ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Master Thesis Financial Economics

Initial Public Offerings and the impact of Private Equity on the issuers board composition and underpricing

Author: Bas Versantvoort

(411046)

Supervisor: Y.S. Gangaram-Panday

Second assessor: M. Korevaar

17-04-2021

Preface

The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

As this master thesis marks the end of my time as a student at the Erasmus University in Rotterdam, I would like to thank a few people. First of all, I would like to thank my parents and sister who have supported me, despite several setbacks, along the way. Furthermore, I would like to thank my roommates and friends who have made my time as a student in Rotterdam unforgettable. A special word of thanks to Cas, who I have spent several hours on the phone with during the thesis process. A thesis process guided by Dr. Gangaram-Panday, who I want to thank for his guidance during the entire process.

My interests in private equity and Corporate Finance in general were triggered by the experiences I gained during my internship at Oaklins Netherlands and the seminar Advanced Corporate Finance; Private Equity, a course that did provide me valuable insights and enthusiasm regarding this topic. I am therefore pleased that from June onwards, after finishing my masters, I will start my second internship within the field of Corporate Finance at Corporate Finance International (*CFI*).

Abstract

The increasing attention for social issues within society causes large underwriters and private equity firms to adjust and revise their investment policies. Increasing competition as well as social awareness regarding social issues as board diversity have increased the necessity for private equity firms to look into the decisions made with respect to the board of directors of their portfolio firm. Hence and as competition tightens, this paper studied the (potential) differences in respectively female, independent and total directors between PE-backed and non-backed issuers to investigate whether the (historical) difference found in underpricing arise from those differences. Due to the critical assessment of private equity firms with respect to the quality and size of the board of directors of their issuing (portfolio) firm, the influence of private equity backing on the established relationship between the afore-mentioned board components and IPO underpricing is investigated and considered as well. The research conducted consists out of 771 companies that went public in Europe between 2000-2019, of which 150 are private equity backed and 621 non-backed. The results suggest that PE-backed issuers have significantly more female and independent directors appointed, but a significant smaller board size compared to non-backed counterparts. Furthermore, the results indicate that PE-backed issuers are significantly less underpriced than non-backed counterparts. There is no evidence that the difference in underpricing found arise from differences in board composition, as it has not been established that private equity backing mitigates the significant positive relationship found between female directors and underpricing, as well as there is no evidence that private equity backing strengthens the respectively non-significant and significant negative relationship between independent directors and board size on the one hand and underpricing on the other.

Keywords: IPO Underpricing, Private Equity, Female directors, Independent directors, Board Size

JEL-Codes: D82, G30, G34, J16, L22

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1. Introduction

“Doing every part of the business well is more important today than ever because the competition and the capital are getting more and more intense … we're going to win by an inch, and we don't know which inch will get us over the goal line” (Spencer Stuart, 2018) - Ken Hanau, managing director at Bain Capital, a private equity firm operating in the US. As Hanau emphasises, in order for private equity firms to proceed with systematically outperforming the public market by realizing massive returns, more is asked as competition within the industry tightens. In order to generate sufficient returns at the portfolio firm’s exit, one should nowadays look beyond timing and economic conditions, but also focus on operating expertise and industry dynamics.

One universal trend private equity firms pick up is the increasing inclusion of outside independent directors, as well as an increase of total board directors as a whole. As Paul Peterson, managing director at US-based private equity firm Wind Point Partners quote: "There's much more thought put in very early into a deal. We like to identify directors early so they have some ability to weigh in on the opportunity, and so we think about the makeup of the board throughout the deal process, from the beginning” (Spencer Stuart, 2018). Furthermore, according to Hanau, private equity firms not only rely on the capabilities independent directors bring to the table, but also profit from relationships outside directors built-up within the specific industry. Therefore, the composition of a portfolio firm’s board has become from increased importance for private equity firms.

However, not solely the urge for sufficient returns led private equity firms to reconsider their portfolio firm’s board composition. Social issues within society regarding board diversity causes large underwriters and private equity firms to adjust and revise their investment policies as well. For example, Swedish private equity firm EQT announced to strive to gender balance within their portfolio firms; from 2020 onwards, EQT aims that 65% of their recruits has female gender. Furthermore, at least 25% of all board members within their portfolio firm should be female, aiming on gender balance in all divisions within the portfolio firm long-term. Other institutions commit their policy to board diversity as well. So did David Solomon, CEO at global investment bank Goldman Sachs, state that from 2021 onwards Goldman Sachs will solely underwrite IPOs within the US and Europe if the board of the issuer consists out of at least two female members. According to Solomon, diverse leadership causes better

performance. He emphasized that US-based companies with at least one female board member outperform their counterparts measured one year post-IPO since 2016.

As private equity firms identify the increasing significance of those corporate governance mechanisms, Gilson and Gordon (2019) stated that publicly traded companies should reconsider the way their board operates and examinate the composition used by private equity firms. Namely, where private equity firms experience high director involvement, resulting in higher value creation within the portfolio firm, publicly traded companies leave directors that are barely informed, have insufficient resources and are limited motivated (Gilson and Gordon, 2019).

As private equity firms differ from non-backed counterparts in their (critical) assessment of the significance of corporate governance mechanisms, such as the size and quality of the issuer's board, it is interesting to investigate whether differences in board composition between PE-backed and non-backed issuers persist and if those differences led PE-backed issuers to outperform their non-backed counterparts in terms of underpricing. Although board composition of the issuing (portfolio) firm becomes from increasingly importance for private equity firms in order to earn sufficient returns, the influence of private equity firms on the relationship between female, independent and total directors on the one hand and underpricing on the other is unclear. Where prior research primarily focused on the influence of female, independent and total directors on underpricing, the influence of private equity backing on those determinants is not considered before. Therefore, this paper attempts to fill the gap within existing literature by investigating the differences between PE-backed and non-backed issuers in terms of their board determinants (female, independent and total directors), as well as the influence of private equity backing on the relationship between those determinants and underpricing. In order to do so, this paper tries to answer the following research question:

What is the influence of private equity backing on the issuers board composition and the degree of underpricing?

The IPO, afore-mentioned by David Solomon (CEO at Goldman Sachs), is the first attempt of a private firm to raise capital in a public market and presents one of the three possible exit routes for a private equity firm to divest their investment within the portfolio firm (Folus and Boutron, 2015). As Ken Hanau mentioned, the competition within the industry is increasing in intensity. Hence, the exit strategy for a PE-firm becomes even more critical for the success of the investments process (Sinha et al., 2005). In other words, in order to achieve sufficient returns,

one should successfully bring the portfolio firm to the public market by minimizing the money that is left on the table.

However, prior research indicates that money is left on the table quite often. Namely, there is a significant difference between the offer price set once the portfolio firm goes public and the price after the first trading day closes, leading to the overall conclusion that the IPO price is set too low. This phenomenon, called IPO underpricing, can be seen as money that shareholders of the portfolio firm, in this case the private equity firm, leave on the table ((Ibbotson, 1975; Loughran and Ritter, 2002**)**. As a result, the return achieved by the private equity firm lowers. Nevertheless, historical research revealed that PE-backed IPOs succeed in leaving less money on the table, as they outperform VC-backed and non-backed counterparts by experiencing significantly less underpricing. This paper confirms the findings of, among others, Levis (2011), Moglivesky and Murgulov (2012) and Rodvang and Ulsrud (2019) by finding significant less underpricing for PE-backed issuers compared to non-backed counterparts. A difference prior research primarily attributed to the certification hypothesis, where the active involvement of a financial sponsor, in this case the private equity firm, can mitigate ex-ante uncertainty regarding the true value of an IPO (Megginson and Weiss, 1991). Certification by a third party would mitigate the information asymmetry between issuer and outside investor, either informed or uninformed, thereby reducing the level of underpricing. Namely, when the (uninformed) investor becomes better informed, the ex-ante uncertainty about the IPOs true value decreases. As a result, compensation in the form of underpricing can be reduced and the issuer's IPO can be sold at a higher price. Hence, the return for the private equity firm will be higher.

To (potentially) explain the difference in underpricing between PE-backed and non-backed issuers, the differences in female, independent and total directors are investigated. Board diversity, that is the inclusion of female directors within the board, may benefit the issuing (portfolio) firm, as female directors stimulate decision-making, board strategic control, board effectiveness, firm performance, managerial competence and earnings quality (Adams and Ferreira, 2009; Badru, Ahmad-Zaluki and Wan-Hussin, 2019; Chen, Ni and Tong, 2016; Leslie et al., 2017; Mcguiness, 2018; Nielsen and Huse, 2010; Terjesen, Couto and Francisco, 2015). On the other hand, due to stereotypes among investors, investors might perceive that female representation lack the abilities to monitor the firm effectively, as females are evidently less confident in decision-making compared to men and often show more risk-averse behaviour than men, thereby unable to fully maximize shareholders' return (Barber and Odean, 2001;

Hillman and Dalziel, 2003; Hillman, Shropshire and Cannella, 2007). The results in the research conducted indicate that issuers backed by private equity have significantly more female directors within their boards, namely 1 out of 4 compared to 1 out of 5 for non-backed issuers. It appears that female directors significantly increase IPO underpricing and there is no evidence that private equity backing mitigates the relationship between female directors and IPO underpricing.

Moreover, the impact of independent directors is investigated. It is argued that a strong board of independent directors can reduce asymmetric information, agency problems and, as a result, underpricing. For example, a board occupied by relative more outside directors could mitigate potential agency problems by monitoring more effectively (Bédard, Coulombe and Courteau, 2008; Howton, Howton and Olson, 2001; Jensen and Meckling, 1976). On the other hand, greater independence within boards can also lead to over monitoring and a reduction of firm value (Fama and Jensen, 1983). Optimally, boards have a large portion of outside directors where potential costs of monitoring are excelled by manager's benefits (Boone, Field, Karpoff and Raheja, 2007). Firm with greater information asymmetry face higher monitoring costs, therefore eventually ending up with smaller and more dependent boards (Maug, 1997; Linck, Netter and Yang, 2008). The results in the research conducted indicate significantly more independent directors within the board of PE-backed issuers with respect to non-backed issuers; within PE-backed boards 3 out of 5 directors is independent, relative to 5.5 out of 10 for issuers not backed by a financial sponsor. However, there is no evidence that independent directors reduce the information asymmetry between issuer and outside investor, as no significant relationship between the proportion of independent directors and underpricing is found. Furthermore, there is no evidence that private equity backing strenghten the relationship between the proportion of independent directors and underpricing.

