Sweden. Instead of merely looking at public market transactions, their study uses a comprehensive swedish data set, unbiased in terms of exit methods. By categorizing operating performance improvement by looking at the EBITDA (Earnings before Interest, Tax, Depreciation and Amortization) margin, ROIC (return on invested capital) and growth, their study proved significant improvements in EBITDA and ROIC metrics. Hence, the authors conclude that private equity sponsored buyouts are followed by significant operational improvements, and are therefore considered to be value-adding.

2.2.1.1 Going Public as an Exit Route

Taking a firm public is one of three common exit strategies for private equity firms, amongst trade sales and secondary buyouts (Povaly, 2007). The exit can be *full,* meaning that the PE-firm sells off all of its shares in connection to the exit The other option is a *partial* exit, where the firm sells off a specified amount of shares while still remaining a shareholder.

Worldwide, trade sales is the most common exit route, accounting for 38 % of all exits between 1970 and 2007. Secondary buyouts are the second most common route (24 %) and exit through IPO is the least common amongst the three, accounting for 14 % (Kaplan and Strömberg, 2009). Folus and Boutron (2015) argues that the reasons for the low popularity of using the IPO as an exit route compared to the alternatives is due to the lengthy process, the cost entailed to the IPO and the regulatory restrictions imposed to the private equity firms when going public, such as the aforementioned lock-up agreements preventing the firm to sell off their whole stake in connection to the IPO.

When exiting through an IPO, private equity firms most commonly only partly exit. Folus and Boutrion (2015) suggest two explanations for this phenomena. Firstly, the lock-up provisions are one of the factors that explain why private equity firms often do not fully exit in connection to an IPO, as they are often forced to remain a (partial) shareholder for a certain amount of time. Secondly, public investors might view a full exit as a lack of confidence in the issuing firms future business prospects.

2.2.3 Private Equity as Certification Tool

The dilemma for many firms is that investors have obvious problems in evaluating the value of the firm. This can partly be explained by the information asymmetry between managers and potential investors.

Tecee (1996) argues that signaling is a tool to reduce information asymmetry without uncovering the source of a firm's competitive advantage, regardless of whether the signaling itself was intentional or not. Spence (1974) suggests that certain variables or indicators provide information to potential investors, allowing them to separate high-quality firms from low-quality depending on the firm specific capabilities. Previous literature have highlighted signaling measures such as hiring a reputable auditor (Beatty, 1989), the level of planned capital expenditures (Trueman, 1986), the level of debt (Ross, 1977), and the choice of an underwriter (Carter and Manaster, 1990).

Another tool to signal firm quality could be the raising of capital. Varma and Szewczyk (1993) argue that several attributes of Private Equity placements showcase as strong mechanisms for high-quality firms to signal their comprehensive value. For instance, professional private investors generally conduct robust due diligence before committing their funds. Furthermore, coupled to the information gathering is a requirement for investors to have their capital committed to the firm for a period of up to two years, similar to the lock up period earlier discussed. Because of this requirement, only high-quality firms are perceived to attract private equity. Lastly, private investors arrange agreements in order to provide ongoing monitoring of firms, in order to mitigate moral hazard problems where the firm is not fully exposed to the cost of their risk taking (Lerner, 1995). Such contracts often contain covenants giving the right to inspect books, records, facilities, timely financial reports as well as operating statements, making it easier for PE-firms to monitor their companies.

Building further on the subject, Hertzel and Smith (1993) concludes in its research that investors favour concentrated ownership structures in companies, as it provides "monitoring services" of managerial performance. This means that companies with a single or a few main owners typically see increased certainty among investors, to some extent, regarding what to expect of the management work and managerial activities. The authors therefore implies that private equity is preferred over public equity when used as a signal.

Megginson and Weiss (1991) have analysed underpricing with focus on a subgroup in private equity: venture capital. The authors claim that the certification effect of venture capital is due to three reasons: reputation, network and strong commitment to stay invested. Venture capital firms with successful IPO track records raise the credibility of future firms taken public. Due to the importance of a venture capital firm's reputation, it is highly unlikely that it would be willing to risk their reputation by taking a low quality firm public. Moreover, venture capital firms have robust abilities to maintain relationships with parties of the IPO and are committed to stay invested post-IPO, raising the confidence of investors, thus reducing the information asymmetry connected to the issuing firm. Furthermore, the monitoring role that venture capital firms take also reduces said information asymmetry (Barry, Muscarella, Peavy and Vetsupens, 1990).

Megginson and Weiss (1991) argues that there are three criteria for financial sponsoring (investments from private equity or venture capital) certification to be seen as credible: First off, the sponsors need to have their own reputation at risk in the case of the event of a false certification. Secondly, the gains in wealth by certifying falsely must be significantly less than the price paid in terms of reputational value. Third, the cost of certification for the issuing firm must be an increasing function of the obscurity surrounding the firm. These criteria are fulfilled by both private equity and venture capital.

There are other factors that could explain the signaling effect gained by private equity. For example, many PE-firms are specialized in certain industries. Cressy, Munari and Malipiero (2007) argue that specialized PE-firms possess a deeper knowledge of the industrial environment and their companies' strengths and weaknesses relative to their competitors. This is giving them a better ability to select stronger firms to invest in while also providing more effective monitoring. The

results of their study of 122 buyouts suggests that industry specialization PE-firms have stronger post-buyout profitability. This is further supported by Nadant, Perdreau and Bruining's (2018) evidence from the French market, showing that improvements in operating performance is positively related with PE specialization. Nadant *et. al* (2018) also suggest —in contrast to Cressy *et. al* (2007)— that PE firms add a strategic significance due to their industry specialization. As such, the specialized knowledge that many PE-firms have may further explain the certification effect of private equity.

2.3 Previous Research

2.3.1 Institutional Ownership

Fundamentally, the winner's curse theory is based on information heterogeneity between investors. Michaely and Shaw (1994) theorizes that if the information heterogeneity goes down to zero, there should be no underpricing. By looking at segments in the IPO market where heterogeneity is likely to be low, this theory could be tested. When looking at the IPO market of master limited partnerships, which institutional (informed) investors to a large degree avoid due to tax reasons, Michealy and Shaw found that among 39 master limited partnership IPOs between 1984 and 1988, the average underpricing was negative 0.04 %. For the same time period, the underpricing among non-master limited partnerships was on average 8.5 %. It is therefore argued that a large degree of institutional owners aggravates the need for underpricing due to a larger information heterogeneity between informed and uninformed investors.

2.3.2 Lock-up Provisions

New theories for IPO underpricing have shifted the focus on traditional explanations for IPO underpricing. One of these studies focuses on the economic consequences of lock-up provisions imposed on the pre-IPO shareholders. A lock-up provision limits the pre-IPO shareholders from selling their shares in the aftermarket for a specified time period after the IPO and is agreed upon by the underwriter and the pre-IPO owners of the issuing firm. The lock-up periods are used to reduce potential conflict between inside and outside investors by ensuring a significant economical interest from the inside investors, reassuring outside investors that they will not be taken

advantage of. This helps to mitigate the adverse selection problems IPO investors face. (Wan-Hussin, 2005)

Mohan and Chen (2001) and Brav and Gompers (2003) argue that the structure of the lock-up provisions reflect the level of the adverse selection problems and thus IPO underpricing. A shorter lock-up period signals less adverse section, leading to lower underpricing. Mohan and Chen furthermore argue that risky IPOs are associated with longer lock-up periods because investors need more time to resolve the uncertainty. To test this hypothesis, they analyzed 729 IPOs from 1990 to 1992, of which 481 firms had the standard lock-up period of 180 days, while 73 firms had lock-ups less than 180 days and 175 firms had lock-ups longer than 180 days. The authors found a U-shaped relationship between lock-up and underpricing, suggesting that firms that depart from the norm of a 180 day lock-up are associated with more severe underpricing. Moreover, Brav and Gompers' examination of 2794 IPOs in the U.S. during 1988-1996 found evidence suggesting that less transparent companies (which are associated with greater informational asymmetry) have longer lock-up periods.

2.3.3 Private Equity and IPO Underpricing

Bergström, Nilsson and Wahlberg (2006) studied the underpricing in private equity-backed firms in the European market. The authors suggest that private equity-firms signal a high quality due to the degree of support they gain from the private equity firm in terms of capital, industry experience and active and professional management. Due to the importance of repeated fundraising and successful exits for private equity firms, private equity-firms may be reluctant to float a low-quality firm since they value their reputation higher than in any other exit route, given the large publicity surrounding IPOs. Investors and other - less informed - parties are less likely to understand the circumstances for which the private equity-backed firms enter the IPO market, and may therefore infer that the mere presence of private equity is a high-quality stamp. Hence, private equity firms may in this regard certify the quality of firms going public and accordingly influence investors to spend less resources on information gathering.

Bergström *et. al* (2006) furthermore argues that private equity backing can reduce the adverse selection problem discussed in Rock's (1989) Winner's Curse, due to the information in private equity-backed IPOs is likely to be more homogeneously spread amongst institutional and retail investors due to greater publicity and transparency before the IPO. The greater information spread

in private equity backed IPOs could therefore narrow the informational gap between investors, hence lowering the ex ante uncertainty about the "true" value of the firm. This lowered ex ante uncertainty provokes fewer investors to produce information, lessening the adverse selection problem. In their examination of the European IPO-market of 1994-2003, Bergström *et. al* (2006) found results that implies that private equity-backed firms are less underpriced. For example, private equity-backed firms across a full industry portfolio in the London Stock Exchange had an average underpricing of 9.68 %, compared to 17.69 % for non-private equity-backed firms, although this difference did not prove to be statistically significant.

2.3.4 Company Specific Characteristics to Explain Underpricing

Previous research has looked at several company specific metrics to explain IPO underpricing, Amongst these are financial characteristics such as key performance indicators. A popular company specific characteristic has been measure of size. Ritter (1984) and Bergström *et al* (2006) looked at the logarithm of sales, and other studies have looked at size in terms of offer size relative to other sales deals in respective countries (Boulton, Smart and Zutter, 2011). In general, theory suggests that there should be a negative relationship between size and underpricing due to greater information availability (Bergström *et al*, 2006). This was partly supported in Bergström *et. al's* (2006) study of the European market, where the London Stock Exchange proved a statistically significant negative relationship between size and underpricing, with a coefficient of -4.78. The Paris stock exchange, however, did not generate any statistically significant results and had a positive coefficient.

Size is however not the only observed indicator. In a sample of over 2000 IPOs from 1980 to 1997, Purnanadam and Swaminathan (2004) looked at the difference between overvalued and undervalued IPOs. By looking at key performance indicators that are commonly used to evaluate financial performance, they find results that suggest that overpriced IPOs are, amongst others, characterized by lower initial sales, lower EBITDA profit margins, higher first day return share turnover and higher analyst earnings growth. The study however finds no significant differences in underwriter quality, the book-to-market ratio or ex-post cash flow volatility between underpriced and overpriced IPOs. Instead, the authors conclude that the key differences across the groups of underpriced and overpriced firms are linked to profitability and expected growth. Overpriced IPOs are suggested to have lower current profitability and higher expected growth while underpriced IPOs on the contrary have higher profitability and lower expected growth.

Previous literature has also looked at the degree of leverage in firms. The leverage is suggested to showcase the financial quality of the offering to the market and it is argued that firms with high debt claims (measured as total debt to total assets) are able to signal a high quality due to the firms' ability to secure debt (James and Wier, 1990; Habib and Ljungqvist, 2001; Schenone, 2004). Habib and Ljungqvist (2001) found statistically significant results in an OLS regression, supporting this theory, however with relatively low value on the coefficient. James and Wier (1990) moreover claims that the presence of a borrowing relationship pre-IPO reduces the uncertainty amongst investors, increasing the IPO proceeds when the issuer enters the market. Private equity-backed firms are furthermore characteristically of higher leverage than non-backed firms, which is motivated by tax and financing incentives (Jensen, 1989). This is due to private equity firms' repeated process of investing, creating strong connections to credit providers which makes it easier for their portfolio firms to secure debt financing.

2.4 Hypothesis Development

As previously stated, the Winner's Curse hypothesis is based on information heterogeneity among investors. Beatty (1989), Carter and Manaster (1990) discuss that historical methods to reduce information heterogeneity includes recruiting a reputable auditor or a prestigious underwriter. However, the presence of an issuing firm being backed by private equity could also imply a strong mechanism for firms to signal their quality, due to PE-firms deeper knowledge and monitoring effects benefiting operational performance. This signaling could possibly reduce the information gathering for private equity-backed IPOs, reducing the information asymmetry between informed and uninformed investors. The credibility of certification is discussed by Megginson and Weiss, (1991), suggesting that the effect of venture capital certification is due to reputation, network and commitment to stay invested. We believe that these criteria are also applicable for private equity, as the two investment types show clear similarities and fit into the criteria for credible certification as argued by previously mentioned authors.

This hypothesis is supported by Bergström *et. al*'s (2006) findings for Private Equity-backed firms in the European Market, where it was found that private equity-backed IPOs on average showed a

lower degree of underpricing compared to their counterpart. We expect to find empirical evidence that supports their results when looking at the Swedish market in isolation. Hence, in line with Michaely and Shaws intuition, suggesting that less information asymmetry results in lower underpricing, our first hypothesis can be formulated:

Hypothesis 1:
There is a difference in the degree of underpricing between private equity-backed firms and non-private equity-backed firms in Sweden

Rock (1986) states that underpricing is a tool to get uninformed investors to purchase stocks issued in an IPO. Informed investors at the same time, have paid a price to get a hold of this information. This creates an opportunity to get compensated for said price paid through purchasing shares in an issue that is priced favorably. Given the assumptions that institutional investors have more information than the rest of the market players, an IPO with several institutional investors should aggravate the winner's curse problem as described by Beatty and Ritter (1986). Should this be true, then IPOs with a larger degree of institutional ownership should also be underpriced to a higher level. This leads us to our second hypothesis:

Hypothesis 2:
Larger institutional ownership results in higher level of IPO underpricing

While lock-up provisions are a relatively new addition to the traditional information asymmetry theories, we believe that the structure of the lock-ups can add a similar -while not as substantial - signaling value as discussed in the above hypothesis. One can argue that the lock-up lowers the insecurity regarding information asymmetry by guaranteeing insider ownership post-IPO. While no convincing results have been presented, previous research suggests that the structure of the lock-up plays a role in the IPO underpricing level. For example, lock-up provisions that depart from the traditional 180 days are suggested to be more underpriced and more underpriced companies tend to have longer lock-up periods. Even though the results in previous research are rather vague, we argue that it is possible that the lock-up period has a signaling value to outside investors that could prove significant when compared to IPOs without any lock-up periods. Our third hypothesis therefore follows:

Hypothesis 3:

Lock-up provisions has an effect on the degree of underpricing

Purnanandam and Swaminathan (2004) shows findings in key performance indicators that can explain differences in underpricing and overpricing among IPOs. Their results suggest that profitability and growth prospects acs as two of the most influential factors for differences among the two groups. However, another tool to signal firm quality can be a firm's level of debt (James and Wier, 1990; Habib and Ljungqvist, 2001; Schenone, 2004). One way to analyze a firm's leverage is to look at the debt-to-capital ratio. Although a high leveraged firm intuitively may suggest a higher risk leading to higher uncertainty, the ability to secure debt financing is claimed to be a sign of quality due to the difficulty for firms to secure debt financing. A higher leveraged firm should therefore indicate higher quality, lowering the uncertainty among investors. Consequently, we expect that the debt-to-capital ratio should correlate *negatively* with the degree of underpricing as the ex-ante uncertainty is lowered when a firm can showcase a higher degree of leverage. Hypothesis 4 is therefore formulated:

Hypothesis 4:

IPOs with a higher degree of debt-to-capital ratio are less underpriced as compared to IPOs with a low debt-to-capital ratio

Hypothesis 1 is dependent on the Private Equity-firm signaling the quality of the issuing firm. However, should the Private Equity firm use the IPO as an exit strategy, the reliability of this signaling could be impacted negatively as implied by Folus and Boutron (2015). We believe that a PE-firm selling off its shares could signal a potential misbelief in the firm and its future capabilities, rather than merely showcasing the private equity firms willingness to reap potential profits. Because of the general lack of popularity of exiting through an IPO as compared to other exit alternatives, a Private Equity exit through an IPO could intuitively indicate a lower quality in the issuing firm, raising the uncertainty surrounding the issuing firm. Therefore, in line with the suggestion that higher uncertainty results in higher underpricing, we expect that Private Equity-firms exiting their position as a shareholder will result in a need for higher underpricing compared to the examples where the Private Equity-firm remains a shareholder. As such, hypothesis 5 is formulated:

Hypothesis 5:

The decision by a private equity firm to exit as shareholder in connection to an IPO has an effect on the degree of underpricing

Size has been a popular metric to use in previous research when looking at company specific characteristics that can explain underpricing (for example Ritter, 1984). In line with Bergström *et. al*'s (2006) intuition that private equity backed firms receive more attention, leading to lower underpricing as a cause of a lowered information heterogeneity, we argue that large companies going public are to be viewed on an equal manner. Intuitively, larger IPOs should draw more attention than smaller IPOs, which could have a positive effect on reducing the information asymmetry between informed and uninformed investors due to a wider public spread of information. This was true when Bergström *et al* examined IPOs in the European market. Hence, should this also be true for IPOs in Sweden, the results in this study should correlate positively with hypothesis 6:

Hypothesis 6:

Large companies going public are less underpriced than small companies

Lastly, one parameter that can not be neglected is the previous findings regarding hot and cold markets by Ibbotson and Jaffe (1975) and Ritter (1984). While the literature does not seem to find consensus regarding the explanation, the existence and corresponding effects to IPO underpricing is well established. Hence, we expect to find results in our data sample that support the theory that periods of large volume of firms going public are correlated with a higher degree of IPO underpricing. However, due to the overwhelming empirical evidence for this phenomenon, IPO year will not be included in our hypotheses but instead used as a control variable when testing our other theories.