Last, the differences in board size between PE-backed and non-backed issuers are investigated. It seems that there exists a trade-off between net benefits compared to the potential costs arising from extra monitoring. Larger boards tend to monitor more effectively, therefore increasing manager's benefits (Harris and Raviv, 2008; Boone, Field, Karpoff and Raheja, 2007). For example, larger boards have larger opportunities to attract additional resources from an investor point of view. Contrarily, monitoring could become less effective if boards become larger (Mak and Kusnadi, 2005). For example, a board with more than seven to eight members works counterproductive (Jensen, 1993). Larger boards tend to have more free-riders, wherefore agency costs increases (Hermalin and Weisbach, 2001).

Although PE-backed issuers appoint significantly more female- and independent directors, the overall board size is statistical significantly smaller compared to non-backed issuers. A significant negative relationship between board size and underpricing is found, indicating that larger boards mitigate the level of underpricing. As the results within the research conducted specify, there is no evidence that private equity backing strengthen this relationship.

Therefore, despite the differences in board composition between PE-backed and non-backed issuers, there is no evidence that private equity backing significantly influences the relationship between mentioned board components and IPO underpricing. These results suggest that private equity firms are able to occupy the certification role, but there is no evidence that differences within board composition induce the differences found in underpricing.

The sample, covering from 2000 until 2019, consists out of 771 IPOs, of which 150 are private equity backed and 621 not backed by a financial sponsor. An univariate and multivariate study of the data, collected in several databases such as Bloomberg, BoardEX, Compustat and ISS, is executed in order to contribute to the existing literature in the field. A contribution is made as research regarding the differences in board composition between PE-backed and non-backed issuers are not examined before. Furthermore, the impact of private equity backing on the relationship between female, independent and total directors on the one hand and underpricing on the other hand is not investigated up to this point. Last, research regarding female directors and their influence on the level of underpricing is limited.

The set-up of this paper is as follows. First, prior academic literature regarding private equity, IPO underpricing and board composition is reviewed. Thereafter, the computed data is presented, as well as the methodology used to conduct empirical testing. Third, the corresponding results after executing both the univariate as well as the multivariate analysis are exposed. Last, a conclusion regarding the implications of the founded results is drawn and discussed, as well as limitations faced and recommendations regarding future research.

2. Literature Review

This section covers the literature discussed regarding IPO underpricing in previous years, as well as foundations on related topics such as private equity and different components of board composition. The first part will solely focus on private equity, hereafter called PE, explaining what PE firms generally do, the life cycle of a PE fund, how IPOs can be utilized as exit strategy and the academic research done with respect to PE activity on the IPO market. Thereafter, an

overview of the theory behind an Initial Public Offering, hereafter called IPO, is given, whereafter the implications of IPO underpricing are explained and defined. Last, the research done related to both the proportion of female and independent directors on the board of an IPO firm, as well as the total board size are reviewed.

2.1. Private Equity

According to Cendrowski, Petro, Martin and Wadecki (2012), an investment by a PE firm can best be described as a medium or long-term equity investment, generally between 7-10 years, in a firm that is not publicly traded on an exchange. Investments in PE also include venture capital and buyout transactions, as well as investments in hedge funds, debt securities, fund of funds and other securities. For the purpose of this thesis, I will exclusively focus on investments made by PE firms in equity.

2.1.1. Structure

The aim of a PE firm is to improve the financial performance of their portfolio company, in order to realize profit when the investment is exited. Those profits are needed, because of the structure a PE firm entails. Before the firm is able to invest in a portfolio firm, capital needs to be acquired. Investments are made out of a fund, with a number of outside investors investing in the fund. Those third party investors are called Limited Partners (LP) (Chemmanur and Fulghieri, 1999). Examples of third party investors are institutional investors, banks and insurance companies (Kaplan and Stromberg, 2009). The PE firm, which manages the fund and makes the decision whether to invest in a portfolio company, is called the General Partner (GP). An overview of the structure of a private equity fund is given in figure 1.

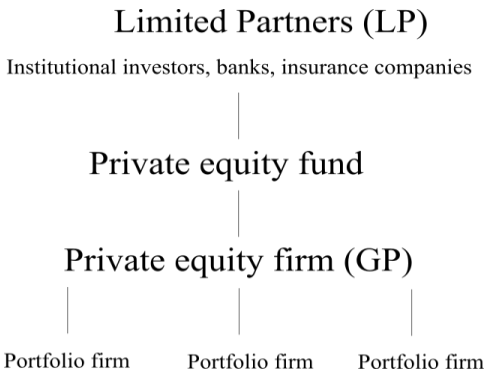

Figure 1. The structure of a private equity fund. The private equity fund is funded by limited partners. Capital within the equity fund is managed by the private equity firm (GP). The capital is invested in portfolio firms by the GP, with approval of initial investors (LP).

If the financial performance of a portfolio company improved under the PE's supervision over the years, the portfolio firm can be sold at a higher price after 5 – 10 years, whereafter profits can be allocated among GPs and LPs. According to past literature, this scenario often occurs. Among others, Harris, Jenkinson and Kaplan (2014) find that private equity funds outperform their public counterparts since 1990, the time the industry started to grow rapidly.

2.1.2. Life Cycle

As can be seen in figure 2, the life cycle of a PE fund is approximately 7-10 years. A fund typically goes through five stages, namely fundraising, deal sourcing, investment, management and exit (figure 2).

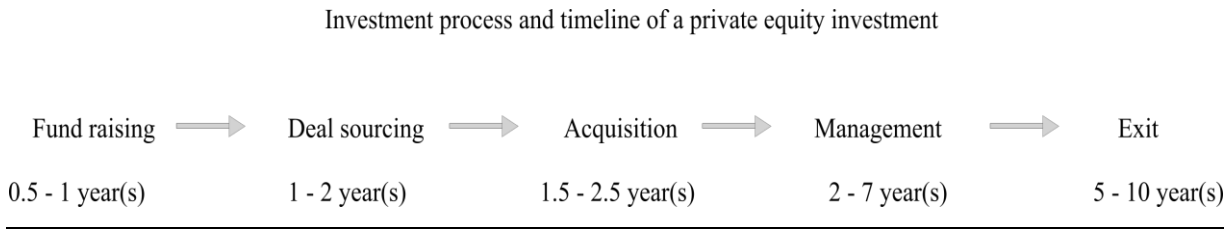

Figure 2. The life cycle and investment process regarding a private equity investment. The total timeline expresses the lifetime of a typical private equity fund.

As mentioned in section 2.1.1., at the beginning of each fund, the PE firm first needs to find investors who want to commit a certain amount of money to pay for the investments made (Kaplan and Stromberg, 2009). Chung, Sensoy, Stern and Weisbach (2010**)** find that the GP's ability to raise capital for future follow-on funds is affected by their current funds' performance. After capital is raised and the investment criteria are determined, the firm can proceed with deal scouting. After the investment in the portfolio firm is made, there is a period of approximately 5 years where the management of the PE firm can implement desired changes, for example the replacement of current management or a shift in geographical focus (Rodvang and Ulsrud, 2019). Usually multiple investments are made, until the funds' capital is insufficient to proceed investing. At the end of the lifetime of the fund, the PE firm will divest its investment, allocate possible returns and initiate future fundraising. According to Folus and Boutron (2015), there are three possible exit routes to allocate possible returns; a sale to a strategic buyer, a sale to another financial buyer or an IPO.

2.1.3. PE activity on the European IPO Market

Section 2.1.2. hightligted the fact that private equity firms have the possiblity to exit their investment through an IPO. Levis (2011) already mentioned the increasing importance of private equity firms on the global equity markets.

An overview of the historical number of European IPOs backed by private equity can be found in figure 3. As can be seen, the number of PE-backed IPOs dropped in 2008 (7%) due to the financial crisis. As shown, the number of PE-backed IPOs started to take a turn in 2013, from 13% in 2012 up to 46% in 2013. Previously, poor post IPO performance and high leverage of PE-backed IPOs caused distrust by investors. However, PE-backed IPOs showed to be a reliable investment, fair priced providing strong cashflows. Therefore, the volume of IPOs backed by private equity increased to 46% in 2013, providing investors new investment alternatives (PwC, 2014). The percentage PE-backed IPOs remained constant in 2015, despite the IPO activity on the London Stock Exchange (LSE) coming from AutoTrader and Worldpay, two of the largest PE-backed IPOs ever. In 2018, the number of IPOs backed by private equity dropped, due to old PE-portfolios expirering and new acquisitions not ready to enter the market yet (PwC, 2018). The trend reversed in 2019, where 42% of all IPOs was PE-backed.

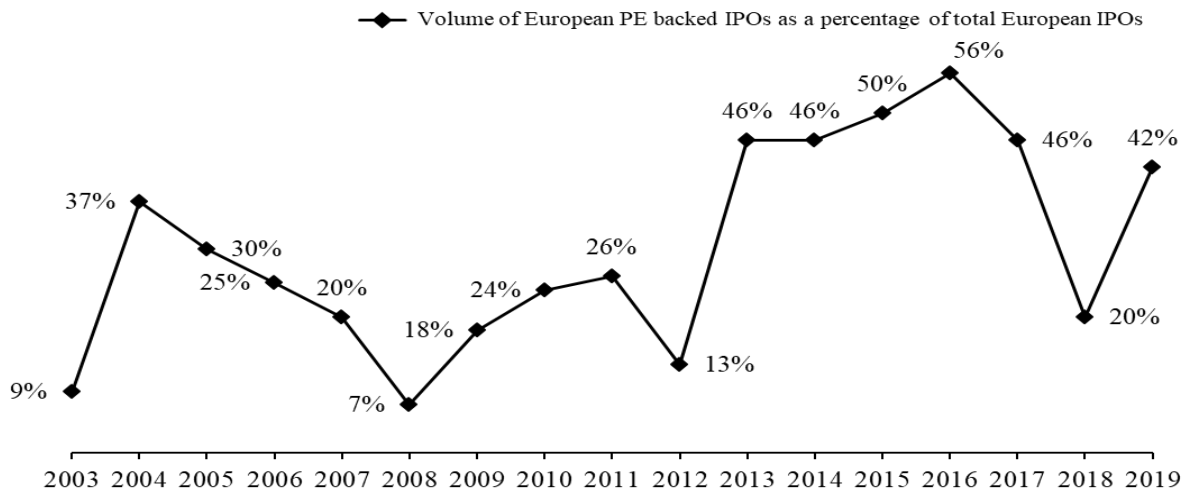

Figure 3. The volume of European PE-backed IPOs as percentage of total European IPOs between 2003-2019. Source: PwC (2014) and PwC (2018)

2.2. Theoretical Framework

According to Carter and Manaster (1990), an IPO is the first attempt of a private firm to raise capital in a public market. A survey undertaken by CFO's regarding 78 firms revealed the strategic and financial considerations firms face when going public (Bancel and Mittoo, 2009). Going public allows the company to enhance future growth, for example by increasing brand awareness and acquisition opportunities (EY, 2014).

2.2.1. IPO Process

Once a company decides to go public, an investment bank to advise and perform several underwriting functions related to the issue needs to be selected. Carter and Manaster (1990) already revealed the important role underwriters play by validating IPOs. An underwriter's first step is to compose a registration statement which includes the company's prospectus. Setting up a prospectus is needed to provide potential buyers credible and accurate information concerning the shares offered for sale (Ellis, Michaely and O'Hara, 1999). Once the registration statement is approved, a road show is set up to attract the attention of institutional investors. A road show's objective is to describe the firm's characteristics, for example its operating activities, products, geographical focus and management (Certo, 2003). After the road show, the underwriter builds up an IPO order book, determining the institutional investors interests by asking the number of shares and price they would pay (EY, 2014). Relying on the quality and quantity of the order book, an issue price is determined. After distributing shares to investors who are part of the order book, the company goes public. From that moment, the price is determined by the exchange the stock is traded on.

2.2.2. European IPO Market

An overview of how the European IPO market performed within the last 12 years can be found in figure 4. As can be seen, the European IPO market reached his top in 2006 with 806 offerings and €87bn total value, whereafter the world financial crisis made the market more unstable and unpredictable (Glavina, 2013). As a result, the number of executed IPOs per year dropped to 220 between 2008 and 2018, where between 1997 and 2007 380 IPOs were executed (Federation of European Securities Exchanges, 2020). In 2010, after the financial crises was resolved and a minimum amount of IPOs was reached in 2009, the volume of the European IPO market tripled (from 126 to 380), raising a total number of €26.286bn (PwC, 2010).

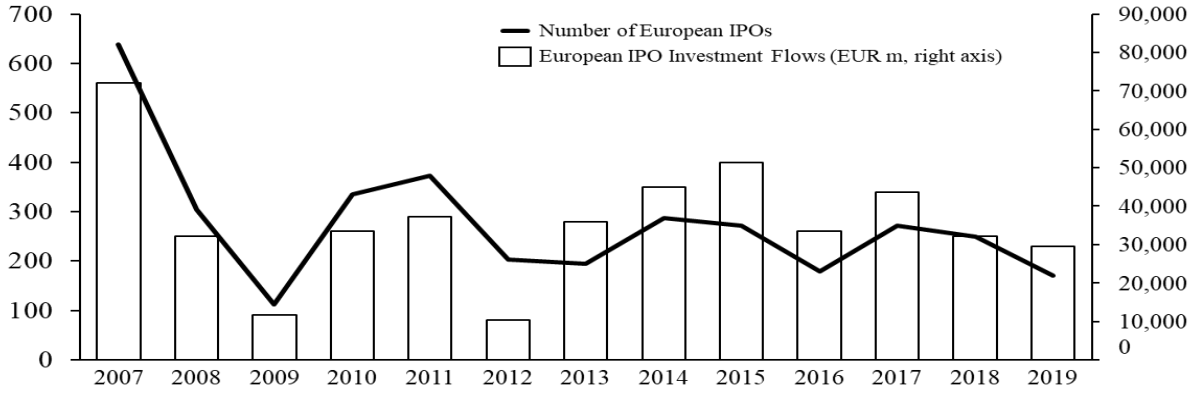

Figure 4. Evolution of European IPO Markets between 2007-2019. The left Y-axis represents the number of European IPOs (line), where the right Y-axis measures the European IPO investments flows in EURm (bars).
Source: Federation of European Securities Exchanges, 2020

Despite economic and political uncertainty coming from, among other causes, the Eurozone crisis, the volume increased in 2011. These uncertainties had their reflection on the first half of 2012, resulting in a downfall of 167 IPOs annually.

As indicated in figure 3 and section 2.1.3., the activity of PE-backed IPOs increased to 46% of total IPOs in 2013. As can be seen in figure 4, the total number of European IPOs remained constant between 2013-2015. Over the period 2015-2018, the number of listed companies decreased by 600 and 50 fewer IPOs took place in 2018 compared to 2015. The decline can be attributed to the decision of smaller companies not to enter the market and Brexit, which had a major effect on (potential) listings in the United Kingdom (Federation of European Securities Exchanges, 2020; PwC, 2018). Due to ongoing Brexit negotiations and US-China tension, the European IPO markets declined even further in 2019. However, due to progress in above-mentioned conflicts, there are optimistic expectations for 2020 and beyond (PwC, 2019).

2.2.3. IPO Underpricing

Section 2.2.1. illustrated that the initial price of an IPO is determined by the IPO order book and the negotiations between the underwriter and the firm (McBain and Krause, 1989). Historically, there is a significant difference between the offer price and the price after the first trading day closes, leading to the overall conclusion that the IPO price is set too low. This phenomenon is called IPO underpricing (Ibbotson, 1975). The underpricing can be seen as money that shareholders of the issuing firm, for example the private equity firm, leave on the table (Loughran and Ritter, 2002).

Over time, several authors tried to come up with a logical explanation for the appearance of underpricing. According to a survey performed by Ljungqvist (2004), the information asymmetry hypothesis provides a sufficient explanation for the occurrence of underpricing in the IPO market (Baron, 1982; Rock, 1986). Naturally, private firms tend to have a larger degree of information asymmetry than public firms, considering the fact that information of (former) publicly traded companies, contrary to private firms, is publicly available. For example, current owners have more (private) information about the managerial credibility and economic potential of the firm (Cohen and Dean, 2005).

The greater the information asymmetry between current owners of the firm and (potential) investors, the greater the ex-ante uncertainty regarding the true value of the firm when the (private) firm decides to go public via an IPO. Beatty and Ritter (1986) argued that the greater the ex-ante uncertainty about the intrinsic value of the IPO, the greater the expected underpricing will be. They stated that IPOs are underpriced on average and in equilibrium, but the degree of underpricing depends on the level of ex-ante uncertainty. Miller and Reilly (1987) reached the same conclusion, indicating that underpricing increases when the value of the firm is uncertain and therefore considered risky. In the US, the level of underpricing has declined after introducing the Sarbanes-Oxley Act (25.5% initial return prior implementation compared to 10.2% afterwards), indicating that greater transparency causes less uncertainty regarding the value of the firm (Johnston and Madura, 2009). Therefore, the issuer is encouraged to keep the information asymmetry between issuer and investor as small as possible, to reduce the ex-ante uncertainty regarding the true value of the issuing firm.

However, while IPOs on average are underpriced, a great portion of IPOs also experience overpricing. An investor that invests in all IPOs would therefore also allocate a substantial amount of shares to overpriced IPOs, leading to an initial return for the investor that is less than average. Hence, investors have an incentive to execute research to distinguish IPOs that are likely to be underpriced.

According to Rock (1986), there are two types of investors; uninformed and informed. The informed investor executes research and therefore solely invests in underpriced IPOs, leading to an equilibrium where the informed investor covers his research costs by investing in underpriced IPOs, subsequently earning profits. Nevertheless, there also exists a group uninformed investors who doesn't execute research in an attempt to free ride. The informed investor has superior information compared to the uninformed investor, resulting in a winner's curse where informed investors only buy shares from underpriced IPOs, leaving uninformed

investors behind with less successful IPOs and an initial return that is less than average. Considering that uninformed investors are unable to distinguish underpriced IPOs from overpriced IPOs, in case the ex-ante uncertainty regarding the intrinsic value of the IPO rises, there is more to lose for uninformed than informed investors (Beatty and Ritter, 1986). Namely, the riskiness of the investment for the informed investor increased, as the ex-ante uncertainty regarding the true value of the issuing firm rises and the uninformed investor, contrary to the informed investor, is unable to distinguish overpriced from underpriced IPOs. As a result, an uninformed investor would only allocate shares to any IPO, underpriced or overpriced, if the average IPO is underpriced. In case the ex-ante uncertainty rises, thereby increasing the risk for the uninformed investor, there will be greater demand to compensate this uninformed investor by leaving more money at the table, implicating higher underpricing. Therefore, the underpricing can be seen as compensation for the uninformed investor, encouraging them to participate in new offerings and preventing the evolvement of a lemons' problem (Akerlof, 1970). In his paper, Akerlof (1970) highlighted the problem arising from information asymmetry in a market situation with second-hand cars, where in equilibrium solely second-hand cars were sold.

Hence, in order to keep the information asymmetry between issuer and investor as small as possible, firms may pursue to signal their quality (Spence, 1973). Spence's signalling theory described the challenge for the issuing firm to illustrate their true quality, in order to reduce the underpricing and amount of money that is left on the table. The different mechanisms which can be assessed by issuers to illustrate their true quality are further discussed in section 2.3.