All of the above mentioned hypotheses will, when applicable, be tested separately for private equity-backed firms and non-private equity-backed firms by isolating the sample into two groups. This is in order to analyse potential differences in the explanations for underpricing between the two groups, in accordance with the questions at issue.

3.0 Methodology

In this part we will go through the methodology used in this paper. It includes the research approach and how data has been gathered. Further, it includes definitions of private equity, underpricing and variables used in the research. Additionally, we will go through the different tests that have been conducted including Satterthwaite-Welch t-test and Ordinary Least Square regression. Lastly the method used has been discussed by the authors.

3.1 Research Approach

The paper has been conducted according to a *deductive research approach*, which means that the paper focuses on selected areas and theories to formulate and test different hypotheses to either confirm or reject them. The focus has primarily been on hypothesis testing of different financial variables that could have an effect on uncertainties in IPO pricing and, hence, lead to underpricing. Further, these tests originate from previous findings within the field and existing theories of factors that might lead to situations with asymmetric information between stakeholders in an IPO. The deductive research approach is favourable in certain aspects because the paper focuses on data-based observations in conjunction with studies that are affected by interpretation or subjectivity. (Bryman and Bell, 2017)

Figure 1. The deductive process

Bryman and Bell (2017)

3.2 Data Gathering

The main source used for gathering quantitative data for the IPOs and the variables that have been used to analyse the data set is Bloomberg. Through the Bloomberg terminal it is possible to gather all historical data for offer to 1st close performance for the selected time frame. Further, Bloomberg

classifies the IPOs according to industry and type of IPO (for example a private equity-backed IPO). It is also possible to gather all company-specific data that will be used as explanatory variables in the regressions and the analysis that will be conducted in this paper. Bloomberg Terminal has approximately 325 thousand users and is the market leading software (approximately 33% market share) for data in the finance industry (Bloomberg, 2020).

In order to answer our question at issue, we looked at the Swedish stock market, in the time frame of 2009-2018. The timeframe has been chosen to avoid different severe economic downturns such as the financial crisis in 2008, as this is a factor that can affect the comparability (Bergström, Grubb and Jonsson, 2007). The Swedish stock market indices reached its bottom during the autumn of 2008, why 2009 has been chosen as the starting year for the study (Bloomberg, 2020). The end date of 2018 was chosen as the full year data for 2019 was not published yet at the start of the study period. The Swedish PE market is the third largest in the world in terms of relation to GDP, behind the UK and US (Bergström *et. al*, 2007). Given the already extensive research published on the UK and US, the Swedish market is considered to be a highly relevant market due to a research gap in the subject of choice, whilst providing a sufficient number of data points during the time frame. For this research 194 non-Private Equity -backed IPOs in Sweden and 84 Private Equity-backed IPOs will be analysed. Further, all stock exchanges in Sweden have been considered in the data sample. While there may exist legal differences between the exchanges which might affect the information asymmetry, including all exchanges provides the data set with strengthening characteristics as well. First of all, it provides the data set with a larger number of observations, which helps the analysis to reach statistically significant conclusions. Secondly, the secondary exchanges generally include smaller-sized companies in comparison to the main list. This provides the data set with a wider range of company sizes, which aids the analysis of the chosen market capitalization variable.

The screening criteria have been selected to reflect a reliable data sample without decreasing the amount of data points to a level that leads to a statistically insignificant number of IPOs. The following criteria has been used:

- **Region/Country:** Sweden, all exchanges
- **Industries:** All, excluding Utilities
- **Offer type:** Initial Public Offering
- **Status of company:** Only active companies

- **Time frame:** 2009-2018

We have gathered data for the offer price (i.e. the IPO price that is decided before the first day of trading), share price performance from the offering to the first day close. This data has also been divided into categories such as size to illustrate the distribution or concentration towards specific groups. Only active firms (i.e. excluding delisted companies) are included in the data set.

3.3 Definition of Private Equity-Backed IPOs

The paper has used Levis' (2011) definition of private equity-backed IPOs to classify the data set. Levis (2011) defines private equity-backed IPOs as an initial public offering where a private equity firm is the largest shareholder (number of shares) at the point of the IPO. To identify these, Bloomberg has been used to categorize these IPOs according to the definition mentioned above.

Therefore, the definition according to Levis has been used which means that IPOs where either a venture capital firm or a later-stage private equity firm was the largest shareholder before the IPO are included. The authors have not chosen to divide late-stage and early-stage firms into separate groups, but have instead chosen to categorise all of them as *"private equity-backed IPOs"* or *"PE-backed IPOs"* while the counterparty is defined as *"non-private equity-backed IPOs"* or *"non-PE-backed IPOs"*. This is because the scope of the paper includes the evaluation of the effect of all kinds of professional investment firms (focusing on private investments) on the IPO-underpricing, not only the sub-group "venture capital". This definition is also aligned with the definition Baker *et. al* (2015) uses. Here, private equity is defined as a collection of several investment strategies stretched over several asset classes with two of the main strategies being buy-outs and venture capital.

When defining if an IPO is backed by a venture capital firm/private equity firm there are some difficulties due to a lack of public information before an IPO. This is discussed by Levis (2011). One problem that will be avoided in this paper is when it is hard to differentiate a private equity fund from an early stage venture capital fund due to the fact that investment firms can have a mix between a variety of funds during the same firm. The reason why this problem is avoided in this

paper is because it analyses all types of private equity-backed IPOs (including more early-stage venture capital funds) and compares it with non-private equity-backed IPOs, rather than comparing early-stage investors to later stage private equity investors.

3.4 Definition Dependent Variable - Underpricing

Ljungqvist (2007) defines IPO underpricing as "the percentage difference between the price at which the IPO shares were sold to investors (the offer price) and the price at which the shares subsequently trade in the market."

Therefore we have chosen the metric that is called "Offer to 1st close" which uses the same definition as mentioned above. The equation is illustrated below.

$$Offer\ to\ 1st\ close\ return = \frac{p(first\ close) - p(offer\ price)}{p(offer\ price)}$$

In this formula, p(first close) is the share price at close on the first day of trading after the IPO and p(offer price) is the offer price (i.e. the price which the IPO is priced at by the underwriters).

Further, according to Lundqvist (2007), there might be market movements between the time when IPO price is set and the first day of trading that could affect the observed underpricing. This would then mean that there might be situations where such an adjustment needs to be made to avoid situations where the data set is not as accurate as it should be. However, in the U.S. and increasingly in Europe, the offer price is typically set just hours before trading on the stock market starts. Hence, the market movements between pricing and trading are negligible and therefore usually ignored. This is therefore something which will be ignored in this paper due to there being no substantial delay between pricing and trading in Sweden.

3.5 Explanatory Variables

In this part, the authors will present the variables used in the paper and what equation that has been applied to define these. While the size-related variable "market capitalisation" has been transformed into the logarithm of market capitalisation to improve the distribution and all variables have been winsorized because of the same reason. All this increased the normal distribution and linearity of the model and henceforth increased the reliability of the OLS-regression.

(1) Net Income Margin

Previous research has concluded that overvalued IPOs are characterized by lower EBITDA profit margins, among other variables. This paper has researched the net income margins as a control variable for measurement of the profitability according to the equation presented below. Because the measurement of profitability has, by previous research conducted by Purnanadam and Swaminathan (2004), showed a strong relationship with underpricing, the variable will be used as a control variable.

$$Net\ income\ margin = \frac{Net\ income\ after\ taxes}{\text{Revenue}}$$

(2) Market Capitalisation

When analysing market capitalisation, we have looked at the value for each company at the IPO-day, defined as price per share multiplied by the number of shares. Size is a variable that has been analysed in previous research and it has also been defined in different ways (market capitalisation, sales etc.). In previous research conducted by Ritter (1984), the author used LOG sales as the explanatory variable to represent size for underpricing. In this paper, we wish to contribute further upon this subject by looking at size in terms of market capitalisation and analyse the potential differences looking at the metric for PE/non-PE-backed IPOs.

$$Log(market\ capitalisation) = Log(price\ per\ share\ x\ number\ of\ shares\ outstanding)$$

(3) Debt-to-total capital ratio

This metric measures the total amount of debt divided by the total value of assets in each company, these values are based on the balance sheet book values. As it has been previously noted by Levis (2011), the debt-level can have a significant impact on the operating performance on a company, and therefore also the uncertainty and underpricing. This paper has used the definition illustrated below to measure leverage and its potential effect on underpricing:

$$Leverage\ (debt\ to\ total\ capital) = \frac{Total\ debt}{\text{Total assets}}$$

(4) Institutional shares purchased in the IPO

Rock (1986) states that underpricing is a tool to get uninformed investors to participate in IPOs. At the same time, informed investors have paid a price to get a hold of this information which creates an opportunity to get compensated through participating in attractively priced IPOs. Given the assumption that institutional investors are considered to be a more informed investor among the market players, an IPO with several institutional investors should aggravate the winner's curse problem as described by Beatty and Ritter (1986). This means that Beatty and Ritter theorizes that the extent to which institutional investors participate in an IPO could have an effect on the dependent variable, underpricing. Therefore, the authors in this paper have defined the following variable:

$$Instituational\ ownership\ inflow = \frac{Number\ of\ shares\ purchased\ by\ institutions\ in\ IPO}{Total\ amount\ of\ outstanding\ shares}$$

Institutional ownership inflow has been measured as a share of the total shares outstanding at the IPO date. This means that the metric illustrates how much of the total shares outstanding that is purchased by institutional investors in the IPO.

3.5.1 Dummies

(1) Lock-up or not

When looking at this metric, the authors have categorised the companies with either the number 1 or a 0. Companies categorised as number 1 include all IPOs where the current owners before the IPO have limitations in their ability to sell a part or their whole holding in the company within a specific time frame. IPOs classified as a 0 include companies with owners that have no limitations regarding selling of shares, and can in theory sell all their shares on the first day of trading. The reason why this variable was included as a dummy and not a continuous variable is because the goal is to illustrate whether or not lock-ups in general increase certainty among investors, which is why the number of lock-up days become less relevant.

1 = Significant shareholders before the IPO is <u>not allowed</u> to sell parts or all of their shares within a specific time frame

0 = Significant shareholders before the IPO is <u>allowed</u> to sell parts or all of their shares at any point in a specific time frame

(2) PE-Exit or not

The second dummy has only been applied to the regression including PE-backed IPOs exclusively. The PE-backed IPOs have been classified with a 1 if the private equity firm backing the IPO has chosen to exit the company as a shareholder as a result of the IPO. PE-backed IPOs classified with a 0 include all IPOs where the private equity firm backing the IPO has remained as a shareholder in the company after the IPO.

1 = PE-backed IPOs where private equity firm backing the IPO has <u>exited</u> as a shareholder through the IPO

0 = PE-backed IPOs where private equity firm backing the IPO has <u>remained</u> as a shareholder after the IPO

(3) IPO-year

The last dummy has been proven to explain underpricing in previous research Ritter (1984) states that years with an unusually high volume of IPOs are often characterised by serious underpricing. This paper will include the IPO-year as a control variable as "hot" markets have been proven to have an effect on IPO underpricing by a significant amount of previous research. As a reference year, the last year (2018) has been used. The most common reference year is usually the first year but as there were only a limited amount of data points for that specific year, 2018 was used instead.

3.6 Test of Difference in Underpricing

To assess if there are any differences in underpricing between private equity-backed IPOs and its counterpart, a *Satterthwaite*-Welch's t-test has been applied. This type of t-test is suitable in this case as the means are from two independent populations. Further, the equation below is suitable when the variances are not equal, which is the case in this paper (Yuen, 1974).

$$t = \frac{X_1 - X_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

In the equation above, the *X* represents the average offer to 1st close performance, the *s* represents the standard deviation and the *N-value* represents the number of observation.

3.7 Test of Explanatory Variables for Underpricing - Ordinary Least Square (OLS)

A regression model has been used to assess and analyse our data sample from 277 firms that went public between 2009-2018. A regression model is usually used to explain and evaluate the relationship between the chosen variables (see below). The variables are categorised as stochastic or non-stochastic where the first one means that a value is randomly derived while non-stochastic variables are the opposite. The variables that are considered stochastic have been categorised as dependent variables and its counterparty has been categorised as independent. This paper will use

the Ordinary Least Square (OLS) method as this is one of the most established methods for regression models (Brooks, 2014). This model also includes the level of significance in the output generated, allowing us to present, analyse and discuss the level of significance of the findings.

This report will conduct four different OLS-regressions. The first regression will include all observations and is the only regression including a "PE or no PE-firm dummy". This is to further confirm or reject the hypothesis if there is a difference in underpricing between non-PE and PE-backed IPOs. The second regression will only include non-PE-backed firms which then has been compared with the third OLS-regression that only includes PE-backed IPOs with the same explanatory variables. The fourth and last regression only includes PE-backed IPOs but with the additional variable, "*PE-exit or not*". This variable has been included to assess whether or not a private equity firm's decision to remain or exit as a shareholder connected to the IPO has any impact on the level of underpricing. Therefore, the fourth regression will only be used to evaluate that specific variable as it is not comparable to the other regression models.

Table 1. Overview of OLS-regression variables

All observations	Non-PE-Backed	PE-backed	PE-backed with PE-exit/no exit
Net income margin	Net income margin	Net income margin	Net income margin
Market capitalisation	Market capitalisation	Market capitalisation	Market capitalisation
Debt to total capital	Debt to total capital	Debt to total capital	Debt to total capital
Institutional ownership	Institutional ownership	Institutional ownership	Institutional ownership
Lock-up dummy	Lock-up dummy	Lock-up dummy	Lock-up dummy
IPO-year	IPO-year	IPO-year	IPO-year
PE-backed or not			PE-exit or not

For the OLS-regression model to be reliable, there are certain criteria that should be fulfilled. The model should be linear and the analysed variables should be able to be described in diagrams with a straight line. If the criteria below are fulfilled, the OLS-regression should be reliable without systematic errors (Brooks, 2014).