2.2.4. PE-backed vs non-backed

As stated in section 2.1.2., private equity firms have the possibility to exit their investment at the end of the life cycle of a fund through an IPO. In order to examine the historical success of this exit route, research has been done about the underpricing of PE-backed IPOs relative to VC- and non-backed counterparts. Differences in information asymmetry, discussed in section 2.2.3., between VC-backed and non-backed IPOs were already found by Megginson and Weiss (1991), resulting in lower underpricing for VC-backed IPOs. These differences can be attributed to the certification hypothesis, where the active involvement of a financial sponsor, in this case the venture capital firm, can mitigate information asymmetry about the true value of the IPO (Megginson and Weiss, 1991).

That is, to prevent the occurrence of market failure described in section 2.2.3. by Akerlof (1970), institutions have an incentive to certify the offer price, by ensuring all private information is reflected within the offer price (Booth and Smith, 1986). Examples of institutions that are capable to certify reliably are underwriters, auditors, banks as well as venture capital and private equity firms (Deb and Marisetty, 2010). Those institutions have the reputation to be better qualified to determine the true value of the issuing firm, as they were involved in the IPO process of multiple firms in the past. Certification by a third party would mitigate the information asymmetry between issuer and outside investor, either informed or uninformed, thereby reducing the level of underpricing. Namely, when the uninformed investor becomes better informed due to certification of the offer price by a third party, the ex-ante uncertainty about the IPOs true value decreases. As a result, compensation in the form of underpricing can be reduced and the issuer's IPO can be sold at a higher price (Megginson and Weiss, 1991).

The certification hypothesis appeared to be even stronger for PE-backed than VC-backed IPOs; Levis (2011) looked into the Londen Stock Exchange and found that PE-backed IPOs are less underpriced than VC- and non-backed counterparts (9.10% against 14.10% and 21.10%). The results found can be explained by differences in size, profitability and operational efficiencies. Larger firms have usually more public information available, hence less uncertainty regarding their true value. Higher operational efficiencies might contribute to higher profitability, which can be seen as a signal of good firm quality (Darmadi and Gunawan, 2013; Reutzel and Belsito, 2015). As a result, issuers backed by private equity firms are considered less risky, resulting in lower underpricing. Ferretti and Meles (2011) did a similar research on the Milan Stock Exchange between 1998-2008 and found significant less underpricing (1.92% relative to 6.57%) for PE-backed IPOs. Following the certification hypothesis, they argue that PE-firms are able to reduce information asymmetry by signalling and certifying the true quality of their (portfolio) firm to investors. Private equity firms establish a reputation by bringing multiple companies to the public market and are actively involved in the portfolio firm's management, wherefore capable to resolve issues relating information asymmetry between issuer and investor.

However, a group of researchers raised questions regarding the occupation of the certification role by private equity firms. They developed alternative theories, such as the grandstanding theory (Lee and Wahal, 2004). The grandstanding theory can be described as follows. Gompers (1996) described the importance for venture capital firms to establish their reputation to take portfolio companies public in order to assure future fundraising (a process described for private equity firms in section 2.1.2.). In order to maintain that reputation, VC-firms might bear the cost of underpricing, resulting in higher underpricing for VC-backed IPOs with respect to PE-backed and non-backed IPOs (Lee and Wahal, 2004). As the VC-firm is a shareholder of the issuer at time of IPO, greater underpricing would imply lower returns for existing shareholders, such as the VC-firm, as there is more money left on the table. As going public is crucial for venture capital firms to ensure future fundraising, VC-firms would accept a lower return, thereby bearing the costs of the underpricing. For example, Mogilevsky and Murgulov (2012) found significantly higher underpricing for VC-backed IPOs relative to non-backed IPOs (23.40% relative to 14.30%).

In section 2.1.2., the importance of current fund performance and the ability to raise future funds for private equity firms is already highlighted. However, private equity firms are usually larger, more mature and less dependent on the success of an IPO than venture capital firms. Therefore, I expect the certification hypothesis to be more applicable for PE-backed IPOs, emphasizing the role private equity firms have in mitigating information asymmetry between the issuing (portfolio) firm and investors. Aforementioned research led to the first hypothesis, which tests whether private equity backed IPOs experience significantly lower levels of underpricing. The first hypothesis is derived as follows:

H1: PE-backed IPOs in Europe experience significantly lower levels of underpricing than their non-backed counterparts

2.3. Board Structure

As discussed in section 2.2.3., in order to reduce information asymmetry between issuer and potential investors regarding the intrinsic value of the firm, the issuer could send signals (Connelly, Certo, Ireland and Reutzel, 2011; Spence, 1973). Such signals would reduce ex-ante uncertainty regarding the value of the issuer of the IPO, thereby reducing underpricing (Reutzel and Belsito, 2015).

Where the historical consensus assumed that investors primarily look at financial statements prior decision making whether to invest, recent authors examined the influence of corporate governance on the investor's decision making process (Chahine and Goergen, 2011). That is, corporate governance could provide nonfinancial information that investors consider when making the decision whether to invest (Certo, 2003). For instance, proper functioning corporate governance would assure investors that managers seek to maximize firm value rather than acting out of self-interest (Bruton et al, 2010; Shleifer and Vishny, 1997).

A visible corporate governance mechanism is the board of directors, which is in charge of executing both strategic and financial decisions (Fama and Jensen, 1983). Furthermore, they are in charge of monitoring the firm and responsible for bringing in external resources (Adams and Ferreira, 2009; Hillman et al., 2007). While boards have these responsibilities, the effectiveness of executing above-mentioned tasks varies between boards (Hillman and Dalziel, 2003). Judging by the functions described above, Sanders and Boivie (2004) stated that the board of directors is a reliable source for firm quality and can serve potential investors in their decision whether to invest in the IPO.

2.3.1. Female Directors

If the board of directors is a reliable source for firm quality (Sanders and Boivie, 2004), it is worthy to look at different board components. One of the components prior research looked into is the influence of the proportion of female directors on IPO underpricing. Namely, increasing female representation in the board room makes the relationship with IPO performance worth looking into (Jourova, 2016).

Several authors already pointed out the potential benefits women bring along, stimulating decision-making within the board (Adams and Ferreira, 2009; Leslie et al., 2017). Nielsen and Huse (2010) emphasized the positive influence of women on board strategic control, increasing both the level of cooperation and activeness within the board. Chen, Ni and Tong (2016) highlighted the positive relationship between board effectiveness and gender diversity, eventually expressed in enhanced risk management and lower R&D risk. Last, firms with more female directors signal higher firm performance (Terjesen, Couto and Francisco, 2015), managerial competence (Mcguiness, 2018) and earnings quality (Gul, Srinidhi and Ng, 2011).

On the other hand, although female representation is rising, Burgess and Tharenou (2002) stressed that the appointment of female directors nowadays is still quite rare. As the vast majority of the directors is male, investors idealize and associate the characteristics of a capable director with masculinity. As a result, investors might perceive that female representation lack the abilities to monitor the firm effectively (Hillman and Dalziel, 2003; Hillman, Shropshire and Cannella, 2007). So did prior research indicate that females are evidently less confident in decision-making compared to men (Barber and Odean, 2001). Female directors often show more risk-averse behaviour than men, thereby unable to fully maximize shareholders' return (Jensen and Meckling, 1976; Olsen and Cox, 2001). In their study, Reutzel and Belsito (2015) showed that, between 1997 and 2007, female directors increased underpricing mainly due to these female stereotypes among investors.

Furthermore, in their research in the US between 1998-1999, Nelson and Levesque (2007) found significant less female directors in boards of venture capital backed companies compared to Fortune 500 companies. They stressed that women may encounter structural barriers in their way to a management position, lack knowledge and skills within the specific sector the venture capitalist invests in and make different strategic choices with respect to men (Greene, Brush, Hart and Saparito, 2001). Based on the research conducted, a second hypothesis is developed. Since females experience structural barriers within venture capital, it is most likely they experience the same barriers in a male-dominated industry as private equity. Therefore and similar to the research executed by Nelson and Levesque (2007) with respect to VC-firms, I expect PE-backed firms to have a significantly lower proportion of female directors than non-backed counterparts:

H2.1: PE-backed firms have a significantly lower proportion of female directors compared with non-backed counterparts

Subsequently, section 2.2.4. referred to the role private equity firms play in the IPO process. Institutions, such as a private equity firm, are able to certify the offer price as they are better qualified to identify the true value of the issuer, taking away most of the uncertainty surrounding the IPO. As Reutzel and Belsito (2015) stressed, the number of female directors increases the level of IPO underpricing due to female stereotypes among investors. I would expect that, due to the certification role private equity firms occupy, private equity backing significantly reduces the positive influence female directors have on underpricing by diminishing the uncertainty surrounding the IPO.

Namely, the certification role private equity firms seize would mitigate the information asymmetry between issuer and outside investor, either informed or uninformed, thereby reducing the ex-ante uncertainty about the IPOs true value. As a result, compensation in the form of underpricing can be reduced and the positive influence of female directors on underpricing would be diminished by the presence and perceived qualifications of the private equity firm to identify the issuer's true value. To test whether the positive relationship between female directors and underpricing can be mitigated by the certification role private equity firms occupy, H2.2 is as follows:

H2.2: Private equity backing mitigates the positive influence of the proportion of female directors on IPO underpricing compared with non-backed counterparts

Several authors highlighted the importance of the number of independent directors and total board size alongside female directors (Boone, Field, Karpoff and Raheja, 2007; Darmadi and Gunawan, 2012; Yatim, 2011). Therefore and to test further implications of different components of board composition, the theoretical overview of both components within the field of IPO underpricing will be discussed in the two following sections.

2.3.2. Independent Directors

A board consists out of inside and outside directors, where inside directors also hold positions within the firm, for example the position of CEO. Outside directors are not involved in the day-to-day operations of the firm (Choi, Park and Yoo, 2007).

Howton, Howton and Olson (2001) argued that a strong board of directors can reduce asymmetric information, agency problems and, as a result, underpricing. For example, a board occupied by relative more outside directors could mitigate potential agency problems by monitoring more effectively (Jensen and Meckling, 1976; Bédard, Coulombe and Courteau, 2008). Therefore, larger and more diversified firms should have more outside directors, in order to deal with a larger variety of operations and (potential) agency problems (Coles, Daniel and Naveen, 2008). Outside directors bring diverse opinions and greater expertise to the table, thereby increasing firm performance (Pearce and Zahra, 1992).