The following criteria that should be fulfilled are:

A. *The errors should have zero mean: E (u_t) = 0*

The error term describes the variation in the dependent variable which cannot be explained by the chosen independent variable. If the model has an interception in the y-axis, this criterium is considered to be approved (Brooks, 2014)

B. The variance of the errors is constant (homoscedasticity): Var (u_t) = $\sigma^2 < \infty$

If the variance of the errors is constant, homoscedasticity is achieved. If it is not achieved, the variance that is not explainable in the dependent variable is affected by changes in the independent variable.

C. The covariance between the errors (cross-sectional) equal zero: Cov (u_i, u_j) = 0

The error terms should not be auto-correlated in regards to time. In this paper, cross-sectional data is used which means that there is no need to test for autocorrelation (Brooks, 2014)

D. There is no relationship between the error and corresponding x variable : Cov (u_i, x_i) = 0

If all of the above is fulfilled, the independent variables do not need to be non-stochastic for the OLS to be relevant (Brooks, 2014). Further, this criteria is difficult to address in cross section samples but will instead be taken into consideration when analysing the results.

E. Explanatory variables should not be very highly correlated

Multicollinearity is when two or more explanatory variables in a regression model are correlated with each other to a very high extent. Some correlation is inevitable, but it becomes problematic when full multicollinearity exists (Brooks, 2014).

F. The errors should be normally distributed: N(u_t)

The underlying data should be normally distributed (Brooks, 2014).

To be able to assess the above mentioned criteria, a number of tests have been done according to what Brooks (2014) considers to be the most suitable ways of analysing potential flaws in the OLS. In this paper linearity has been tested through a Ramsey RESET test which is considered to be suitable when multiple independent variables exist. Homoscedasticity will be tested with White's T-test which is a suitable way of testing if the variance of the errors is constand. To investigate whether or not variables are very highly correlated or not, a correlation matrix has been analysed. Lastly, to examine if the errors are normally distributed, a Jarque-Bera test has been used. These tests are considered to ensure the validity of the study.

3.7.1 Regression Model

Following the above mentioned dependent variable, independent variables and criteria that should be fulfilled, the four different regression models are described in detail below.

OLS-Regression 1: All observations

$$R_i = \beta_0 + \beta_1(\text{Net income margin}) + \beta_2(\text{Market capitalisation}) + \beta_3(\text{Debt to total capital}) + \beta_4(\text{Institutional shares purchased in IPO in relation to total shares}) + D_{(\text{Lock-up [Yes/No]})} + D_{(\text{IPO-year})} + D_{(\text{PE-backed or not})}$$

In this regression model, underpricing (offer to 1st close return) is the dependable variable. The independent variables are (1) Net income margin, (2) Market capitalisation (SEKm). (3) Debt to total capital ratio, (4) Institutional shares purchased in IPO in relation to total shares outstanding. Further, the dummies used are (1) Lock-up (if owners are in any way prohibited to sell parts or all of their holdings within a time frame), Additionally the dummy (2) IPO-year is included. Lastly, the dummy categorising if the IPO is (3) PE-backed or not is included analysing if private equity-backed IPOs show a difference in underpricing compared to non-PE-backed IPOs . This model has not been compared to the other regressions as it contains an additional variable, affecting comparability.

Following this the second and third model will be constructed according to the equation illustrated below:

OLS-Regression 2 and 3: Comparing non-PE-backed and PE-backed

$$R_i = \beta_0 + \beta_1(\text{Net income margin}) + \beta_2(\text{Market capitalisation}) + \beta_3(\text{Debt to total capital}) + \beta_4(\text{Institutional shares purchased in IPO in relation to total shares}) + D_{(\text{Lock-up [Yes/No]})} + D_{(\text{IPO-year})}$$

The model above will be used to compare the non-PE-backed with the PE-backed IPOs and is

identical for the two groups. It does not, in comparison to the two other models, include any variables that are specific to one or the other IPO group which will enable comparability.

Lastly, the third model only looking at PE-backed IPOs is presented below:

OLS-Regression 4: Only PE-backed IPOs

$$R_i = \beta_0 + \beta_1(\text{Net income margin}) + \beta_2(\text{Market capitalisation}) + \beta_3(\text{Debt to total capital}) + \beta_4(\text{Institutional shares purchased in IPO in relation to total shares}) + D_{(\text{Lock-up [Yes/No]})} + D_{(\text{PE-exit or not})} + D_{(\text{IPO-year})}$$

This model includes the dummy PE-exit or not (if the private equity firm chooses to remain or exit as a shareholder through the IPO). This dummy is only applied for a separate regression when looking at this specific variable, as it cannot be compared to non-PE-backed firms.

3.8 Discussion of method

3.8.1 Classification of IPO Groups

In chapter 3.3 the definition of private equity-backed firms presented. The definition used in this paper is likely to have an impact on the results when compared to similar research that are using other possible definitions. Consequently, results are expected to differ to a certain degree when comparing this paper with previous research conducted in the same area.

Further, the authors have not chosen to consider the potential legal differences that might affect the underpricing that could occur between different financial markets in Sweden. This means that one stock exchange might have different regulatory requirements than another in Sweden - which in turn can have an effect on the output. This is a limitation in the paper that should be considered.

3.8.2 Choice of Explanatory Variables

In this paper, the authors have chosen a number of variables to analyse if private equity-backed IPOs are less underpriced and the reasons behind such a phenomenon. This means that there might be relevant variables being left out which means that it is hard to include all possible reasons to why the observations made look in a certain way. Adding to that, there were missing data points to some of the variables for specific companies which means that the regression model excluded some data points. This must be considered when interpreting the results in this paper as the results might have differed if all the companies had public available data for all the explanatory variables.

Additionally, when looking at the IPO year as an explanatory variable the regression demands that one year is set as reference year. In this paper 2018, i.e. the last year, has been used as a reference point. The most common method is to use the first year as reference but as there were only a limited amount of data points for the first year, 2018 was used instead. The consequence for this is that the results might differ from the output that would have been generated with another reference year. This is something that should be considered in the paper and the presented results.

Further, the authors had to exclude some variables that would have been interesting to analyse. One of these variables was "Offer size" which shows how much capital a company raises in an IPO. This variable was excluded because it correlated to a large extent with other size metrics such as *market capitalisation*. This would have been an alternative way of analysing how the size of the offering affects underpricing but as it was not included the paper is limited to one size-related metric in this paper, *market capitalisation*.

3.8.3 Sample

As mentioned above, the sample has been gathered from Bloomberg and only includes IPOs that entered the public market in Sweden since 2009. This means that there might be flaws in the data as there is a risk that the database has left out data points that would have been included if the data had been gathered from another platform. To minimize this risk, the authors have chosen to do sample tests of data from other platforms such as CapitalIQ which have shown that the information gathered from Bloomberg is most likely complete and includes no or a very few flaws.

As this paper is only based on data from Sweden, the results are not applicable for private equity-backed vs. non-private equity-backed IPOs in other geographies. The results in this study could be affected by geography-specific factors that do not exist in other countries.

3.8.4 Reliability

Data gathering has been performed in the Bloomberg terminal. Bloomberg is a well-renowned and broadly used quantitative database, with 325,000 users implying a ~33% market share in the finance industry (Bloomberg, 2020). Since the data is received by a widely-used database in the professional industry, the data set is considered to be of high quality. An alternative, should the data set not have been complete, could have been to add missing data points from company filings or other academically accepted databases. This was not deemed to be necessary, as the data set was complete from the Bloomberg terminal. A new study aimed towards the same purpose should therefore come to similar conclusions as will be the case in this study.

3.8.5 Analysis of Participation Biases

Apart from limiting the study to a specific time frame (2009-2018), it only includes IPOs in Sweden. This means that the results in this paper cannot be generalised for PE- and non-PE-backed IPOs across different geographies, as all of them except Sweden are excluded. As mentioned in 3.9.1, the classification for private equity-backed IPOs used in the paper might also lead to biases that could alter the results presented in comparison with previous research using another definition.

Additionally, only active firms are included in the paper. This means that there might be a risk for misspecification called “survival-related bias” that can occur when failing firms are not included in the analysed data (Pukthuanthong, Roll and Walker, 2007). This means that lower-quality companies that fail to survive will not be included in the results, which in turn might lead to misleading conclusions. On the other hand, the amount of inactive companies is assumed to be a smaller part of the total sample, which might decrease the level or misspecification.

Further, there might be relevant differences between PE- and non-PE-backed companies that are not accounted for in the model. This means that the paper could miss out on significant insights in factors affecting underpricing and differences when comparing PE-backed IPOs with non-PE-backed ones. One the other hand, this problem is partly avoided by using two separate models.

Lastly, companies within the industry sector “utilities” have been excluded. The reason for this is that the amount of companies was marginal and because the companies typically have a different financial structure than companies in other industries. An example of this could be a generally high amount of leverage which was confirmed in the data set, something that might lead to misrepresentations in the regression. Financial firms are, however, included in the paper. This is considered to be motivated as there were a high amount of data points within that industry which means that leaving them out would significantly decrease the amount of observations.

4.0 Data Sample and Variables

In this part, the data set used in the paper is presented. In the first part, an overview of the data sample is presented and how the underpricing differs between the two groups. The data points are also divided into groups based on explanatory variables.

4.1 Summary of Data Sample

The data sample contains 194 Non-PE-Backed IPOs and 83 PE-backed IPOs. This sample was collected according to the screening criteria. During the selected time period (2009-2018), approximately SEK 16.7bn was raised through initial public offerings where the majority was raised through PE-backed IPOs. PE-backed IPOs represent 30% of the total sample size based on the number of observations. Further, the average offer to 1st close performance for PE-backed IPOs was 3.1% while the Non-PE-Backed IPOs performed an average positive return of 9.9% from the offering to the first close. The PE-backed IPOs typically consist of larger companies in comparison with non-PE-backed IPOs, something that is further illustrated in Table 3.

Table 2. Overview on IPO data sample

Category	Total number (#)	Share of total	Avg. offer to 1st close return
PE-backed	83	30%	3.1
Non-PE-Backed	194	70%	9.9
Total	**277**	**100%**	**7.9**

4.2 Data Sample for Explanatory Variables

4.2.1 Profit Margin (Net Income Margin)

The net income margin for the data sample showed large variations within the two groups (non-PE-backed IPOs and PE-backed) but also differed when comparing the two groups with each other. The data sample for non-PE-backed IPOs ranged from unprofitable companies to companies with a net income margin of up to 60%. For PE-backed IPOs the profit margin ranges from unprofitable companies to data points showing a profitability of approximately 67%.

4.2.2 Market Capitalisation

The two groups differ significantly in the average market capitalisation and PE-backed IPOs are, based on the data sample, larger when looking at the metric. Market capitalisation is defined as the total value of a company's shares on a stock market (Cambridge Dictionary, 2020), also defined in part 3.5. The average market capitalisation is approximately 2.9 times larger for PE-backed IPO, which also has a higher standard deviation based on the data sample.

Table 3. Market capitalisation based on group

Category	Total number (#)	Average market cap.	Standard deviation
PE-backed	83	2 858,5	4 416,5
Non-PE-Backed	194	977,7	2 589,1
Total	**277**	**1 598,9**	**3 412,8**

4.2.3 Debt-to-Total-Capital Ratio

As illustrated below, PE-backed IPOs experience a higher average debt-to-capital ratio compared to non-PE-backed IPOs. The residual between the two groups is approximately 5.2 percentage points and the standard deviation in the two groups are 23.4 for PE-backed and 20.6 for non-PE-backed IPOs.

Table 4. Average debt-to-total-capital based on group

Category	Total number (#)	Avg. debt/total capital (%)	Standard deviation
PE-backed	83	22,1	23,4
Non-PE-Backed	194	16,9	20,6
Total	**277**	**18,6**	**21,6**

4.2.4 Institutional Inflow

Institutional inflow/outflow of shares is the amount of shares purchased by institutional investors in the IPO. This has been put in relation to the total amount of shares to illustrate how large a share of the total outstanding shares that is purchased by institutions in the IPO. As illustrated below, there is no major difference between the two groups when looking at this metric. PE-backed IPOs experience a slightly larger institutional inflow compared to non-PE-backed (18% compared to 16%). Standard deviation is 22 percentage points and 23 percentage points respectively.

Table 5. Average institutional inflow/outflow of shares in IPO in relation to total shares outstanding

Category	Total number (#)	Instit. inflow/total shares	Standard deviation
PE-backed	83	18%	22%
Non-PE-Backed	194	16%	23%
Total	**277**	**17%**	**23%**

4.2.5 Dummy — Lock-Up or No Lock-Up

IPOs with a lock-up period include all the offerings where certain stakeholders (company management for example) cannot sell shares during a specified time period. In the data sample lock-up periods ranging from 90 to 750 days have been identified with the majority of the IPOs with lock-up having time periods ranging from 180 to 365 days. PE-backed IPOs have the largest share of IPOs with lock-up periods — 84 % of the IPOs. For Non-PE-Backed IPOs, this number is approximately 62 %.

Table 6. Number of IPOs with and without lock-up period based on group

Category	Total number (#)	# of IPOs with lock-up	# without lock-up
PE-backed	83	70	13
Non-PE-Backed	194	121	73
Total	**277**	**191**	**86**

4.2.6 Private Equity-Specific Dummy — Exit or No-Exit

In the table below, IPO data is presented showing if the private equity firm chose to make an "exit" in connection to the IPO (i.e. sell all or a portion of its shares in the company) or remain with all of its shares after the IPO. The data set is divided into two groups: one where the private equity firm remained their full ownership after the IPO and one where a firm decided to make an exit.

Table 7. Exit / No-Exit IPO

Category	Total number (#)	Avg. 1st day performance	Standard deviation
Exit at IPO	39	10,1	12,2
Remaining as shareholder	44	-3,2	20,4
Total	**83**	**3,1**	**18,2**

4.2.7 Dummy - IPO Year

As illustrated in Table 8, the vast majority of IPOs are concentrated in the years 2014 to 2018, as well as in 2010. This is true for both of the groups included in the data sample, except for the outlying year 2010. The largest number of total IPOs was in 2017, which is also the year where the number PE-backed IPOs was the largest. For non-PE-backed IPOs, 2016 was the year with the most public offerings. During the last 4 years, where the majority of the IPOs took place, there is also a large discrepancy between the average underpricing between non-PE-backed and PE-backed IPOs. Further, the underpricing is largest in 2009 and 2013 where the number of IPOs were a small part of the total number. However, as illustrated, there are only a few number of observations during these two years.

Table 8. Number of IPOs and offer to 1st close performance, based on year and group

Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
# of PE-backed IPOs	0	1	1	0	0	5	16	17	31	12
# of Non-PE-Backed IPOs	2	22	8	6	3	9	25	53	50	16
Total	**2**	**23**	**9**	**6**	**3**	**14**	**41**	**70**	**81**	**28**

Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Avg. offer to 1st close - PE-backed IPOs (%)	N.A	-0.6	2.8	N.A	N.A	10	9.6	2.6	0.5	-0.5
Avg. offer to 1st close non-PE-backed IPOs (%)	33.1	12.4	14.7	-7.8	41.8	4.9	13.5	6.8	12.6	1.0
Total	**33.1**	**11.8**	**17.5**	**-7.8**	**41.8**	**14.9**	**23.1**	**9.4**	**13.1**	**0.5**

5.0 Results and Analysis

In this chapter, the results generated from the Satterthwaite t-test and OLS regression are presented and analysed using the theoretical foundation of the paper as well as previous literature. The chapter begins with presenting the results of the tests to measure differences in private equity and non-private equity-backed IPOs, before comparing the results generated for each variable included in the OLS between the two samples. The chapter ends with a summary of the results connected to the paper's hypotheses.