After investigating 525 IPO firms in Taiwan, Lin and Chuang (2011) concluded that independent directors reduce underpricing significantly by 2.60%. This result can primarily be contributed to the weakened control of controlling shareholders, thereby mitigating principal-principal conflicts between current management and those shareholders (Anderson and Reeb,

2004). In particular, inside directors might protect current shareholders by increasing IPO underpricing, thereby causing oversubscription as the initial price is set too low, preventing potential institutional investors to take over control (Lin and Chuang, 2011). A larger proportion of outside directors would prevent the occurrence of this scenario. Consistent with Lin and Chuang (2011) and after investigating 251 IPOs in the UK between 1999 and 2000, Filatotchev and Bishop (2002) concluded that if independent directors represent more than 1/3th of the board seats, a negative relationship between independent directors and the level of underpricing occurs. Yet, in his study, Yatim (2011) failed to find a significant relationship between independent directors and the level of underpricing in Malaysia between 1999 and 2008.

At the same time, greater independence within boards can also lead to over monitoring and a reduction of firm value (Fama and Jensen, 1983). Optimally, boards have a large portion of outside directors where potential costs of monitoring are excelled by manager's benefits (Boone, Field, Karpoff and Raheja, 2007). Firm with greater information asymmetry face higher monitoring costs, therefore eventually ending up with smaller and more dependent boards (Maug, 1997; Linck, Netter and Yang, 2008). For example, Darmadi and Gunawan (2013) found a significant positive relationship between IPO underpricing and the proportion of independent directors, implying that independent directors fail to mitigate agency problems and increase underpricing. Their finding, which is found in the emerging economy of Indonesia, can be explained by the limited contribution independent directors are able to provide in insider dominated boards.

Boone, Field, Karpoff and Raheja (2007) emphasized the positive influence outsider ownership, such as a venture capital firm, has on the number of outside directors. Outsider ownership decreases managers' influence (Hermalin and Weisbach, 1998), putting constrains to their decision-making abilities, eventually decreasing agency problems as the proportion of outside directors increases. So did Baker and Gompers (2003) find that boards backed by venture capital firms have more independent directors on the board, indicating that venture capitalists replace tasks normally performed by inside directors. As private equity firms, similar to venture capitalists, actively monitor the management of the (portfolio) company and therefore have a positive influence on board independence, one could expect that PE-backed firms have a higher proportion of independent directors (Boone, Field, Karpoff and Raheja, 2007). Therefore, the third hypothesis is set up as follows:

H3.1: PE-backed firms have a significantly higher proportion of independent directors compared with non-backed counterparts

Furthermore, section 2.1.2. described the critical assessment of the issuer's management private equity firms execute after taking over a portfolio firm. For example, Cornelli and Karakas (2011) appointed the large turnover of directors within firms backed by private equity firms, emphasizing the active role private equity firms play in restructuring the issuer's board. As a result, private equity quickly replace directors who underperform (Acharya, Kehoe and Reyner, 2009). Those underperformed directors are replaced by highly qualified, motivated and more financially developed outside directors who have the capability to make better strategic and financial decisions (Masulis and Thomas, 2009). As the critical assessment of current management is lacking by non-backed companies, thereby failing to identify and replace directors who underperform, I assume outside directors backed and appointed by private equity firms to outperform their non-backed counterparts in making strategic as well as financial decisions. Hence, I expect the negative effect independent (outside) directors have on underpricing to be stronger for directors backed by private equity firms, as they, contrary to their non-backed counterparts, passed through the critical assessment made by private equity firms. As directors backed by private equity firms successfully persist the critical evaluation or be replaced if they fail, those directors are perceived to make more adequate strategic and financial decisions compared to directors not backed by any financial sponsor. Therefore, hypothesis H3.2 is as follows:

H3.2: Private equity backing strengthens the negative influence of the proportion of independent directors on IPO underpricing compared with non-backed counterparts

2.3.3. Board Size

The third factor, board size, is another important determinant to access the effectiveness of corporate governance (Dalton, Daily, Johnson and Ellstrand, 1999).

The size of the board is determined after considering the trade-off between the net benefits compared to the potential costs arising from extra monitoring (Harris and Raviv, 2008). On the one hand, larger boards tend to monitor more effectively, thereby increasing manager's benefits (Harris and Raviv, 2008; Boone, Field, Karpoff and Raheja, 2007). Therefore and along the line of reasoning used in section 2.3.2., a large variety of complex operations lead to a larger board and a more hierarchical structure within the firm (Coles, Daniel and Naveen, 2008). This theory is also called the scope of operations hypothesis (Fama and Jensen, 1983). Consistent with this hypothesis, several authors illustrate the positive relationship between board and firm size, indicating that larger firms have larger boards (Yermack, 1996; Denis and Sarin, 1999).

Within IPO context, Darmadi and Gunawan (2013) found a significant negative influence of board size on IPO underpricing, implying that larger boards mitigate information asymmetry between issuer and investor and reduce uncertainty regarding the firm's quality. Certo, Daily and Dalton (2001) reached the same conclusion, appointing the larger opportunities larger boards have to attract additional resources from an investors point of view.

On the other hand, an inverse relationship between board size and firm value is illustrated, indicating the more effective coordination and decision making within smaller boards (Mak and Kusnadi, 2005). The monitoring hypothesis states that monitoring becomes less effective if boards become larger. As mentioned in section 2.3.2. and therefore, the costs of monitoring rises if boards become larger, causing firms facing higher information asymmetry eventually ending up with smaller boards (Linck, Netter and Yang, 2007). For example, Jensen (1993) stated that a board with more than seven to eight members works counterproductive. Larger boards tend to have more free-riders, wherefore agency costs increases (Hermalin and Weisbach, 2001), a conclusion which is shared by Hearn (2011). He found a positive relationship between board size and IPO underpricing, coming from larger asymmetric information costs through worse coordination within the board. However, his research was conducted in the emerging economy of West Africa, which is relatively more influenced by the dominance of a few individuals in political economy compared to more developed economies in Europe.

Overall and as mentioned, the size of the board is determined after considering the trade-off between the net benefits compared to the potential costs arising from extra monitoring (Harris and Raviv, 2008). If information asymmetry is high, the costs of extra monitoring may exceed the net benefits, eventually resulting in smaller boards (Linck, Netter and Yang, 2007). Keeping the quote of Paul Peterson, managing director at US-based private equity firm Wind Point Partners in mind (introduction), as private equity backing results in a reduction of information asymmetry between the issuing firm and (outside) investors (section 2.2.4) and an active revision of the issuer's board composition and size, I expect that private equity firm weigh the trade-off between the net benefits compared to the costs of extra monitoring, contrary to non-backed counterparts, more carefully. I anticipate the benefits of extra monitoring to exceed potential costs managers face within PE-backed boards, as PE-backed issuers experience lower information asymmetry than non-backed counterparts. Hence, this would result in larger boards for PE-backed firms compared with non-backed firms.

Consistent with Darmadi and Gunawan (2013), a fourth and last hypothesis is set:

H4.1: PE-backed firms have a significantly larger board size than non-backed counterparts

As mentioned above, the size of the board is determined after considering a trade-off between net benefits compared to the potential costs arising from extra monitoring. Moon (2006) stressed that private equity firms create, compared to public firms who are not backed by a financial sponsor, superior governance structures due to their active interference within the portfolio firm. Namely, private equity firms may be superior compared to the current management of a (portfolio) firm in determining how to effectively monitor the company, as they learn from experiences within previous (portfolio) firms (De Clercq and Dimov, 2008). As private equity firms actively consider the portfolio firm's management, both in composition as well as in size, I expect that private equity firms, compared to their non-backed counterparts, weigh the above-mentioned trade-off more carefully in order to optimize their board size to let monitoring be as effective as possible. To illustrate, Acharya, Kehoe and Reyner (2009) found that boards backed by private equity firms score significantly higher in terms of effectiveness compared to non-backed counterparts. As a result, I expect the negative effect of board size for private equity backed firms to be stronger as private equity firms, in contrast to non-backed counterparts, actively revise their portfolio firm's management to be as effective as possible. Therefore, hypothesis H4.2 is as follows:

H4.2: Private equity backing strengthens the negative influence of board size on IPO underpricing compared to non-backed counterparts

The next section will discuss the data used to assess the hypotheses set, the transformations executed to end up with the finite sample and the rationale behind the empirical research conducted.

3. Data and Methodology

In this section, the data and methodology used in order to test the hypotheses set are clarified. First, an overview of the data collection process is given, as well as transformations that were necessary to compute. Afterwards, the methodology chosen for empirically testing is elaborated on.

3.1. Data

As mentioned, an overview of the data collection process is given. A specification of the source appealed to conduct the data, the variables selected and how its information is used in order to execute empirical analysis is provided.

3.1.1. Data Collection

The data gathered is originated from several databases. The final dataset contains data regarding the IPO itself (Bloomberg), financial data (Compustat) and board data (BoardEx and ISS). After adjusting the data provided, the sample contained PE-backed and non-backed IPOs with the effective date, which is the first date the IPO is traded on the market, the issuer's ticker, the corresponding company name and company age at time the IPO occurred. Only IPOs executed within Europe are selected, a Country ISO Code is added for simplification. As can be seen in table 1, the majority of IPOs are conducted within the UK. According to PwC, the London Stock Exchange is the most active market in Europe, only partially subdued due to Brexit (PwC, 2019).

Second, to be able to illustrate the performance of the IPO, the offer size, offer price and offer to 1st close are selected. Third, the market cap at offer, total assets, total liabilities, shareholders equity and net income are included to assess the companies financials, whereafter the Debt-to-Equity ratio[1] (D/E) and return on assets[2] (ROA) are calculated and added in order to evaluate both the firm's liquidity and profitability. All variables are acquired in the year the IPO occurred, for instance from the IPO prospectus. Fourth, in order to be able to control for underwriter influence, the IPOs underwriter(s) market share(s) are added and considered. Fifth, variables from an individual level are included, such as the average age of directors within the board, the average time directors spend on the board prior to the IPO and the average number of qualifications the board members have. Last, to answer the formulated hypotheses, the size of the board, the amount of positions filled by women and the number of independent directors at IPO are added. A complete overview of all variables, their definitions and source can be found in the appendix (table 1A).