5.1 Satterthwaite-Welch t-test Result

In order to answer the first hypothesis regarding whether private equity-backed firms are less underpriced than their counterpart, two different tests have been conducted: a Satterthwaite-Welch t-test and an OLS regression using the full sample of PE-backed and non-PE-backed firms. For the results of the OLS regression, see chapter 5.3

The Satterthwaite-Welch t-test was performed to establish whether there is a difference between underpricing of PE-backed and non-PE-backed IPOs. The result was statistically significant, in a 95% confidence interval. We therefore come to the conclusion that the level of underpricing differs between IPOs performed by PE-backed companies and non-PE-backed companies. However, this only shows that there is a difference in underpricing between the two groups - the underlying reasons for this result is not established through the t-test.

Table 9. Result - Satterthwaite-Welch t-test

Method	df	Value	Probability
Satterthwaite-Welch t-test	2633,69	2,165	0,0337**
Welch F-test	-1263,69	4,558	0,0337**

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level.

The underlying factors that might contribute to the underpricing in non-PE-backed IPOs and PE-backed IPOs will be further analysed in combination with the OLS-regressions in 5.3.

5.2 Ordinary Least Squares Results

The results in the OLS-regressions further confirms the results in the Satterthwaite-Welch t-test, that PE-backed companies are less underpriced compared to non-PE-backed companies.

Regarding the explanatory variables, an accumulated overview of explanatory variables is illustrated in Table 10. The results imply that some of the variables have an effect on the IPO-underpricing. Firstly, the variable *market capitalisation* shows significance on the 1%- level for non-PE-backed firms and on the 10 % level for PE-backed firms. Worth noticing is that the coefficient was positive, which means that the larger the company is, the higher the underpricing. Secondly, the *debt-to-capital*, determining how leveraged the companies were at the time of the IPO, showed significance in the regression and had a negative relationship to underpricing, in line with our expectations. Thirdly, the control variable *IPO year* shows significance for the year 2017 on a 5%-level and for 2016 on the 10%-level. Both years had positive coefficients.

Most notably, when overviewing the results from the regression made on PE-backed IPOs in isolation *(see Appendix 2D)*, the variable looking at whether PE-firms chose to remain as shareholders after the IPO and those that chose to exit, is the variable with the highest coefficient and statistical significance for underpricing. However, this was with a p-value of 0.066, meaning that this is not an explanatory factor of the same credibility as those earlier highlighted, yet still highly relevant to discuss.

All of the variables will be discussed and analysed more in depth in section 5.2.3.

Table 10. Overview of OLS regression results: Non-PE-Backed Firms and PE-Backed firms excl PE-Exit

OLS Regression results		
Variables	Sample	
	Non-PE-Backed Firms	**PE-backed firms**
Constant	-17,833	-21,369
	11,7600	*10,7165*
Profit margin	0,0011	-0,0007
	0,0009	0,0009
Debt to capital	-0.2937***	0,0747
	0,1028	*0,1420*
Institutional ownership	4,8689	12,5405
	15,109	*11,083*
Lock-up or not	-2,9179	-0,3856
	7,4691	*6,0441*
LN market cap	4.6003***	0.3254*
	1,3384	*1,9351*
IPO year 2009	35,0690	N.a.
	21,890	*N.a.*
IPO year 2010	10,9490	-3,2535
	11,321	*6,1559*
IPO year 2011	8,3690	-2,9138
	19,373	*7,0278*
IPO year 2012	16,5710	N.a.
	10,952	*N.a.*
IPO year 2013	27,4910	N.a.
	21,949	*N.a.*
IPO year 2014	-1,9521	-1,6246
	11,383	*7,3219*
IPO year 2015	4,6703	5,3265
	7,9400	*6,2017*
IPO year 2016	12.3555*	7,4362
	7,0465	*6,4286*
IPO year 2017	15.7739**	4,4999
	-7,563	*6,1174*
# of observations	120	66
R2	0,1707	0,1413
Adjusted R2:	0.0602	-0,033

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level.

First row showing coefficient. Second (italic) row showing standard error.

However, before each variable can be discussed in depth, the reliability of the regression results are worth noticing. The OLS-regressions have an R^2 ranging between 0,14 and 0.19, and an adjusted R^2 ranging between 0.07 to -0.03 respectively. This should be considered when interpreting the results from the OLS-regression. Furthermore, a diagnostic of the OLS regression is presented below.

5.2.1 Diagnostics of OLS-regression

To test linearity in the regression a Ramsey RESET test has been conducted. For the regression including all observations and the sample including non-PE-backed IPOs the p-value was 0.48 and 0.57 respectively. Moreover, for PE-backed IPOs the p-value was 0.86 and for the PE-regression including PE-exit or not the p-value was 0.49 (see appendix 3A-D). All values are above the 5%-level which means that the null hypothesis is accepted and that the data achieves the criterium of being linear.

To test for homoscedasticity, White's T-test was applied. The value observed for all observations was 0.001, 0.03 for non-PE-backed IPOs and 0.55 for PE-backed IPOs. Lastly, the PE-regression including PE-exit or not dummy had a value of 0.38 (see appendix 4A-D). Hence, the null hypothesis is rejected for two of the tests and accepted for the PE-related model. This means that there are tendencies for heteroscedasticity in some regressions but homoscedasticity among the residuals for PE-backed. To minimize this negative effect, the p-values have been adjusted in the regressions, leading to more reliable results even though homoscedasticity was not achieved for all models.

To evaluate multicollinearity, a correlation matrix has been used (see appendix 5A-D). As illustrated in the matrix there are no signs of very high-correlated explanatory variables which means that there is no problem in this criterium.

Lastly, the Jarque-Bera test has been used to assess whether or not the errors are normally distributed (see appendix 6A-D). The p-value for all observations was 0.005 with a coefficient of 10.5, for non-PE-backed IPOs was 0.02 with a coefficient of 7.8, while the p-value was 0.57 for PE-backed IPOs and 0.68 for PE-backed IPOs including the PE-exit/not dummy. This means that the null hypothesis is accepted for all except for the model including non-PE-backed IPOs and the model with all observations. A reasonable explanation for this could be that the data sample has a high amount of extreme values which could affect the normal distribution. However, the variables have been winsorized and the logarithm of market capitalisation has been used to increase the normal distribution of the variables. This significantly improved the normal distribution and therefore increased the reliability of the OLS-regression.

5.2.2 Differences in underpricing between PE- and non-PE-backed firms

To continue from 5.1, examining if there is a difference in underpricing between PE-backed and non-PE-backed IPOs, an OLS regression for the full sample of 277 IPOs including a PE or not PE-backed variable was conducted. This additional test was done to increase the trustworthiness of the results, as having only one set of coefficients might not highlight the true relationship between the two groups. The full regression model can be seen below.

Table 11. Overview of OLS regression results: All observations including PE or not

OLS Regression results	
Variables	Sample
	All observations
Constant	-15.54777
	8.3549
Pe or Not	-7.9461**
	3.188232
Profit margin	0.0006
	0.0007
Debt to capital	-0.2165***
	0.0803
Institutional ownership	7.4267
	9.793
Lock-up or not	-3.6008
	5.4544
LN market cap	4.1778***
	1.0244
IPO year 2009	32.8545
	20.7293
IPO year 2010	7.5529
	8.430
IPO year 2011	4.9505
	14.4026
IPO year 2012	12.8881*
	7.4193
IPO year 2013	24.5019
	21.2657
IPO year 2014	-2.2715
	7.5397
IPO year 2015	7.2100
	5.3541
IPO year 2016	9.8342**
	4.9799
IPO year 2017	12.435**
	4.839
# of observations	186
R2	0.147
Adjusted R2:	0.071

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level.

First row showing coefficient. Second (italic) row showing standard error.

As illustrated, the variable "PE or Not" is significant with a negative coefficient, implying that PE-backed IPOs experience less underpricing. The coefficient of has a value of -7.9, with a statistically significant p-value of 0.0136. This result, in combination with the results generated in the Satterthwaite-Welch t-test, allows us to conclude that there appears to be a difference in underpricing between PE-backed and non-PE-backed firms. This is consistent with Bergström *et. al*'s (2006) expectations in their previous study of the stock exchanges in London and Paris, where the authors found that the PE-backed IPOs were underpriced by approximately 9.7%, compared to 17.7 % for non-PE-backed IPOs. However, in contrast to their study, the result generated in this paper's regression is statistically significant and has a high negative coefficient value, implying that the presence of private equity has a large impact on the level of underpricing. The differentiating results compared to Bergström *et. al's* (2006) study could suggest that private equity firms in Sweden are more capable of certifying the quality in comparison to other markets, or that the certification effect from private equity as discussed by Megginson and Weiss (1991) and Varma and Szewczyk (1993) has increased in the time gap between the studies.

Since the hypothesis regarding the differences in underpricing between PE and non-PE-backed firms has now been accepted, the results for the other explanatory variables within PE and non-PE-backed firms will be compared and further analysed below.

5.2.3 Results and analysis of explanatory variables

5.2.3.1 Market Capitalisation

As earlier mentioned and illustrated in Table 10, market capitalisation was a significant variable in the OLS-regression. The test showed that the variable is significant on a 1%-level for non-PE-backed firms and on a 10%-level for PE-backed firms. Surprisingly, the relationship between size and underpricing is *positive*, suggesting that the larger the company is, the higher the underpricing, which was in contrary with our hypothesis. Moreover, the coefficient has a rather large value of 4.6 for non-PE-backed firms, suggesting that the size of the firm has a large effect on the degree of underpricing. For PE-backed firms, the value of the coefficient is significantly lower however, showing that size has lesser impact on the underpricing of PE-backed firms.

Size was one of the company specific metrics that previous research conducted by Ritter (1984), Boulton *et. al* (2011) and Bergström *et. al* (2006) included. Bergström *et. al*'s results showed a statistically significant negative relationship in the London exchange, with a coefficient of -4.782. Hence, the results for size in this study is in sharp contrast to the results in previous research. Potential reasoning for this is discussed below.

Table 12. Overview of results on market capitalisation

Variable	Sample	
	Non-PE-Backed Firms	**PE-backed firms**
LN Market Cap	4.6003***	0.3254*
	1.3384	*1.9351*

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level.
First row showing coefficient. Second (italic) row showing standard error.

In the hypothesis, it was argued that a larger company could either provide a quality-stamp or, in-line with Berström *et. al's* arguments, attract more interest in the IPO. This would then mean that the uncertainty among investors is reduced or that the information heterogeneity decreases with more participants analysing the company. However, the results in this paper implicate the opposite. Theories that could explain the results presented is the signaling theory established by Allen and Faulhaber (1989) and the further additions made by Habib and Ljungqvist (2001). Allen and Faulhaber argue that high quality firms are incentivized to underprice their issues in order to signal their quality. On the other hand, as Habib and Ljungqvist claims, this will only be done when the marginal cost of reducing uncertainty outweighs the benefits. The high level of underpricing amongst large companies in Sweden may therefore imply that there are few tools for large companies in Sweden to signal quality, or that most of these do not have the high enough marginal benefit of lowering uncertainty compared to the costs. Consequently, large companies in Sweden are left with no other options than to lower their issuing prices in order to signal quality. Private equity may, however, be one of the viable tools allowing larger firms to signal their quality. This would explain the differences seen in the coefficients between the two groups. As such, differences in size does not have the same impact on the underpricing among PE-backed firms, due to a reduced information asymmetry.

5.2.3.2 Debt-to-Capital Ratio

Looking further into the debt-to-capital ratio, we first note that the variable showed a significance on the 1%-level for non-PE-backed companies, while showing no significance at all for PE-backed companies. Further, as illustrated in Table 13, the leverage in terms of total debt in relation to total capital has a coefficient of -0.3. This means that non-PE-backed companies with a lower amount of leverage show a higher degree of underpricing, which is in line with our expectations. This variable is insignificant for PE-backed IPOs as it has a p-value of 0.6.

Even though the metric shows a strong level of significance, the impact on the level of underpricing seems to be rather low as compared to other metrics. The low value of the coefficient, shows that a change in the debt-to-capital ratio - while having an impact - does not seem to have a *large* effect on the level of underpricing amongst non-PE-backed firms.

Table 13. Overview of results on debt to capital

Variable	Sample	
	Non-PE-Backed Firms	**PE-backed firms**
Debt to Capital	-0.2937***	0.0747
	0.1028	*0.1420*

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level
First row showing coefficient. Second (italic) row showing standard error.

The statistical significance that was generated for this metric are considered to be aligned with previous research conducted and theories within this area. Previous research conducted by Habib and Ljungqvist (2001) suggest that leverage is a significant variable affecting underpricing. Further, the research also concluded that the coefficient is relatively low which might imply that the extent to which it affects underpricing is low. This is aligned with this paper's results, which shows a coefficient of 0.3.

Multiple authors including James and Wier (1990), Habib and Ljungqvist (2001) and Schenone (2004) suggest that companies with a high amount of leverage signal high quality due to the companies' ability to secure debt. In other words, companies with a low amount of debt could in some cases be categorised as lower-quality companies as they cannot raise as much debt as firms

that are considered to be of a higher quality. Therefore, our results further implies that debt-to-capital could be a variable that investors find important when looking at IPOs, and that the variable could either increase or decrease uncertainty of the true value of the firm.

The reason why this uncertainty occurs could partly be explained by investors viewing it as a risk that the company might not be able to raise debt from a bank or from the public market - implying that the company is of lower quality. This uncertainty would then, as discussed by Beatty and Ritter (1986) increase the underpricing in the IPO which is aligned with the results in this paper implying a higher underpricing for companies with a low amount of debt. However, given the small negative value of the coefficient, it seems that the level of debt does not have a large impact on said uncertainty.

As this variable did not show any significance for PE-backed IPOs, the results in this paper implies that this metric is not important for investors when looking at that specific group. The reason for this could be that the metric loses its importance when a private equity firm is able to certify the quality. As PE-backed firms tend to have an easier way of securing debt due to private equity-firms' close relationships to credit givers, the quality signaling from a private equity firm having a high debt may not be as credible in the view of investors.

5.2.3.3 PE-Exit or Not

As discussed earlier, a 0.066 significance in the variable "PE exit or not" was found through the OLS-regression of PE-backed firms including the PE exit or not variable *(for the full regression table, see Appendix 2D)*. The regression shows a correlation with PE-exits and a higher underpricing in the IPO.

Table 13. Overview of results on PE-Exit or not

Variable	Sample
	PE-backed firms incl PE Exit
PE Exit or Not	11.5369*
	6.1391

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level

First row showing coefficient. Second (italic) row showing standard error.

This was in line with our hypothesis and our expectations when looking at the descriptive data, presenting that the level of underpricing for PE-backed firms without an exit showed an average of *negative* 3.2 %, as compared to positive 10.1 % for firms with a PE-firm that exited in connection to the IPO.

The results are in line with claims in previous literature. Kaplan and Strömberg (2009) found that exiting through an IPO is the least popular among the common exit strategies in private equity firms. This is likely due to the reasons presented by Folus and Boutron (2015), arguing that the lengthy process combined with regulatory restrictions make other exit strategies more appealing. It is therefore possible that investors view an exit through an IPO as a sign of desperation for the private equity firm, as other strategies instead would have been utilized, if possible. Exiting through an IPO could therefore create uncertainty amongst investors, questioning the motivation for the IPO as an exit strategy.

Folus and Boutron (2015) further claims that the rare scenario of "full exits" in connection to the IPO is due to investors potentially viewing a full exit as a lack of confidence in the future business prospects for the issuing firm. Information asymmetry models would view this as a potential signaling, indicating lower quality of the firm as the certification effect of the private equity firm is significantly reduced as discussed by Megginson and Weiss (1991). Since this paper analysed both partial and full exits in using one variable, the results suggest that both partial and full exits could showcase this effect.

The claims made by Megginson and Weiss (1991) regarding the credibility in the certification effect of private equity further expands upon this argument. First off, reputational aspects are largely important for private equity firms during an IPO process. The IPO process involves a significant amount of publicity, which leaves the PE firm's public reputation at stake should it take a poor firm public, as an underperforming stock could leave a fraudulent perception of the PE-firms value-adding capabilities. With this in mind, one could assume that investors view an exit as a sign of poor firm quality which the private equity-firm does not want to be associated with, due to the associated reputational risk. This would raise the uncertainty of the issuing firm. Another criteria for private equity certification credibility mentioned by Megginson and Weiss (1991), is the commitment to stay invested. Given a private equity firm's decision to exit is in direct contrast to

this assumption, the exit strategy through an IPO, partly or fully, would undermine the certification effect.

Our results therefore suggest that private equity firms exiting through an IPO results in higher underpricing, in line with Beatty and Ritter's (1986) theory.

Lastly, the impact of a PE-exit on underpricing should not be overseen. The coefficient showed a high value of 11.537, which is the largest coefficient among the variables in the isolated sample of PE-firms that includes the PE exit variable. This means that the decision for a PE firm to exit appears to have a substantial effect on the level of underpricing. Consequently, it appears to be of the highest interest for issuing firms to try to ensure that the private equity firm does not choose to exit in connection to the IPO, in order to raise as much capital as possible when going public.

5.2.3.4 IPO Year

First off, as can be seen in Table 14, no significance in connection with IPO year is seen for the PE-backed IPO:s. Looking at the entire data set and non-PE-backed IPOs, there seems to be a positive correlation between underpricing and markets when there have been a large number of IPOs. The years 2016 and 2017 are the periods with the largest number of firms going public, totalling 151 IPOs during the two years. This represents 55% of the total observations of 277 IPOs between 2009 and 2018. As these two years are also the only periods in time showing significance when assessing underpricing, the fact that the data sample is tilted towards those two years could have affected the significance. Both 2016 and 2017 show a positive coefficient, meaning that firms that went public in the mentioned years experienced a higher degree of underpricing in comparison to the benchmark of year 2018.

Table 14. Overview of results divided by IPO year

Variables	Sample	
	Non-PE-Backed Firms	**PE-backed firms**
IPO year 2009	35.0690	N.a.
	21.890	*N.a.*
IPO year 2010	10.9490	-3.2535
	11.321	*6.1559*
IPO year 2011	8.3690	-2.9138
	19.373	*7.0278*
IPO year 2012	16.5710	N.a.
	10.952	*N.a.*
IPO year 2013	27.4910	N.a.
	21.949	*N.a.*
IPO year 2014	-1.9521	-1.6246
	11.383	*7.3219*
IPO year 2015	4.6703	5.3265
	7.9400	*6.2017*
IPO year 2016	12.3555*	7.4362
	7.0465	*6.4286*
IPO year 2017	15.7739**	4.4999
	-7.563	*6.1174*

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level

First row showing coefficient. Second (italic) row showing standard error.

These findings are closely aligned with previous theories looking at "Hot issue" markets. Ritter (1984) refers to hot issue markets as periods of unusually high volume of IPOs and serious underpricing which is what the OLS-regressions in this paper confirm. As illustrated in Table 8, 2016 and 2017 was a period with a significantly high amount of IPOs and underpricing. Therefore this period of time can be classified as a hot issue market, which is a significant variable explaining the underpricing during these years. As illustrated in the table above, both years show positive coefficients implying that IPOs in hot issue years tend to lead to a higher underpricing when compared to the benchmark year 2018.

However, this paper does not find "hot issue" market years to be an explanatory variable for PE-backed IPOs. Hence, the phenomenon that Ritter highlights in his research cannot be applied for that group. As such, underpricing in PE-backed firms does not seem to be explained by PE-backed firms going public during hot issue markets.

Concluding, the results in this paper show that hot issue years could have a significant impact on underpricing - supporting previous research conducted in the area. However, this implication only seems to hold true for non-PE-backed IPOs as no significance were to be found when looking at PE-backed IPOs in isolation.

5.2.3.5 Institutional Ownership

The variable measuring the amount of institutional inflow/outflow of shares in the IPO in relation to the total shares outstanding was not a significant variable affecting the underpricing according to the OLS-regression. For non-PE-backed IPOs, a p-value of 0.75 was generated and for PE-backed IPOs the p-value was 0.26. Consequently, no statistical significance was found.

Table 15. Overview of results on institutional ownership

Variable	Sample	
	Non-PE-Backed Firms	**PE-backed firms**
Institutional Ownership	4.8689	12.5405
	15.109	*11.083*

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level

First row showing coefficient. Second (italic) row showing standard error.

Previous theory established by Rock (1986) suggests that underpricing is a tool to get uninformed investors to purchase stocks issued in an IPO. At the same time, informed investors, including institutions, have paid a price to become informed which creates an opportunity to get compensated by participating in favourably priced offerings. This would then mean that the underpricing would have been higher for IPOs with a larger institutional ownership inflow. This theory was tested by Michaely and Shaw (1994), showing empirical evidence that low institutional ownership may result in lower underpricing. However, our results contrast those claims, as no significance was found. Hence, this variable may not be an important factor when considering uncertainty among investors - eigher for PE-backed and non-PE-backed firms.

5.2.3.6 Lock-up or No Lock-up

Lock-up restrictions, meaning that pre-IPO owners have to stay invested in the issuing firm for a decided time frame, did not prove to have a significant effect on underpricing for either PE-backed or non-PE-backed IPOs.

Table 16. Overview of results on lock-up or not

Variable	Sample	
	Non-PE-Backed Firms	**PE-backed firms**
Lock-up or Not	-2.9179	-0.3856
	7.4691	*6.0441*

(***) Significant at the 0.01 level, (**) Significant at the 0.05 level, (*) Significant at the 0.10 level
First row showing coefficient. Second (italic) row showing standard error.

Previous research by Mohan and Chen (2001) found a U-formed relationship between lock-up and underpricing, suggesting that firms that depart from the norm of using a 180 day lock-up signal more uncertainty and are hence more underpriced. In this paper, lock-up periods have been further researched by analysing whether the (non)existence of a lock-up provision can explain underpricing in Sweden. It was argued that firms that do not have a lock-up period may signal poor quality to investors, raising uncertainty and the degree of underpricing. Our results however, shows no convincing evidence for the existence of such a relationship. For non-private equity-backed firms, a p-value of 0.697 was generated, implying that the lock-up has no correlation with underpricing. Although the p-value was drastically lower for private equity-backed firms (0.263), it still does not show convincing enough results to conclude that the existence of a lock-up-provision or not should have a clear impact on the level of underpricing.

5.4 Result Summary - Hypotheses

Based on the results presented in section 5, the following conclusions for this paper's hypotheses can be drawn:

Hypothesis 1:
There is a difference in the degree of underpricing between private equity-backed firms and non-private equity-backed firms in Sweden

***Result**: Null hypothesis is rejected and Hypothesis 1 is therefore accepted*

Hypothesis 2:

The decision by a private equity firm to exit as shareholder in connection to an IPO has an effect on the degree of underpricing

***Result**: Null hypothesis is rejected and Hypothesis 2 is therefore accepted (on a 10%-level)*

Hypothesis 3:

Larger institutional ownership results in higher level of IPO underpricing

***Result**: Null hypothesis is accepted and Hypothesis 3 is therefore rejected*

Hypothesis 4:

Lock-up provisions has an effect on the degree of underpricing

***Result**: Null hypothesis is accepted and Hypothesis 4 is therefore rejected*

Hypothesis 5:

IPOs with a higher degree of debt-to-capital ratio are less underpriced as compared to IPOs with a low debt-to-capital ratio

***Result**: Null hypothesis is rejected and Hypothesis 5 is therefore accepted*

Hypothesis 6:

Large companies going public are less underpriced than small companies

***Result**: Null hypothesis is accepted and Hypothesis 6 is therefore rejected*

6. Conclusion and Discussion

This chapter summarizes the findings and conclusions that can be drawn, before discussing the relevance of the results and suggestions for further research emerged from the results and methods used in the study.

6.1 Summary of Results

Previous research has provided evidence that firms going public are systematically underpriced. The reasons behind this phenomena have been widely analysed, and speculation has been made suggesting that private equity could, amongst several other factors, reduce said underpricing.

Earlier research produced have looked at private equity-backed IPOs in the European market, showing that private equity-backed IPOs on average are less underpriced than non-PE-backed IPOs. However, said research has not shown statistically significant results and has not analysed all factors that might explain the differences in underpricing between the firms that are backed and not. This paper aims to extend upon this research by studying several variables that could explain this difference in underpricing, by analysing 83 PE-backed IPOs and 194 non-PE-backed IPOs between 2009-2018 in Sweden as isolated groups. The questions aimed to be answered was:

Question 1: Do Private Equity-backed companies tend to see a lower level of underpricing than its counterpart in Sweden?;

Question 2A: Given the result in question 1, which are the factors explaining underpricing among PE-backed and non-PE-backed firms in Sweden?; and

Question 2B: Are there differences in the factors explaining underpricing between PE-backed and non-PE-backed firms in Sweden?

The results prove that there is a significant difference in underpricing between private equity-backed firms and non-backed firms. Moreover, variables including debt-to-capital, market capitalisation and IPO-year showed strong statistical significance in affecting underpricing in

non-backed IPOs. Notably market capitalisation showed a high value in the coefficient for non-PE-backed firms, implying that the variable has a large effect on underpricing within said group. This level of significance and its effect on underpricing was drastically lower for the observed PE-backed firms, however. In contrast to the hypotheses made, neigher the degree of institutional ownership or the presence of a lock-up provision proved to be statistically significant variables affecting underpricing in any of the observed groups.

Notably, the variable showing the highest statistical significance for PE-backed firms was whether the backing firm chose to exit or remain as a shareholder in connection to the IPO. This variable was also proved to have a large impact on the level of underpricing experienced amongst PE-backed firms. Given the results explained, it can be concluded that there are considerable differences in the factors determining underpricing between the two groups.

This is explained by evidence from previous research arguing that PE-firms are able to increase operational performance as an effect of their industry experience, network and monitoring. Two main factors reducing underpricing are highlighted. First, the quality signaling through being backed by private equity reduces the need for the issuing firm to signal their quality by underpricing their issues. Secondly, the high-quality signaling has an effect on the information production amongst investors, reducing the information asymmetry amongst informed and uninformed investors. Consequently, the adverse selection problem is significantly mitigated for uninformed investors. When the private equity-firm announces an exit however, this certification effect loses its credibility and effect — hence a higher level of underpricing is to be expected.

6.2 Discussion and Further Research

What can be noted from the results is that some variables that were expected to yield a statistically significant result did not, while others did. What should be noted is the variable showing how much that could be explained by our regressions, measured as R-squared. The regression with the highest R-squared showed a value of 0.19 (and adjusted R-squared of 0.07), which leads us to be conservative regarding drawing major conclusions based on the regressions. The risk of external factors being the explanatory factor behind the resulting significance is too high.

Further, the definition of private equity-backed IPOs differed in this report in comparison to some of the previous research conducted. The results might have been different if the paper would have looked at more nisched sub-groups within private equity and it might have resulted in insightful conclusions for the sub-groups, rather than generalising for private equity as a whole. Therefore, an interesting alternative way of conducting research within this area would be to categorise the different sub-groups and compare them with each other as well as with non-PE-backed IPOs. This would bring a multi-dimensional view on the subject which could increase the precision of the conclusion.

Additionally, as some of the data points did not have all the variables the OLS-regressions excluded some of the observations. This decreased the significance of the results and if further research should be done within this area, a larger sample would have been preferred to be able to draw conclusions with a higher certainty. This is of extra importance should future research want to further divide private equity into smaller sub-groups.

As this study is limited to one geography and to a specific time frame, it is hard to generalise the findings concluded in part 6.0. This means that the findings for Sweden between 2009 and 2018 might differ a lot in comparison to different geographies and time frames and the relationship between the explanatory variables and the underpricing might be significantly different when conducting this study on other groups. Therefore, an interesting area for further research would be to look at how similar variables affect underpricing but across a longer period of time or multiple markets with similar attributions.

Moreover, the data sample and the construction for some of the variables used in the OLS regression that did not showcase significant results need to be tweaked and further researched before any final conclusion of their importance can be made. One example of this is the variable observing whether a private equity firm chose to exit or not in connection to the IPO. As there are two ways of exiting, partial or full, it would be interesting to further examine the importance of the two methods in relation to underpricing. Although this paper shows evidence that an exit in general has an effect on the level of underpricing, the possibility exists that one exit strategy has significantly larger (or lower) impact on the level of underpricing. Further, when looking at the IPO year variable, there are factors that could argue for and against this variable being relevant

although it showed significance. For example, it could be rational for companies to proceed with an IPO during times of high economic activity as a high number of IPOs could lead to more interest among investors which might make it easier to raise the amount of capital needed. On the other hand, although this shows statistical significance, the variable could also be less relevant based on the sample in this paper. As the sample is relatively small, the years with a higher amount of observations will be more likely to show significance. This could imply that although some years show significance, the actual impact the IPO year has on the underpricing is less relevant.

Further, previous research on lock-up periods by (Mohan and Chen, 2001) concluded that lock-up provisions that depart from the norm of 180 days show higher underpricing. This paper only observed whether the presence of a lock-up period affects underpricing, in line with the theoretical foundations that this paper is built upon. However, in order to further build upon these results, future research could construct a variable in line with "180 day-lock-up or not" to examine whether Mohan and Chen's (2001) results are applicable in Sweden (or other markets) as well.

Similarly, institutional ownership can be researched upon further. The previous study by Michaely and Shaw (1994), suggesting that the level of institutional ownership impacts uncertainty chose to compare two samples: one sample with very limited institutional ownership and one sample covering the rest of the market. In this paper, the level of institutional ownership was very similar in all observed samples, (in average 18 % for private equity-backed firms; 16 % for non-backed firms). The large differences in results in this paper compared to Michaely and Shaw's could suggest the sheer *magnitude* of institutional ownership does not affect underpricing to a larger degree, as the presence of informed investors has already created informational asymmetry and need for underpricing. Future research, comparing samples with large differences in the level of institutional owners is needed in order to draw convincing conclusions regarding the importance of this variable.

Lastly, this study only included a limited amount of variables when trying to explain underpricing for the different groups. This is a significant limitation which should be considered if further research is conducted within the area and it would be interesting to increase the amount of variables to increase the relevance of the results. This would then give a broader perspective on what factors that might affect underpricing in non-PE and PE-backed IPOs.