[1] Debt-to-Equity ratio = Total Liabilities / Total Shareholders' Equity
[2] Return on Assets = Net Income / Total Assets

Table 1. *Reports the distribution* of *IPO listings per country and their specifications between 2000-2019. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The country-specific ISO codes are retrieved from Bloomberg.*

Country	ISO Code	PE	NB
Austria	AT	2	10
Belgium	BE	4	23
Bulgaria	BG	0	1
Croatia	HR	0	0
Cyprus	CY	0	4
Czech Republic	CZ	1	0
Denmark	DK	3	15
Estonia	EE	0	1
Finland	FI	0	12
France	FR	9	49
Germany	DE	14	42
Gibraltar	GI	0	2
Great Britain	GB	51	119
Greece	GR	0	22
Hungary	HU	0	1
Ireland	IE	3	24
Italy	IT	6	54
Lithuania	LT	0	1
Luxembourg	LU	4	12
Malta	MT	0	0
Norway	NO	6	37
Poland	PL	1	30
Portugal	PT	0	3
Romania	RO	1	5
Russia	RU	4	22
Slovakia	SK	0	0
Spain	ES	5	39
Sweden	SE	18	24
Switzerland	CH	7	23
The Netherlands	NL	10	30
Turkey	TR	1	11
Ukraine	UA	0	5

Table 2 provides a detailed clarification of the distribution of PE-backed (150) and non-backed (621) IPOs over the sample size. As mentioned in section 2.1.3., PE-backed IPOs reached their peak from 2013 until 2015. Our sample showcases this finding, 43 more PE-backed IPOs were executed between 2013-2015 compared to 2008-2012 (62 by 19).

Table 2. *Reports the distribution of private equity backed (PE) and non-backed (NB) IPOs between 2000-2019. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The number of IPOs with respect to total IPOs within the selected subgroup is given in parentheses.*

Year	PE	NB
2000	3	44
	(0.020)	(0.071)
2001	0	26
	(0.000)	(0.042)
2002	6	14
	(0.040)	(0.023)
2003	1	5
	(0.007)	(0.008)
2004	7	37
	(0.047)	(0.060)
2005	8	58
	(0.053)	(0.093)
2006	8	67
	(0.053)	(0.108)
2007	5	68
	(0.033)	(0.110)
2008	0	15
	(0.000)	(0.024)
2009	0	5
	(0.000)	(0.008)
2010	10	27
	(0.067)	(0.043)
2011	6	23
	(0.040)	(0.037)
2012	3	11
	(0.020)	(0.018)
2013	13	18
	(0.087)	(0.029)
2014	29	38
	(0.193)	(0.061)
2015	20	55
	(0.133)	(0.089)
2016	10	27
	(0.067)	(0.043)
2017	12	36
	(0.080)	(0.058)
2018	6	34
	(0.040)	(0.055)
2019	3	13
	(0.020)	(0.021)

As Beatty and Ritter (1986) mentioned, there needs to exist underpricing on average for uninformed investors to participate in an IPO. However, some first day returns deviate far from what is expected to be normal. In order to exclude these observations the sample is trimmed, meaning the exclusion of observations that lies respectively above and beyond the upper and lower quartile calculated with a z-score. The z-score[3] is calculated by subtracting the mean of the sample from value X of issuer I, divided by the standard deviation of the sample. Similar to Rodvang and Ulsrud (2019), the z-score is used for outliers within the first day return and excludes the 1% most extreme observations. Exclusion of outliers ultimately leads to a sample selection of 771 observations, which comes down to the exclusion of 6 observations. A detailed breakdown of the sample size can be found in table 3.

Table 3. *Reports the sample construction, a detailed breakdown of the steps taken regarding the finalized sample*.

	Sample selection criteria	Number of observations
	Initial sample	4886
Less:	Missing values in offer price, price at first day close	4109
Less:	Missing values in board size, female- and independent directors	771

3.1.2. Dependent Variable

In order to evaluate the underpricing of an IPO, its short-term performance needs to be measured. In past literature, the first day return is often taken to proxy the level of IPO underpricing (Badru, Ahmad-Zaluki and Wan-Hussin, 2019; Beatty and Ritter, 1986; Darmadi and Gunawan, 2013; Mogilevsky and Murgulov, 2012; Reutzel and Belsito, 2015; Yatim, 2011**)**. In this case, the initial offer price is subtracted from the first day closing price, after which the difference is divided by the offer price. The mathematical expression is described in equation 1:

$$\text{Underpricing}_i = \frac{P_{i,1} - P_{i,0}}{P_{i,0}} \quad (1)$$

Where Underpricing can be seen as the initial return after first day close, $P_{i,1}$ the price of issuer I at first day close and $P_{i,0}$ the offer price of issuer I. If the first day closing price exceeds the offer price, positive returns are accomplished after the first day, indicating that the IPO is

[3] $Z - \text{score} = \left(\frac{X_i - \bar{X}}{\sigma}\right)$

underpriced at first. Purnanandam and Swaminathan (2004) stated that IPOs with the largest degree of information asymmetry should earn the highest first day returns. In other words, IPOs with a higher degree of information asymmetry should have higher underpricing. On the other hand, if the offer price turns out to be higher than the first day closing price, indicating negative returns after the first day, the issue is referred to be overpriced. Last, in case the offer price equals the closing price after the first day, indicating no returns at the end of the period, the IPO is correctly priced.

Beatty and Ritter (1986) stated that if first day returns are chosen as appropriate measure, the market returns can be expected to be small on average intraday (Rodvang and Ulsrud, 2019). Therefore, adjusting for market returns would only lead to minor changes. Hence, the inclusion of a benchmark is not deemed appropriate and necessary when measuring underpricing using first day returns (Beatty and Ritter, 1986).

3.1.3. Independent Variables

To examine the influence of different components of board composition on the degree of underpricing, several independent variables are included within the model.

In order to capture the (potential) difference between PE-backed and non-backed IPOs, a dummy is created and added to the model. The dummy represents whether the IPO is backed by private equity, where unity (1) confirms the latter and 0 involves the observations where no private equity firm is involved (Levis, 2011; Mogilevsky and Murgulov, 2012).

Second, the impact of female directors is measured by taking the proportion of female directors with respect to total board members, following prior research conducted by Badru, Ahmad-Zaluki and Wan-Hussin (2019) and Mcguiness (2018). To check the robustness of the results, an alternative measure is considered as well. Therefore, the absolute number of female directors is also studied (Li and Chen, 2018; Reutzel and Belsito, 2015; Terjesen, Couto and Francisco, 2016).

Third, the proportion of independent directors is included to examine the effect independent directors have on IPO underpricing, following prior research conducted by Mcguiness (2018), Terjesen, Couto and Francisco (2016) and Yatim (2011). Last, the impact of the size of the board is tested by taking the total number of directors, similar to research conducted by Baker and Gompers (2003), Coles, Daniel and Naveen (2008), Linck, Netter and Young (2008) and Yatim (2011).

To test the robustness of the results, respectively the number of independent directors and the natural logarithm of total board members are considered as well (Badru, Ahmad-Zaluki and Wan-Hussin, 2019; Carter, Simkins and Simpson, 2003; Darmadi and Gunawan, 2013; Li and Chen, 2018; Mak and Kusnadi, 2004).

3.1.4. Control Variables

Prior studies have shown that several variables have an impact on the return and, simultaneously, the underpricing of an IPO. To distinguish the effect of different components of board composition and private equity backing, the model needs to be controlled for several factors.

Two proxies are used to control for the maturity of the firm; one of the factors that needs to be controlled for is the firm's age. Young IPO firms may need to overcome their newness (Freeman, Carroll and Hannan, 1983). Therefore, one can expect that older, mature firms have reduced information asymmetry as more public information is available and therefore experience less underpricing. Muscarella and Vetsuypens (1989) found supporting evidence, as well as Beatty and Ritter (1986), indicating that younger firms experience larger ex-ante uncertainty with respect to older, mature firms. As a result, several authors included age as control variable in their model (Adams and Ferreira, 2009; Beiner, Drobetz and Schmid et al., 2006; Ferretti and Meles, 2011; Megginson and Weiss, 1991; Mogilevsky and Murgulov, 2012; Yatim, 2011). Age is measured as the difference between the year the company was founded and the year the IPO occurred. Similar to prior research conducted by Beiner, Drobetrz and Schmid et al. (2006), Ferretti and Melis (2011), Mogilevsky and Murgulov (2012) and Yatim (2011), the natural logarithm of age is used.

The second proxy is the size of the firm. Size is a proxy for ex-ante uncertainty, as one expects more publicly available information and reduced uncertainty as the firm appears to be larger. As mentioned before in section 2.2.3., Beatty and Ritter (1986) already found the relation between information asymmetry and uncertainty. Therefore, and as Mogilevsky and Murgulov (2012) already concluded, a larger company size reduces the amount of information asymmetry between issuer and investors and, consequently, underpricing. Hence, I include the natural logarithm of total assets in the model, following prior research conducted by Beiner, Drobetrz and Schmid et al. (2006), Ferreti and Melis (2011), Mak and Kusnadi (2005) and Mogilevsky and Murgulov (2012).

Howton, Howton and Olsen (2001) stressed the importance to include the debt-to-equity ratio in the model. Managers follow a pecking order regarding finance decisions, preferring internal resources at first. Namely, internal resources, such as retained earnings, have the lowest information asymmetry and are therefore cheaper to address. If internal funds turn out to be insufficient, management shifts to external resources, preferring debt over equity because of lower information asymmetry and, consequently, lower costs (Myers and Maljuf, 1984). Given that equity brings the most information asymmetry costs, therefore the least favourable financing option, firms can signal their superior quality by taking on debt, revealing positive information to investors by showing confidence in the financial position of the firm (Su, 2004; Harris and Raviv, 1990). Howton, Howton and Olsen (2001) found the inverse relationship between debt-to-equity ratio and initial return, implying that higher debt levels indeed reveal positive information, thereby reducing the amount of IPO underpricing. Therefore, a debt-to-equity ratio is included, measured by dividing total liabilities by shareholders' equity.