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Appendix

Appendix 1 - Satterthaite-Welch T-test of differences in means between PE- and non-PE-backed IPOS

Test for Equality of Means Between Series
Date: 05/04/20 Time: 14:01
Sample: 1194
Included observations: 194

Method	df	Value	Probability
Satterthwaite-Welch t-test*	263.6895	2.134975	0.0337

*Test allows for unequal cell variances

Analysis of variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	2700.886	2700.886
Within	275	258957.6	941.6639
Total	276	261658.5	948.0379

Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. Of Mean
Non_PE	194	9.904846	34.64833	2.487605
PE_BACKED	83	3.088477	18.23282	2.001312
All	277	7.862396	30.79022	1.850005

Appendix 2A - Ordinary Least Square:

All IPOs

Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 19:57
Sample: 1 277
Included observations: 186
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-15.54777	8.354984	-1.860898	0.0645
PROFIT_MARGIN_W	0.000588	0.000655	0.897164	0.3709
DEBT_TO_CAP_W	-0.216519	0.080339	-2.695079	0.0077
INSTIT_OWNER_PERC_W	7.426705	9.793080	0.758363	0.4493
LOCK_UP_NOT_DUMMY	-3.600827	5.454396	-0.660170	0.5100
LN_MARKET_CAP_W	4.177887	1.024437	4.078228	0.0001
PE_OR_NOT_DUMMY	-7.946163	3.188232	-2.492342	0.0136
IPO_YEAR01=2009	32.85452	20.72936	1.584927	0.1148
IPO_YEAR01=2010	7.552948	8.430124	0.895947	0.3715
IPO_YEAR01=2011	4.950483	14.40264	0.343720	0.7315
IPO_YEAR01=2012	12.88811	7.419366	1.737091	0.0842
IPO_YEAR01=2013	24.50194	21.26570	1.152181	0.2509
IPO_YEAR01=2014	-2.271536	7.539767	-0.301274	0.7636
IPO_YEAR01=2015	7.210036	5.354137	1.346629	0.1799
IPO_YEAR01=2016	9.834223	4.979982	1.974751	0.0499
IPO_YEAR01=2017	12.43501	4.838741	2.569885	0.0110

R-squared	0.146751	Mean dependent var	8.840259
Adjusted R-squared	0.071465	S.D. dependent var	22.72561
S.E. of regression	21.89851	Akaike info criterion	9.092809
Sum squared resid	81522.64	Schwarz criterion	9.370293
Log likelihood	-829.6313	Hannan-Quinn criter.	9.205256
F-statistic	1.949235	Durbin-Watson stat	1.666255
Prob(F-statistic)	0.021636	Wald F-statistic	2.889598
Prob(Wald F-statistic)	0.000447		

Appendix 2B - Ordinary Least Square:

Non-PE-backed IPOs

Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 19:59
Sample: 1 277 IF PE_OR_NOT_DUMMY=0
Included observations: 120
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.83264	11.76009	-1.516369	0.1324
PROFIT_MARGIN_W	0.001091	0.000884	1.233806	0.2200
DEBT_TO_CAP_W	-0.293711	0.102792	-2.857322	0.0052
INSTIT_OWNER_PERC_W	4.868917	15.10911	0.322250	0.7479
LOCK_UP_NOT_DUMMY	-2.917886	7.469079	-0.390662	0.6968
LN_MARKET_CAP_W	4.600333	1.338440	3.437086	0.0008
IPO_YEAR01=2009	35.06857	21.89005	1.602032	0.1122
IPO_YEAR01=2010	10.94916	11.32110	0.967147	0.3357
IPO_YEAR01=2011	8.369008	19.37338	0.431985	0.6666
IPO_YEAR01=2012	16.57079	10.95221	1.513008	0.1333
IPO_YEAR01=2013	27.49078	21.94938	1.252462	0.2132
IPO_YEAR01=2014	-1.952105	11.38308	-0.171492	0.8642
IPO_YEAR01=2015	4.670334	7.939965	0.588206	0.5577
IPO_YEAR01=2016	12.35554	7.046517	1.753426	0.0824
IPO_YEAR01=2017	15.77395	7.562560	2.085795	0.0394

R-squared	0.170737	Mean dependent var	10.47885
Adjusted R-squared	0.060169	S.D. dependent var	25.55254
S.E. of regression	24.77188	Akaike info criterion	9.373764
Sum squared resid	64432.85	Schwarz criterion	9.722201
Log likelihood	-547.4258	Hannan-Quinn criter.	9.515266
F-statistic	1.544178	Durbin-Watson stat	1.950999
Prob(F-statistic)	0.108207	Wald F-statistic	2.693940
Prob(Wald F-statistic)	0.002065		

Appendix 2C - Ordinary Least Square:

PE-Backed IPOs (without PE-exit/not dummy)

Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 19:59
Sample: 1 277 IF PE_OR_NOT_DUMMY=1
Included observations: 66
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-21.36965	10.71652	-1.994086	0.0512
PROFIT_MARGIN_W	-0.000690	0.000885	-0.779471	0.4391
DEBT_TO_CAP_W	-0.074717	0.141956	-0.526343	0.6008
INSTIT_OWNER_PERC_W	12.54052	11.08341	1.131468	0.2629
LOCK_UP_NOT_DUMMY	-0.385563	6.044115	-0.063792	0.9494
LN_MARKET_CAP_W	3.272482	1.935126	1.691095	0.0966
IPO_YEAR01=2010	-3.253504	6.155871	-0.528520	0.5993
IPO_YEAR01=2011	-2.913781	7.027814	-0.414607	0.6801
IPO_YEAR01=2014	-1.624618	7.321880	-0.221885	0.8252
IPO_YEAR01=2015	5.216531	6.201701	0.841145	0.4040
IPO_YEAR01=2016	7.436191	6.428592	1.156737	0.2525
IPO_YEAR01=2017	4.499976	6.117380	0.735605	0.4652

R-squared	0.141282	Mean dependent var	5.860996
Adjusted R-squared	-0.033641	S.D. dependent var	16.14209
S.E. of regression	16.41137	Akaike info criterion	8.596791
Sum squared resid	14543.98	Schwarz criterion	8.994910
Log likelihood	-271.6941	Hannan-Quinn criter.	8.754107
F-statistic	0.807680	Durbin-Watson stat	1.230397
Prob(F-statistic)	0.632135		

Appendix 2D - Ordinary Least Square:

PE-backed IPOs (including PE-exit/not dummy)

Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 20:01
Sample: 1 277 IF PE_OR_NOT_DUMMY=1
Included observations: 66
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-12.79437	10.77221	-1.187721	0.2402
PROFIT_MARGIN_W	-0.000915	0.000905	-1.011539	0.3164
DEBT_TO_CAP_W	-0.161342	0.143914	-1.121101	0.2673
INSTIT_OWNER_PERC_W	9.439070	10.61391	0.889311	0.3779
LOCK_UP_NOT_DUMMY	-0.260077	5.675253	-0.045826	0.9636
LN_MARKET_CAP_W	1.588380	1.978225	0.802932	0.4256
PE_EXIT_OR_NOT	11.53690	6.139138	1.879238	0.0657
IPO_YEAR01=2010	-7.880445	6.904656	-1.141323	0.2589
IPO_YEAR01=2011	-9.814426	8.233920	-1.191951	0.2386
IPO_YEAR01=2014	1.773512	7.828821	0.226536	0.8217
IPO_YEAR01=2015	3.693532	6.754206	0.546849	0.5868
IPO_YEAR01=2016	4.877235	7.136403	0.683430	0.4973
IPO_YEAR01=2017	3.174411	6.528068	0.486271	0.6288

R-squared	0.193477	Mean dependent var	5.860996
Adjusted R-squared	0.010868	S.D. dependent var	16.14209
S.E. of regression	16.05413	Akaike info criterion	8.564386
Sum squared resid	13659.97	Schwarz criterion	8.995682
Log likelihood	-269.6248	Hannan-Quinn criter.	8.734812
F-statistic	1.059517	Durbin-Watson stat	1.126271
Prob(F-statistic)	0.411760		

Appendix 3A - Ramsey RESET test

All IPOs

Ramsey RESET Test
Equation: EQ_W_ALL
Specification: OFFER_TO_1ST_CLOSE_W C PROFIT_MARGIN_W DEBT_TO_CAP_W INSTIT_OWNER_PERC_W LOCK_UP_NOT_DUMMY LN_MARKET_CAP_W PE_OR_NOT_DUMMY @EXPAND(IPO_YEAR01,@DROPLAST)
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.715283	169	0.4754
F-statistic	0.511630	(1, 169)	0.4754
Likelihood ratio	0.562245	1	0.4534

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	246.0563	1	246.0563
Restricted SSR	81522.64	170	479.5449
Unrestricted SSR	81276.58	169	480.9265
Unrestricted SSR	81276.58	169	480.9265

LR test summary:

	Value	df
Restricted LogL	-829.6313	170
Unrestricted LogL	-829.3502	169

Unrestricted Test Equation:
Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 22:51
Sample: 1 277
Included observations: 186
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.31827	8.267104	-1.610996	0.1090
PROFIT_MARGIN_W	0.000480	0.000663	0.723616	0.4703
DEBT_TO_CAP_W	-0.174840	0.099166	-1.763101	0.0797
INSTIT_OWNER_PERC_W	5.903966	9.984427	0.591317	0.5551
LOCK_UP_NOT_DUMMY	-2.751041	5.588558	-0.492263	0.6232
LN_MARKET_CAP_W	3.307613	1.398333	2.365396	0.0191
PE_OR_NOT_DUMMY	-6.001189	4.151915	-1.445403	0.1502
FITTED^2	0.013139	0.015130	0.868398	0.3864
IPO_YEAR01=2009	19.29977	26.72956	0.722039	0.4713
IPO_YEAR01=2010	7.185744	8.470926	0.848283	0.3975
IPO_YEAR01=2011	5.109396	14.63584	0.349102	0.7274
IPO_YEAR01=2012	11.36204	7.372644	1.541108	0.1252
IPO_YEAR01=2013	12.56046	24.32280	0.516407	0.6062
IPO_YEAR01=2014	-0.261968	8.104726	-0.032323	0.9743
IPO_YEAR01=2015	6.730424	5.312423	1.266922	0.2069
IPO_YEAR01=2016	8.935186	4.977945	1.794955	0.0744
IPO_YEAR01=2017	10.56339	5.064040	2.085962	0.0385

R-squared	0.149327	Mean dependent var	8.840259
Adjusted R-squared	0.068790	S.D. dependent var	22.72561
S.E. of regression	21.93004	Akaike info criterion	9.100539
Sum squared resid	81276.58	Schwarz criterion	9.395366
Log likelihood	-829.3502	Hannan-Quinn criter.	9.220014
F-statistic	1.854135	Durbin-Watson stat	1.651556
Prob(F-statistic)	0.028005	Wald F-statistic	2.771205
Prob(Wald F-statistic)	0.000563		

Appendix 3B - Ramsey RESET test

Non-PE-backed IPO

Ramsey RESET Test
Equation: EQ_W_NOPE
Specification: OFFER_TO_1ST_CLOSE_W C PROFIT_MARGIN_W DEBT_TO_CAP_W INSTIT_OWNER_PERC_W LOCK_UP_NOT_DUMMY LN_MARKET_CAP_W @EXPAND(IPO_YEAR01,@DROPLAST)
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.576396	104	0.5656
F-statistic	0.332233	(1, 104)	0.5656
Likelihood ratio	0.382734	1	0.5361

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	205.1782	1	205.1782
Restricted SSR	64432.85	105	613.6462
Unrestricted SSR	64227.67	104	617.5737
Unrestricted SSR	64227.67	104	617.5737

LR test summary:

	Value	df
Restricted LogL	-547.4258	105
Unrestricted LogL	-547.2345	104

Unrestricted Test Equation:
Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 22:55
Sample: 1 277 IF PE_OR_NOT_DUMMY=0
Included observations: 120
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-15.29286	11.49914	-1.329914	0.1865
PROFIT_MARGIN_W	0.000979	0.000878	1.114416	0.2677
DEBT_TO_CAP_W	-0.244503	0.118539	-2.062637	0.0416
INSTIT_OWNER_PERC_W	4.026659	15.33807	0.262527	0.7934
LOCK_UP_NOT_DUMMY	-2.520449	7.540556	-0.334252	0.7389
LN_MARKET_CAP_W	3.755440	1.486797	2.525860	0.0130
FITTED^2	0.009717	0.011845	0.820334	0.4139
IPO_YEAR01=2009	24.77879	25.52598	0.970728	0.3339
IPO_YEAR01=2010	9.989448	11.40834	0.875627	0.3833
IPO_YEAR01=2011	8.032546	19.66141	0.408544	0.6837
IPO_YEAR01=2012	14.44243	10.83143	1.333381	0.1853
IPO_YEAR01=2013	18.35260	23.48204	0.781559	0.4362
IPO_YEAR01=2014	-0.254265	11.80105	-0.021546	0.9829
IPO_YEAR01=2015	5.102816	8.008193	0.637199	0.5254
IPO_YEAR01=2016	11.23753	7.048099	1.594405	0.1139
IPO_YEAR01=2017	13.61560	7.892650	1.725099	0.0875

R-squared	0.173378	Mean dependent var	10.47885
Adjusted R-squared	0.054154	S.D. dependent var	25.55254
S.E. of regression	24.85103	Akaike info criterion	9.387241
Sum squared resid	64227.67	Schwarz criterion	9.758907
Log likelihood	-547.2345	Hannan-Quinn criter.	9.538176
F-statistic	1.454216	Durbin-Watson stat	1.935670
Prob(F-statistic)	0.136685	Wald F-statistic	2.653520
Prob(Wald F-statistic)	0.001937		

Appendix 3C - Ramsey RESET test

PE-Backed IPOs (without PE-exit/not dummy)

Ramsey RESET Test
Equation: EQ_W_PE
Specification: OFFER_TO_1ST_CLOSE_W C PROFIT_MARGIN_W DEBT_TO_CAP_W INSTIT_OWNER_PERC_W LOCK_UP_NOT_DUMMY LN_MARKET_CAP_W @EXPAND(IPO_YEAR01,@DROPLAST)
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.183339	53	0.8552
F-statistic	0.033613	(1, 53)	0.8552
Likelihood ratio	0.041845	1	0.8379

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	9.218088	1	9.218088
Restricted SSR	14543.98	54	269.3330
Unrestricted SSR	14534.77	53	274.2409
Unrestricted SSR	14534.77	53	274.2409

LR test summary:

	Value	df
Restricted LogL	-271.6941	54
Unrestricted LogL	-271.6732	53

Unrestricted Test Equation:
Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 22:56
Sample: 1 277 IF PE_OR_NOT_DUMMY=1
Included observations: 66
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.73631	14.07903	-1.401824	0.1668
PROFIT_MARGIN_W	-0.000606	0.000950	-0.637762	0.5264
DEBT_TO_CAP_W	-0.076329	0.139429	-0.547436	0.5864
INSTIT_OWNER_PERC_W	11.32705	13.53922	0.836610	0.4066
LOCK_UP_NOT_DUMMY	-0.616656	6.016109	-0.102501	0.9187
LN_MARKET_CAP_W	3.061942	2.497342	1.226080	0.2256
FITTED^2	0.009923	0.053938	0.183969	0.8547
IPO_YEAR01=2010	-2.996111	6.652745	-0.450357	0.6543
IPO_YEAR01=2011	-2.527080	8.040197	-0.314306	0.7545
IPO_YEAR01=2014	-1.401959	7.668313	-0.182825	0.8556
IPO_YEAR01=2015	4.624216	6.742891	0.685791	0.4958
IPO_YEAR01=2016	6.799168	6.905978	0.984534	0.3293
IPO_YEAR01=2017	4.135106	6.236148	0.663087	0.5101

R-squared	0.141827	Mean dependent var	5.860996
Adjusted R-squared	-0.052477	S.D. dependent var	16.14209
S.E. of regression	16.56022	Akaike info criterion	8.626460
Sum squared resid	14534.77	Schwarz criterion	9.057756
Log likelihood	-271.6732	Hannan-Quinn criter.	8.796886
F-statistic	0.729924	Durbin-Watson stat	1.232718
Prob(F-statistic)	0.716034		

Appendix 3D- Ramsey RESET test

PE-backed IPOs including PE-Exit/not Variable

Ramsey RESET Test
Equation: EQ_W_PE_EXIT
Specification: OFFER_TO_1ST_CLOSE_W C PROFIT_MARGIN_W DEBT_TO_CAP_W INSTIT_OWNER_PERC_W LOCK_UP_NOT_DUMMY LN_MARKET_CAP_W @EXPAND(IPO_YEAR01,@DROPLAST) PE_EXIT_OR_NOT
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.693806	52	0.4909
F-statistic	0.481367	(1, 52)	0.4909
Likelihood ratio	0.608156	1	0.4355

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	125.2913	1	125.2913
Restricted SSR	13659.97	53	257.7352
Unrestricted SSR	13534.68	52	260.2822
Unrestricted SSR	13534.68	52	260.2822

LR test summary:

	Value	df
Restricted LogL	-269.6248	53
Unrestricted LogL	-269.3207	52

Unrestricted Test Equation:
Dependent Variable: OFFER_TO_1ST_CLOSE_W
Method: Least Squares
Date: 05/26/20 Time: 22:57
Sample: 1 277 IF PE_OR_NOT_DUMMY=1
Included observations: 66
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.35007	11.89592	-0.954115	0.3444
PROFIT_MARGIN_W	-0.000645	0.000982	-0.656503	0.5144
DEBT_TO_CAP_W	-0.105313	0.225241	-0.467558	0.6421
INSTIT_OWNER_PERC_W	5.826198	14.18024	0.410867	0.6829
LOCK_UP_NOT_DUMMY	-1.312999	5.841627	-0.224766	0.8230
LN_MARKET_CAP_W	1.572710	2.071070	0.759371	0.4511
PE_EXIT_OR_NOT	6.739846	10.59204	0.636312	0.5274
FITTED^2	0.032490	0.062519	0.519682	0.6055
IPO_YEAR01=2010	-5.143959	9.229527	-0.557337	0.5797
IPO_YEAR01=2011	-4.669395	14.63895	-0.318971	0.7510
IPO_YEAR01=2014	0.439083	7.744340	0.056697	0.9550
IPO_YEAR01=2015	2.470515	7.098385	0.348039	0.7292
IPO_YEAR01=2016	3.404749	7.585103	0.448873	0.6554
IPO_YEAR01=2017	2.202917	6.518876	0.337929	0.7368

R-squared	0.200875	Mean dependent var	5.860996
Adjusted R-squared	0.001094	S.D. dependent var	16.14209
S.E. of regression	16.13327	Akaike info criterion	8.585475
Sum squared resid	13534.68	Schwarz criterion	9.049947
Log likelihood	-269.3207	Hannan-Quinn criter.	8.769010
F-statistic	1.005474	Durbin-Watson stat	1.096132
Prob(F-statistic)	0.459952		

Appendix 4A - White's test

All IPOs

Heteroskedasticity Test: White

F-statistic	2.674229	Prob. F(15,170)	0.0011
Obs*R-squared	35.50986	Prob. Chi-Square(15)	0.0021
Scaled explained SS	34.47326	Prob. Chi-Square(15)	0.0029

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/26/20 Time: 22:52
Sample: 1 277
Included observations: 186
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	807.0587	180.7631	4.464731	0.0000
PROFIT_MARGIN_W^2	5.29E-07	1.82E-06	0.290776	0.7716
DEBT_TO_CAP_W^2	-0.099579	0.034509	-2.885589	0.0044
INSTIT_OWNER_PERC_W^	338.4610	530.1105	0.638473	0.5240
LOCK_UP_NOT_DUMMY^2	-300.8227	149.1931	-2.016331	0.0453
LN_MARKET_CAP_W^2	-5.225083	1.943465	-2.688540	0.0079
PE_OR_NOT_DUMMY^2	-170.6816	84.70205	-2.015083	0.0455
(IPO_YEAR01=2009)^2	61.15202	238.8777	0.255997	0.7983
(IPO_YEAR01=2010)^2	-82.57425	253.7657	-0.325396	0.7453
(IPO_YEAR01=2011)^2	242.4989	534.1188	0.454017	0.6504
(IPO_YEAR01=2012)^2	-676.0236	218.3874	-3.095525	0.0023
(IPO_YEAR01=2013)^2	266.8161	255.6181	1.043808	0.2981
(IPO_YEAR01=2014)^2	-94.16126	166.9412	-0.564038	0.5735
(IPO_YEAR01=2015)^2	169.0435	142.6567	1.184967	0.2377
(IPO_YEAR01=2016)^2	201.9847	125.6892	1.607018	0.1099
(IPO_YEAR01=2017)^2	319.4825	120.2726	2.656320	0.0087

R-squared	0.190913	Mean dependent var	438.2938
Adjusted R-squared	0.119523	S.D. dependent var	670.0105
S.E. of regression	628.6958	Akaike info criterion	15.80727
Sum squared resid	67193938	Schwarz criterion	16.08475
Log likelihood	-1454.076	Hannan-Quinn criter.	15.91971
F-statistic	2.674229	Durbin-Watson stat	1.983137
Prob(F-statistic)	0.001122		

Appendix 4B - White's test

Non-PE-backed IPO

Heteroskedasticity Test: White

F-statistic	1.945455	Prob. F(14,105)	0.0295
Obs*R-squared	24.71608	Prob. Chi-Square(14)	0.0375
Scaled explained SS	19.44185	Prob. Chi-Square(14)	0.1487

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/26/20 Time: 22:55
Sample: 1 277 IF PE_OR_NOT_DUMMY=0
Included observations: 120
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	895.7014	264.5018	3.386371	0.0010
PROFIT_MARGIN_W^2	6.64E-07	2.83E-06	0.234455	0.8151
DEBT_TO_CAP_W^2	-0.125034	0.048572	-2.574212	0.0114
INSTIT_OWNER_PERC_W^	869.4296	837.9781	1.037533	0.3019
LOCK_UP_NOT_DUMMY^2	-397.6060	193.6949	-2.052744	0.0426
LN_MARKET_CAP_W^2	-7.608166	2.771296	-2.745346	0.0071
(IPO_YEAR01=2009)^2	-97.33350	369.2936	-0.263567	0.7926
(IPO_YEAR01=2010)^2	-57.92765	352.5668	-0.164303	0.8698
(IPO_YEAR01=2011)^2	208.4238	651.6455	0.319842	0.7497
(IPO_YEAR01=2012)^2	-792.2214	332.5973	-2.381924	0.0190
(IPO_YEAR01=2013)^2	129.0254	353.5694	0.364923	0.7159
(IPO_YEAR01=2014)^2	-115.3705	258.5497	-0.446222	0.6564
(IPO_YEAR01=2015)^2	124.5805	269.2111	0.462761	0.6445
(IPO_YEAR01=2016)^2	230.8013	177.5045	1.300256	0.1964
(IPO_YEAR01=2017)^2	446.0813	195.4117	2.282777	0.0245

R-squared	0.205967	Mean dependent var	536.9404
Adjusted R-squared	0.100096	S.D. dependent var	772.9104
S.E. of regression	733.2079	Akaike info criterion	16.14920
Sum squared resid	56447356	Schwarz criterion	16.49764
Log likelihood	-953.9523	Hannan-Quinn criter.	16.29071
F-statistic	1.945455	Durbin-Watson stat	2.697106
Prob(F-statistic)	0.029452		

Appendix 4C - White's test

PE-Backed IPOs (without PE-exit/not dummy)

Heteroskedasticity Test: White

F-statistic	0.899227	Prob. F(11,54)	0.5471
Obs*R-squared	10.21792	Prob. Chi-Square(11)	0.5109
Scaled explained SS	6.875070	Prob. Chi-Square(11)	0.8091

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/26/20 Time: 22:57
Sample: 1 277 IF PE_OR_NOT_DUMMY=1
Included observations: 66
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	222.4799	120.6961	1.843306	0.0708
PROFIT_MARGIN_W^2	-4.25E-07	8.64E-07	-0.491950	0.6247
DEBT_TO_CAP_W^2	-0.022352	0.036619	-0.610396	0.5442
INSTIT_OWNER_PERC_W^	-370.2309	246.8464	-1.499843	0.1395
LOCK_UP_NOT_DUMMY^2	10.72379	98.21325	0.109189	0.9135
LN_MARKET_CAP_W^2	-1.937972	2.102392	-0.921794	0.3607
(IPO_YEAR01=2010)^2	-66.02354	101.1618	-0.652653	0.5167
(IPO_YEAR01=2011)^2	-102.9105	88.59933	-1.161527	0.2505
(IPO_YEAR01=2014)^2	94.88416	125.7421	0.754593	0.4538
(IPO_YEAR01=2015)^2	144.5468	91.62466	1.577597	0.1205
(IPO_YEAR01=2016)^2	93.57708	130.4435	0.717376	0.4762
(IPO_YEAR01=2017)^2	223.7456	108.3561	2.064910	0.0437

R-squared	0.154817	Mean dependent var	220.3634
Adjusted R-squared	-0.017350	S.D. dependent var	314.8307
S.E. of regression	317.5501	Akaike info criterion	14.52211
Sum squared resid	5445257.	Schwarz criterion	14.92023
Log likelihood	-467.2298	Hannan-Quinn criter.	14.67943
F-statistic	0.899227	Durbin-Watson stat	1.399435
Prob(F-statistic)	0.547085		

Appendix 4D - White's test

PE-Backed IPOs (including PE-exit/not dummy)

Heteroskedasticity Test: White

F-statistic	1.105901	Prob. F(12,53)	0.3751
Obs*R-squared	13.21658	Prob. Chi-Square(12)	0.3535
Scaled explained SS	7.141288	Prob. Chi-Square(12)	0.8481

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/26/20 Time: 22:58
Sample: 1 277 IF PE_OR_NOT_DUMMY=1
Included observations: 66
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	153.3399	134.3256	1.141554	0.2588
PROFIT_MARGIN_W^2	-6.32E-07	7.68E-07	-0.822739	0.4143
DEBT_TO_CAP_W^2	0.003302	0.033651	0.098126	0.9222
INSTIT_OWNER_PERC_W^	-188.9309	224.0324	-0.843319	0.4028
LOCK_UP_NOT_DUMMY^2	47.16851	88.17582	0.534937	0.5949
LN_MARKET_CAP_W^2	0.613089	1.907278	0.321447	0.7491
PE_EXIT_OR_NOT^2	-188.3104	102.7028	-1.833546	0.0723
(IPO_YEAR01=2010)^2	22.82695	136.3500	0.167414	0.8677
(IPO_YEAR01=2011)^2	-35.00922	135.8867	-0.257635	0.7977
(IPO_YEAR01=2014)^2	7.816776	129.3410	0.060435	0.9520
(IPO_YEAR01=2015)^2	121.6731	119.1731	1.020978	0.3119
(IPO_YEAR01=2016)^2	70.70630	136.2562	0.518922	0.6060
(IPO_YEAR01=2017)^2	171.6297	119.2784	1.438900	0.1561

R-squared	0.200251	Mean dependent var	206.9692
Adjusted R-squared	0.019176	S.D. dependent var	269.9808
S.E. of regression	267.3796	Akaike info criterion	14.18979
Sum squared resid	3789069.	Schwarz criterion	14.62109
Log likelihood	-455.2632	Hannan-Quinn criter.	14.36022
F-statistic	1.105901	Durbin-Watson stat	1.530492
Prob(F-statistic)	0.375086		

Appendix 5A - Correlation Matrix

All IPOs

	OFFER_TO_1	PROFIT_MAR	DEBT_TO_CA	INSTIT_OWN	LOCK_UP_NO	LN_MARKET_	PE_OR_NOT_
OFFER_TO_1	1.000000	0.077267	-0.088549	0.080818	-0.023952	0.154748	-0.097487
PROFIT_MAR	0.077267	1.000000	0.280715	-0.045539	-0.043097	0.151571	0.035102
DEBT_TO_CA	-0.088549	0.280715	1.000000	0.200785	-0.148235	0.393852	0.146669
INSTIT_OWN	0.080818	-0.045539	0.200785	1.000000	-0.231312	0.171215	0.080153
LOCK_UP_NO	-0.023952	-0.043097	-0.148235	-0.231312	1.000000	0.126923	0.256651
LN_MARKET_	0.154748	0.151571	0.393852	0.171215	0.126923	1.000000	0.344371
PE_OR_NOT_	-0.097487	0.035102	0.146669	0.080153	0.256651	0.344371	1.000000
IPO_YEAR01=	0.111711	0.030451	-0.057780	0.165465	-0.042350	-0.123305	-0.077319
IPO_YEAR01=	-0.053487	0.006833	0.013603	-0.021800	-0.372967	-0.296105	-0.187444
IPO_YEAR01=	0.022672	0.010339	-0.126219	0.045569	-0.175151	-0.007803	-0.053787
IPO_YEAR01=	-0.008071	0.035675	0.031584	0.072949	-0.154881	-0.164195	-0.077319
IPO_YEAR01=	0.114430	0.033199	0.054352	0.163952	-0.154881	0.039692	-0.077319
IPO_YEAR01=	-0.035995	0.086785	0.293690	0.221408	-0.361710	0.290437	-0.027011
IPO_YEAR01=	0.023906	0.054518	0.166152	0.094507	0.074307	0.284292	0.133045
IPO_YEAR01=	0.022365	-0.002739	-0.055849	-0.141080	0.085960	-0.054150	-0.051149
IPO_YEAR01=	0.066075	-0.025626	-0.184464	-0.107505	0.322087	-0.091133	0.129286

	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=
OFFER_TO_1	0.111711	-0.053487	0.022672	-0.008071	0.114430	-0.035995	0.023906
PROFIT_MAR	0.030451	0.006833	0.010339	0.035675	0.033199	0.086785	0.054518
DEBT_TO_CA	-0.057780	0.013603	-0.126219	0.031584	0.054352	0.293690	0.166152
INSTIT_OWN	0.165465	-0.021800	0.045569	0.072949	0.163952	0.221408	0.094507
LOCK_UP_NO	-0.042350	-0.372967	-0.175151	-0.154881	-0.154881	-0.361710	0.074307
LN_MARKET_	-0.123305	-0.296105	-0.007803	-0.164195	0.039692	0.290437	0.284292
PE_OR_NOT_	-0.077319	-0.187444	-0.053787	-0.077319	-0.077319	-0.027011	0.133045
IPO_YEAR01=	1.000000	-0.031985	-0.017328	-0.010870	-0.010870	-0.028580	-0.045720
IPO_YEAR01=	-0.031985	1.000000	-0.050990	-0.031985	-0.031985	-0.084098	-0.134535
IPO_YEAR01=	-0.017328	-0.050990	1.000000	-0.017328	-0.017328	-0.045561	-0.072886
IPO_YEAR01=	-0.010870	-0.031985	-0.017328	1.000000	-0.010870	-0.028580	-0.045720
IPO_YEAR01=	-0.010870	-0.031985	-0.017328	-0.010870	1.000000	-0.028580	-0.045720
IPO_YEAR01=	-0.028580	-0.084098	-0.045561	-0.028580	-0.028580	1.000000	-0.120212
IPO_YEAR01=	-0.045720	-0.134535	-0.072886	-0.045720	-0.045720	-0.120212	1.000000
IPO_YEAR01=	-0.056305	-0.165683	-0.089761	-0.056305	-0.056305	-0.148044	-0.236833
IPO_YEAR01=	-0.065814	-0.193663	-0.104920	-0.065814	-0.065814	-0.173046	-0.276828

	IPO_YEAR01=	IPO_YEAR01=
OFFER_TO_1	0.022365	0.066075
PROFIT_MAR	-0.002739	-0.025626
DEBT_TO_CA	-0.055849	-0.184464
INSTIT_OWN	-0.141080	-0.107505
LOCK_UP_NO	0.085960	0.322087
LN_MARKET_	-0.054150	-0.091133
PE_OR_NOT_	-0.051149	0.129286
IPO_YEAR01=	-0.056305	-0.065814
IPO_YEAR01=	-0.165683	-0.193663
IPO_YEAR01=	-0.089761	-0.104920
IPO_YEAR01=	-0.056305	-0.065814
IPO_YEAR01=	-0.056305	-0.065814
IPO_YEAR01=	-0.148044	-0.173046
IPO_YEAR01=	-0.236833	-0.276828
IPO_YEAR01=	1.000000	-0.340922
IPO_YEAR01=	-0.340922	1.000000