With the inclusion of the debt-to-equity ratio in the model, the solvency of the firm is assessed. However, the profitability of the firm might also influence the degree of underpricing (Reutzel and Belsito, 2015; Yatim, 2011). Following the signalling theory, a higher profitability could provide a positive signal regarding the firms quality, therefore resulting in lower underpricing (Darmadi and Gunawan, 2013). Profitability is measured by the return on assets (ROA), which is determined by dividing net income by total assets, thereby following prior research conducted by Easterwood, Ince and Raheja (2012).

Further, Section 2.2.2. presented the important role underwriters play during the course of an IPO process. Therefore, the underwriter's market share is also included as control variable. Following to the certification hypothesis presented in section 2.2.4. and according to Carter and Manaster (1990), higher qualified underwriters can be a reliable signal for investors, signalling the firm's quality through their reputation, thereby mitigating the information asymmetry between issuer and investor. Namely, assigning a more precious underwriter leads to less uncertainty regarding the IPOs value and, consequently, lower underpricing. Over the years, the negative relation between the underwriter's reputation and IPO underpricing is found by several authors (Logue, 1973; Carter, Dark and Singh, 1998). Butler, Keefe and Kieschnick (2014) concluded that the underwriters' market share is an appropriable variable to include in a regression. Therefore and similar to Megginson and Weiss (1990) and Simon (1989), a market share based approach is used where a higher market share indicates a higher reputation (Chen,

Shi and Xu, 2014). In case the issuing firm has multiple underwriters, the average of market shares is taken (Megginson and Weiss, 1990).

Where prior variables control on a firm and IPO level, individual measures need to be taken into account as well. Several authors emphasized the importance to include proxies for individual directors' demographics (Adams and Ferreira, 2009; Coles, Daniel and Naveen, 2008). Therefore, the average age, number of qualifications and time spend at the board prior to the IPO (tenure) on an individual level are included and controlled for as well, following prior research conducted by Boone, Field, Karpoff and Raheja (2007), Burgess and Tharenou (2002), Linck, Netter and Yang (2008) and Mcguiness (2018).

3.2. Methodology

In this section, the research methodology used to conduct the empirical analysis is explained and elaborated on. First, the procedure of the univariate analysis is described. Next, the methodology and rationale behind multiple multivariate regressions is defined to test the hypotheses conducted.

3.2.1. Univariate study

The univariate study will test whether the means of the variables of interest are significantly different. The univariate analysis follows the procedure used by Rodvang and Ulsrud (2019). First, Levene's test is conducted to examine whether the variables within the sample hold equal variance (Levene, 1960). I compare, similar with Rodvang and Ulsrud (2019), the variances of PE-backed IPOs and non-backed IPOs via a variance ratio[4]. In case the variances of variables between PE-backed and non-backed issuers significantly differ (Levene's test < 0.1), Welch tests for unequal variances are performed. If differences in variance between the two groups are found to be insignificant, which is the case for female- and independent directors, two-sample T-tests are appropriate. Welch tests and two-sample T-tests are executed to explore (potential) inequality regarding the means of underpricing, the proportion of female- and independent directors and board size between PE-backed and non-backed issuers. Welch's Test is especially applicable if the two groups are unequal in variance or sample size (Welch, 1938).

[4] Variance ratio= $\left(\frac{SD_{nb}}{SD_{pe}}\right)^2$

As hypothesis 1 state, I would expect that PE-backed IPOs experience significantly less underpricing than non-backed counterparts. Furthermore, as hypotheses 2.1, 3.1 state, respectively significant less female and more independent directors are expected for PE-backed issuers compared to issuers without a financial sponsor. Last, as hypothesis 4.1 states, a significant larger board size for PE-backed issuers is hypothesized. Based on the above-mentioned tests, I am also able to conclude whether the differences in female, independent and total directors are significantly different from zero and therefore can be interpreted in the result section.

3.2.2. Multivariate study

In addition to the univariate study performed above, several multivariate OLS regressions will be composed in order to test the different hypotheses conducted and review the robustness checks mentioned in section 3.1.3. The purpose of the multivariate OLS regression, which include several control variables, is to explain the Y variable (Underpricing) via a change in variable X, the independent (explanatory) variable (Dougherty, 2011). In order to do so, the following model is drafted:

$$\begin{aligned} Underpricing_i = {} & \alpha + \beta_1 * PE_i + \beta_2 * Female\_directors_i + \beta_3 * Independent\_directors_i + \beta_4 * \\ & Board\_size_i + \beta_{5 * LN} Age_i + \beta_{6 * LN} Assets_i + \beta_7 * D/E_i + \beta_8 * ROA_i + \beta_9 * \\ & Underwriter_i + \beta_{10} * D\_Age_i + \beta_{11} * D\_Qualifications_i + \beta_{12} * D\_Tenure_i \\ & + Industry\_dummies_i + Year\_dummies_i + Country\_dummies_i + \varepsilon_i \end{aligned} \quad (2)$$

Where *i* represents the firms within the constructed sample, Underpricing the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price, PE a dummy variable where unity (1) illustrates whether the issuer is backed by a private equity firm, Female_directors and Independent_directors the proportion of respectively female and independent directors with respect to total directors and Board_size the issuer's board size at time the IPO occurred. Control variables on a firm level are LN Age, which is the natural logarithm of the firm's age at time the IPO occurred, LN Assets the natural logarithm of total assets, D/E the debt-to-equity ratio of the issuer, ROA the return-on-assets of the firm and Underwriter the underwriter(s)' market share. Control variables on an individual level include D_Age, which equals the average directors' age at time the IPO occurred, D_Qualifications the average number of qualifications within the board and D_Tenure, the average time the directors served within the board prior to the IPO. Last, Industry_dummies, Year_dummies and

Country_dummies are respectively the industry, year and country fixed effects, where α and ε_i respectively represent the intercept and the error term.

β_1[5] up to and including β_4 represent the coefficients of the independent variables of interest, β_5 through β_9 the control variables on a firm level and β_{10} through β_{12} the individual control variables. In addition to the univariate study, the model presented in equation 2 provides a finite answer whether PE-backed IPOs are significantly less underpriced compared to non-backed counterparts (hypothesis 1) and investigates the stand-alone effect of female, independent directors and board size on the perceived level of underpricing. As I expect less underpricing for PE-backed issuers compared to non-backed issuers, the coefficient of dummy variable PE is perceived to be negative. Moreover, and as hypothesis 2.1 state, I would expect a positive coefficient for female directors as the proportion of female directors is hypothesized to have a positive effect on the perceived level of underpricing. Following the same reasoning, a negative coefficient for independent directors is expected as a higher proportion of independent directors is hypothesized (hypothesis 3.1) to reduce the perceived level of underpricing. Last, a larger board size is expected to reduce the level of underpricing (hypothesis 4.1), hence a negative beta coefficient.

Afterwards and similar to Hogan, Olson and Kish (2001) and Michala (2019), to investigate the influence of private equity on different components of board composition, interaction terms are included. The usage of an interaction term will reveal the influence of private equity firms on the relationship between different components of board composition of the issuer and underpricing. Therefore, a second model is set up:

$$\begin{aligned} Underpricing_i = {} & \alpha + \beta_1 * PE_i + \beta_2 * Female\_directors_i + \beta_3 * Independent\_directors_i + \beta_4 * \\ & Board\_size_i + \beta_5 * Female\_directors_i * PE_i + \beta_6 * Independent\_directors_i * \\ & PE_i + \beta_7 * Board\_size_i * PE_i + \beta_8 * {}_{LN} Age_i + \beta_9 * {}_{LN} Assets_i + \beta_{10} * D/E_i + \beta_{11} \\ & * ROA_i + \beta_{12} * Underwriter_i + \beta_{13} * D\_Age_i + \beta_{14} * D\_Qualifications_i + \\ & \beta_{15} * D\_Tenure_i + Industry\_dummies_i + Year\_dummies_i + \\ & Country\_dummies_i + \varepsilon_i \end{aligned} \quad (3)$$

[5] $\beta = \frac{\text{Cov (X,Y)}}{\text{Var (X)}}$ (Dougherty, 2011)

Where interaction effects are captured by $\beta_5 * Female\_directors_i * PE$, $\beta_6 * Independent\_directors_i * PE$ and $\beta_7 * Board\_size_i * PE$. As hypothesis 2.2 state, I expect a mitigation of the observed positive effect for female directors due to private equity backing. Furthermore and stated in hypotheses 3.2 and 4.2, an amplification of the observed negative effect for respectively independent and total directors, due to critical assessment of the issuer's management made by private equity firms, is anticipated. Therefore, a negative coefficient for each interaction term is predicted. Following the example of Hogan, Olson and Kish (2001), a significant negative coefficient for $Independent\_directors * PE$ would indicate that the proportion of independent directors is more negatively related to PE-backed than non-backed IPOs, implying that independent directors of issuers backed by private equity are more suitable to reduce underpricing than non-backed counterparts.

I control, in accordance with Boone, Field, Karpoff and Raheja (2007), for industry-fixed effects within the multiple multivariate OLS regressions. Inclusion will reduce the (potential) occurrence of endogeneity, as industry-fixed effects control the economic conditions that can be the foundation behind board size and independence. An overview of all industries and their distribution can be found in the appendix (table 2A). Following a similar reasoning with respect to endogeneity and in line with Banerjee, Dai and Shrestha (2011), Chung, Sensoy, Stern and Weisbach (2012) and Linck, Netter and Yang (2008), year-fixed effects are controlled for in the model as well. Last, following the research conducted by Hearn (2012) and Lin, Pukthuanthong and Walker (2013), country-fixed effects to control for differences on a country level are applied as well. Control variables on a firm and individual level are similar to those in equation 2 and are enhanced in the appendix (table 1A). In comparison with Yatim (2011), the variables are drafted in stages. The first regression will solely consist out of the independent variables, whereafter control variables for firm (regression 2) and individual (regression 3) characteristics are added. To assess the relationship between the chosen variables and lock out the (potential) existence of multicollinearity, Pearson correlation coefficients are evaluated. In addition, the regressions conducted are tested for multicollinearity by performing a test on VIF, the variance inflation factor. A VIF score below threshold 10 will indicate the absence of multicollinearity between variables in the regression. In case the VIF exceeds the level of 10, the exceeding can be explained by the usage of the product of a variable (interaction term). Last, the normality and variance of the error term are assessed by evaluating respectively the Shapiro-Wilk and Breusch-Pagan test.