Appendix 5B - Correlation Matrix

Non-PE-backed IPOs

	OFFER_TO_1	PROFIT_MAR	DEBT_TO_CA	INSTIT_OWN	LOCK_UP_NO	LN_MARKET_	IPO_YEAR01=
OFFER_TO_1	1.000000	0.077267	-0.088549	0.080818	-0.023952	0.154748	0.111711
PROFIT_MAR	0.077267	1.000000	0.280715	-0.045539	-0.043097	0.151571	0.030451
DEBT_TO_CA	-0.088549	0.280715	1.000000	0.200785	-0.148235	0.393852	-0.057780
INSTIT_OWN	0.080818	-0.045539	0.200785	1.000000	-0.231312	0.171215	0.165465
LOCK_UP_NO	-0.023952	-0.043097	-0.148235	-0.231312	1.000000	0.126923	-0.042350
LN_MARKET_	0.154748	0.151571	0.393852	0.171215	0.126923	1.000000	-0.123305
IPO_YEAR01=	0.111711	0.030451	-0.057780	0.165465	-0.042350	-0.123305	1.000000
IPO_YEAR01=	-0.053487	0.006833	0.013603	-0.021800	-0.372967	-0.296105	-0.031985
IPO_YEAR01=	0.022672	0.010339	-0.126219	0.045569	-0.175151	-0.007803	-0.017328
IPO_YEAR01=	-0.008071	0.035675	0.031584	0.072949	-0.154881	-0.164195	-0.010870
IPO_YEAR01=	0.114430	0.033199	0.054352	0.163952	-0.154881	0.039692	-0.010870
IPO_YEAR01=	-0.035995	0.086785	0.293690	0.221408	-0.361710	0.290437	-0.028580
IPO_YEAR01=	0.023906	0.054518	0.166152	0.094507	0.074307	0.284292	-0.045720
IPO_YEAR01=	0.022365	-0.002739	-0.055849	-0.141080	0.085960	-0.054150	-0.056305
IPO_YEAR01=	0.066075	-0.025626	-0.184464	-0.107505	0.322087	-0.091133	-0.065814

	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=
OFFER_TO_1	-0.053487	0.022672	-0.008071	0.114430	-0.035995	0.023906	0.022365
PROFIT_MAR	0.006833	0.010339	0.035675	0.033199	0.086785	0.054518	-0.002739
DEBT_TO_CA	0.013603	-0.126219	0.031584	0.054352	0.293690	0.166152	-0.055849
INSTIT_OWN	-0.021800	0.045569	0.072949	0.163952	0.221408	0.094507	-0.141080
LOCK_UP_NO	-0.372967	-0.175151	-0.154881	-0.154881	-0.361710	0.074307	0.085960
LN_MARKET_	-0.296105	-0.007803	-0.164195	0.039692	0.290437	0.284292	-0.054150
IPO_YEAR01=	-0.031985	-0.017328	-0.010870	-0.010870	-0.028580	-0.045720	-0.056305
IPO_YEAR01=	1.000000	-0.050990	-0.031985	-0.031985	-0.084098	-0.134535	-0.165683
IPO_YEAR01=	-0.050990	1.000000	-0.017328	-0.017328	-0.045561	-0.072886	-0.089761
IPO_YEAR01=	-0.031985	-0.017328	1.000000	-0.010870	-0.028580	-0.045720	-0.056305
IPO_YEAR01=	-0.031985	-0.017328	-0.010870	1.000000	-0.028580	-0.045720	-0.056305
IPO_YEAR01=	-0.084098	-0.045561	-0.028580	-0.028580	1.000000	-0.120212	-0.148044
IPO_YEAR01=	-0.134535	-0.072886	-0.045720	-0.045720	-0.120212	1.000000	-0.236833
IPO_YEAR01=	-0.165683	-0.089761	-0.056305	-0.056305	-0.148044	-0.236833	1.000000
IPO_YEAR01=	-0.193663	-0.104920	-0.065814	-0.065814	-0.173046	-0.276828	-0.340922

	IPO_YEAR01=
OFFER_TO_1	0.066075
PROFIT_MAR	-0.025626
DEBT_TO_CA	-0.184464
INSTIT_OWN	-0.107505
LOCK_UP_NO	0.322087
LN_MARKET_	-0.091133
IPO_YEAR01=	-0.065814
IPO_YEAR01=	-0.193663
IPO_YEAR01=	-0.104920
IPO_YEAR01=	-0.065814
IPO_YEAR01=	-0.065814
IPO_YEAR01=	-0.173046
IPO_YEAR01=	-0.276828
IPO_YEAR01=	-0.340922
IPO_YEAR01=	1.000000

Appendix 5C - Correlation Matrix

PE-Backed IPOs (without PE-exit/not dummy)

	OFFER_TO_1	PROFIT_MAR	DEBT_TO_CA	INSTIT_OWN	LOCK_UP_NO	LN_MARKET_	IPO_YEAR01=
OFFER_TO_1	1.000000	0.077267	-0.088549	0.080818	-0.023952	0.154748	-0.053487
PROFIT_MAR	0.077267	1.000000	0.280715	-0.045539	-0.043097	0.151571	0.006833
DEBT_TO_CA	-0.088549	0.280715	1.000000	0.200785	-0.148235	0.393852	0.013603
INSTIT_OWN	0.080818	-0.045539	0.200785	1.000000	-0.231312	0.171215	-0.021800
LOCK_UP_NO	-0.023952	-0.043097	-0.148235	-0.231312	1.000000	0.126923	-0.372967
LN_MARKET_	0.154748	0.151571	0.393852	0.171215	0.126923	1.000000	-0.296105
IPO_YEAR01=	-0.053487	0.006833	0.013603	-0.021800	-0.372967	-0.296105	1.000000
IPO_YEAR01=	0.022672	0.010339	-0.126219	0.045569	-0.175151	-0.007803	-0.050990
IPO_YEAR01=	-0.035995	0.086785	0.293690	0.221408	-0.361710	0.290437	-0.084098
IPO_YEAR01=	0.023906	0.054518	0.166152	0.094507	0.074307	0.284292	-0.134535
IPO_YEAR01=	0.022365	-0.002739	-0.055849	-0.141080	0.085960	-0.054150	-0.165683
IPO_YEAR01=	0.066075	-0.025626	-0.184464	-0.107505	0.322087	-0.091133	-0.193663

	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=
OFFER_TO_1	0.022672	-0.035995	0.023906	0.022365	0.066075
PROFIT_MAR	0.010339	0.086785	0.054518	-0.002739	-0.025626
DEBT_TO_CA	-0.126219	0.293690	0.166152	-0.055849	-0.184464
INSTIT_OWN	0.045569	0.221408	0.094507	-0.141080	-0.107505
LOCK_UP_NO	-0.175151	-0.361710	0.074307	0.085960	0.322087
LN_MARKET_	-0.007803	0.290437	0.284292	-0.054150	-0.091133
IPO_YEAR01=	-0.050990	-0.084098	-0.134535	-0.165683	-0.193663
IPO_YEAR01=	1.000000	-0.045561	-0.072886	-0.089761	-0.104920
IPO_YEAR01=	-0.045561	1.000000	-0.120212	-0.148044	-0.173046
IPO_YEAR01=	-0.072886	-0.120212	1.000000	-0.236833	-0.276828
IPO_YEAR01=	-0.089761	-0.148044	-0.236833	1.000000	-0.340922
IPO_YEAR01=	-0.104920	-0.173046	-0.276828	-0.340922	1.000000

Appendix 5D - Correlation Matrix

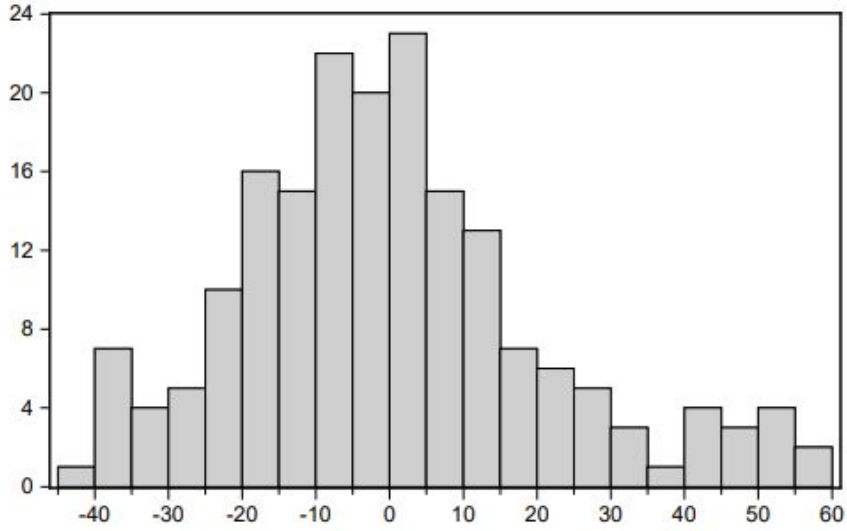
PE-Backed IPOs (including PE-exit/not dummy)

	OFFER_TO_1	PROFIT_MAR	DEBT_TO_CA	INSTIT_OWN	LOCK_UP_NO	LN_MARKET_	PE_EXIT_OR_
OFFER_TO_1	1.000000	-0.070531	0.065530	0.145915	-0.012247	0.280418	0.317606
PROFIT_MAR	-0.070531	1.000000	0.311990	0.004285	-0.124982	0.251010	0.327300
DEBT_TO_CA	0.065530	0.311990	1.000000	0.343294	-0.424359	0.527324	0.565809
INSTIT_OWN	0.145915	0.004285	0.343294	1.000000	-0.413298	0.239626	0.249975
LOCK_UP_NO	-0.012247	-0.124982	-0.424359	-0.413298	1.000000	-0.156092	-0.203828
LN_MARKET_	0.280418	0.251010	0.527324	0.239626	-0.156092	1.000000	0.670669
PE_EXIT_OR_	0.317606	0.327300	0.565809	0.249975	-0.203828	0.670669	1.000000
IPO_YEAR01=	-0.050220	0.041168	0.061799	0.093351	-0.293520	0.002853	0.109810
IPO_YEAR01=	-0.023467	0.041521	-0.135076	0.039861	0.052414	0.049250	0.109810
IPO_YEAR01=	0.035335	0.084204	0.318903	0.404216	-0.423972	0.304554	0.096927
IPO_YEAR01=	0.144211	-0.083406	0.284785	0.189713	-0.174173	0.280599	0.261588
IPO_YEAR01=	0.072084	0.138859	-0.182716	-0.331368	0.103033	0.052583	0.054662
IPO_YEAR01=	-0.082003	-0.147341	-0.230117	-0.050192	0.319438	-0.387676	-0.282694

	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=	IPO_YEAR01=
OFFER_TO_1	-0.050220	-0.023467	0.035335	0.144211	0.072084	-0.082003
PROFIT_MAR	0.041168	0.041521	0.084204	-0.083406	0.138859	-0.147341
DEBT_TO_CA	0.061799	-0.135076	0.318903	0.284785	-0.182716	-0.230117
INSTIT_OWN	0.093351	0.039861	0.404216	0.189713	-0.331368	-0.050192
LOCK_UP_NO	-0.293520	0.052414	-0.423972	-0.174173	0.103033	0.319438
LN_MARKET_	0.002853	0.049250	0.304554	0.280599	0.052583	-0.387676
PE_EXIT_OR_	0.109810	0.109810	0.096927	0.261588	0.054662	-0.282694
IPO_YEAR01=	1.000000	-0.015385	-0.031505	-0.067267	-0.061430	-0.093761
IPO_YEAR01=	-0.015385	1.000000	-0.031505	-0.067267	-0.061430	-0.093761
IPO_YEAR01=	-0.031505	-0.031505	1.000000	-0.137751	-0.125796	-0.192006
IPO_YEAR01=	-0.067267	-0.067267	-0.137751	1.000000	-0.268593	-0.409960
IPO_YEAR01=	-0.061430	-0.061430	-0.125796	-0.268593	1.000000	-0.374382
IPO_YEAR01=	-0.093761	-0.093761	-0.192006	-0.409960	-0.374382	1.000000

Appendix 6A - Jarque-Bera

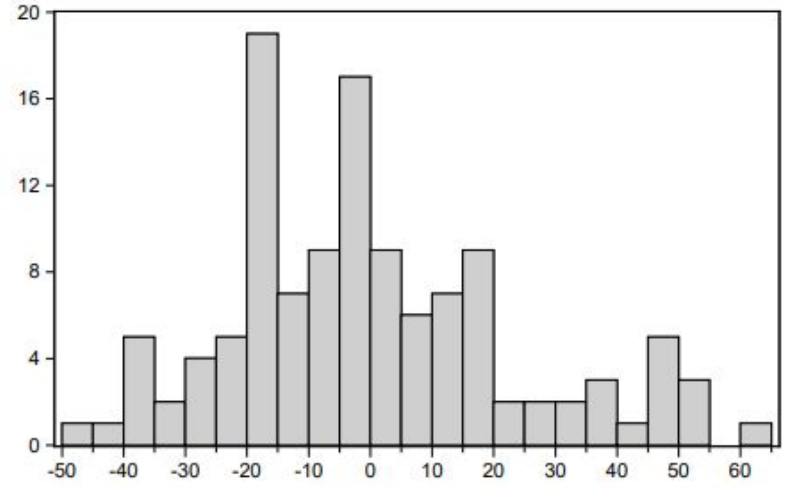
All IPOs



Series: Residuals	
Sample 1 277	
Observations 186	
Mean	5.23e-15
Median	-2.606722
Maximum	58.51787
Minimum	-44.01268
Std. Dev.	20.99197
Skewness	0.557648
Kurtosis	3.324296
Jarque-Bera	10.45517
Probability	0.005366

Appendix 6B - Jarque-Bera

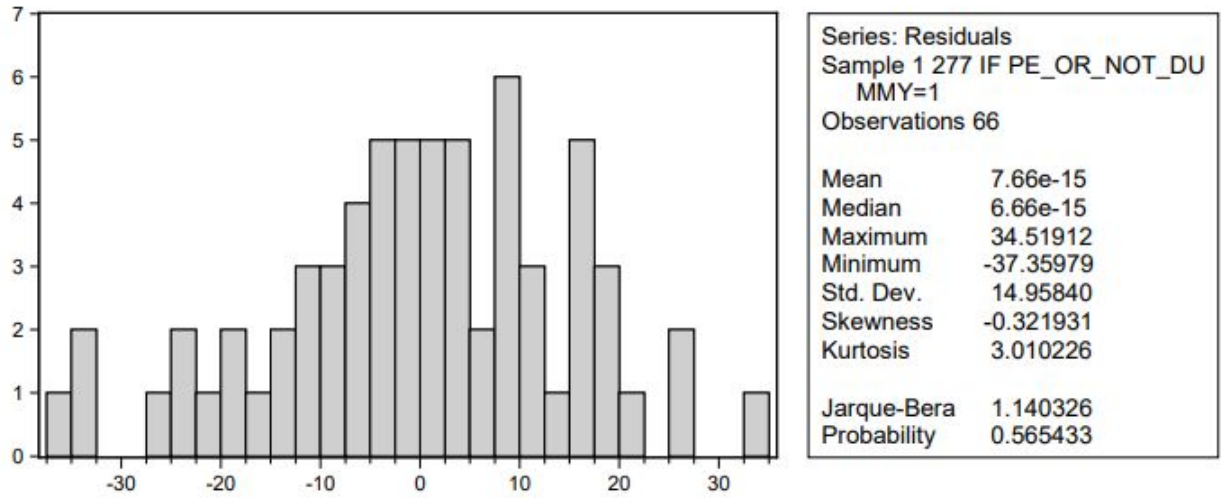
Non-PE-backed IPOs



Series: Residuals	
Sample 1 277 IF PE_OR_NOT_DU MMY=0	
Observations 120	
Mean	2.66e-15
Median	-4.226999
Maximum	63.91100
Minimum	-46.93100
Std. Dev.	23.26913
Skewness	0.623776
Kurtosis	3.054811
Jarque-Bera	7.796959
Probability	0.020273

Appendix 6C - Jarque-Bera

PE Backed IPOs (without PE Exit/Not dummy)



Appendix 6D - Jarque-Bera

PE-Backed IPOs (including PE-exit/not dummy)