To summarize, the univariate study provides preliminary results regarding the differences in underpricing and board composition between PE-backed and non-backed issuers (hypotheses 1, 2.1, 3.1 and 4.1), whereafter equation 2 investigates the difference in underpricing between PE-backed and non-backed issuers found in the univariate study (hypothesis 1) even further, as well as looks into the stand-alone effect of the researched board components (female, independent and total directors) on underpricing. Namely, the interpretation of the interaction term included in equation 3 is related to the stand-alone effect observed in equation 2 (Brambor, Clark and Golder, 2006). The inclusion of three interaction terms in equation 3 will provide an answer on respectively hypotheses 2.2, 3.2. and 4.2. , which investigates whether private equity backing mitigates or amplifies the observed effect found for different board components in equation 2. Thereafter, I can conclude whether (potential) differences in underpricing between PE-backed and non-backed issuers can be explained by the differences in board composition and the impact of private equity backing on the relationship between those board components and underpricing. The results and implications of both the univariate and multivariate study will be presented and discussed in section 4 and 5.

4. Empirical Analysis and Results

In this section, the results of the univariate and multivariate analysis will be discussed. The lay-out of this section is as follows. First an overview of the descriptive statistics is given to provide a more clear understanding of the characteristics of the sample. Afterwards, an univariate analysis is executed, which will solely focus on the differences between PE-backed and non-backed issuers in terms of underpricing and board composition. Thereafter, multiple multivariate regressions will be performed in order to investigate the influence of private equity backing on the relationship between IPO underpricing and board composition even further. All coefficients within the results section are interpreted *ceteris paribus*.

4.1. Descriptive statistics

Similar with past academic literature, I make an overview of the descriptive statistics of dependent, independent and control variables (Darmadi and Gunawan, 2013; Levis, 2011; Mogilevsky and Murgulov, 2012). An overview provides a more clear understanding of characteristics of the sample. Descriptive statistics regarding the characteristics of the issuer

can be observed in table 4. All results with respect to the control variables regarding Levene's, Welch's and the two-sample T-tests can be found in the appendix (table 3A and 4A).

Since private equity firms usually invest in more mature and larger businesses (section 2.2.4.), I would expect issuers backed by private equity to be larger in offer size, market capitalization and maturity with respect to non-backed issuers. As can be seen, PE-backed IPOs have, on average, a significantly larger offer size (719 million vs 574 million). However and against the findings of Levis (2011) and Mogilevsky and Murgulov (2012), non-backed firms appear to be larger in terms of market capitalization (2145 compared to 2083). Moreover, contrary as expected PE-backed issuers within the sample appears to be four years younger compared to non-backed counterparts. Nevertheless, table 4A illustrates that the differences between non-backed- and PE-backed firms in terms of market capitalization and age are found to be insignificantly different, while offer size is found to be significantly different on a 1% level. Therefore, PE-backed and non-backed issuers solely differ significantly in offer size, where PE-backed IPOs, as expected, are significantly larger than non-backed counterparts. The result obtained is similar to the findings of Levis (2011), who concluded that issuers backed by private equity firms are significantly larger than non-backed counterparts.

Another important result illustrates the critical assessment private equity firms execute regarding the management of their portfolio firm. As private equity firms actively and critically review the firms' management right after investment, directors in the board of PE-backed issuers are significanlty older and more qualified compared to non-backed counterparts (59.847 across 58.473 and 2.067 compared to 1.834). The significant higher qualification of these directors is in line with the theory described to formulate hypothesis 3.2, stating that due to the private equity firm's critical assesment of the issuer's management, directors are likely to be higher qualified compared to non-backed issuers where critical assesment is lacking.

Last and similar to the findings of Mogilevsky and Murgulov (2012), PE-backed IPOs hire significanlty more prestigeous underwriters with respect to non-backed IPOs (4.853% over 3.350%, a difference significant at a 1% level). As Carter and Manaster (1990) described, higher qualified underwriters can be a reliable signal for investors, signalling the firm's quality through their reputation, thereby mitigating the information asymmetry between issuer and investor. Namely, assigning a more precious underwriter leads to less uncertainty regarding the IPOs value and, consequently, lower underpricing. Overall, table 4 highlights the significant differences in offer size, individual directors' demographics and underwriter reputation between PE-backed and non-backed issuers.

Table 4. *Reports the descriptive statistics of characteristics on a firm and individual level. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed and is presented in the columns "Total", "PE" and "NB" respectively. Fluctuations within the number of observations can be attributed to the data available. The descriptive statistics for Offer Size and Market Capitalization are presented in EURm, where Offer Size represents the total value of shares offered and Market Capitalization the value of total equity of the issuer. The variable Age is measured as the difference between the year the IPO occurred and the year the issuer was founded. DE and ROA are calculated as respectively Total Liabilities / Total Shareholders' Equity and Net Income / Total Assets. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age, D_Qualifications and D_Tenure represent individual characteristics, where the average with respect to age, number of qualification and time within the board of all board members is taken at time the IPO went public.*

	Total	PE	NB
Offer Size (€M)			
Mean	602	719	574
Std. Dev	956	627	1018
N	771	150	621
Market Cap (€M)			
Mean	2131	2083	2145
Std. Dev	4888	2308	5411
N	576	129	447
Age			
Mean	27.307	23.974	28.194
Std. Dev	44.717	31.872	47.547
N	547	115	432
DE			
Mean	2.687	1.756	2.913
Std. Dev	8.758	7.534	9.020
N	770	150	620
ROA			
Mean	0.043	0.038	0.044
Std. Dev	0.313	0.111	0.345
N	529	105	424
Underwriter			
Mean	3.645	4.853	3.350
Std. Dev	2.723	2.225	2.753
N	764	150	614
D_Age			
Mean	58.977	59.847	58.473
Std. Dev	5.692	5.554	6.515
N	373	95	278
D_Qualifications			
Mean	1.890	2.067	1.834
Std. Dev	0.740	0.546	0.785
N	422	102	320
D_Tenure			
Mean	3.703	3.836	3.645
Std. Dev	3.624	4.295	3.298
N	336	102	234

The distribution and descriptive statistics of the independent variables can be found in table 5 and outlines the number of observations, mean, median, standard deviation, minimum and maximum**.** The sample consists out of 771 firms, providing 7,022 board positions (5,458 male, 1,564 female). All firms have minimal 2 male directors, where 116 firms (13 PE, 103 NB) have no female director within the board. This would indicate that approximately 15% of all firms didn't have at least one women appointed at time the IPO occurred. PE-backed issuers have slightly more females appointed on average (2.273 over 1.969), where vice versa is the case for males (6.433 compared to 7.267).

Table 5. *Reports the descriptive statistics and distribution of independent variables. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The variables male, female, independent and board size stand for the total number of observations of the sample, where a distinction is made subsequently with respect to private equity backed and non-backed issuers. # of directors positions represents the total director positions within the sample, where # of companies account for the companies wherefore the statistic is applicable. Descriptive statistics include the mean, median, standard deviation, minimum and maximum of the sample.*

Distribution of directors	# of director positions	# of companies	Mean	Median	Std. Dev	Min	Max
Male	5,458	771	7.105	7.000	3.027	2.000	26.000
PE	965	150	6.433	6.000	1.937	2.000	13.000
NB	4,493	621	7.267	7.000	3.216	2.000	26.000
Female	1,564	655	2.028	2.000	1.503	0.000	7.000
PE	341	137	2.273	2.000	1.474	0.000	7.000
NB	1,223	518	1.969	2.000	1.505	0.000	7.000
Independent	3,858	771	5.004	5.000	2.597	1.000	20.000
PE	816	150	5.440	5.000	2.740	1.000	20.000
NB	3,042	621	4.899	5.000	2.552	1.000	20.000
Board Size	7,022	771	9.093	9.000	3.264	3.000	28.000
PE	1,306	150	8.647	8.000	2.485	4.000	20.000
NB	5,716	621	9.201	9.000	3.418	3.000	28.000

Furthermore, all firms within the sample have minimal 1 independent director. In line with literature discussed in section 2.3.2., PE-backed issuers have on average more independent directors appointed than non-backed firms (5.440 over 4.899). It turns out that 5 out of 9 directors are independent, following the consensus that private equity firms appoint relatively more outsiders to the board (Boone, Field, Karpoff and Raheja, 2007).

Last, the average firm consists out of 7 male members and 2 female members, indicating a total board size of 9 directors. Contrary to our predictions, non-backed issuers have a larger board size relative to PE-backed issuers, namely 9.201 over 8.647 directors. The univariate analysis will reveal whether the observed difference is both economical as well as statistical significantly different. Moreover, as can be seen, the largest non-backed issuer has 28 appointed directors, dependent and independent, relative to 20 for private equity backed issuers.

4.2. Univariate study

Before executing the univariate analysis, Pearson correlation coefficients are evaluated. Table 6 indicates no multicollinearity between the variables of interest. As can be seen, the dummy PE is significant negatively correlated with underpricing. Furthermore, the proportion of female and independent directors is positively correlated with private equity backing, indicating a higher proportion of female and independent directors for private equity backed issuers. Last, significant correlations are found between PE on the one hand and underwriter and qualifications on the other hand, indicating that private equity backed issuers are more likely to hire more prestigious underwriters and appoint more qualified board members.

Table 6. *Reports the correlation matrix of estimated Pearson correlation coefficients. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. Underpricing is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. PE is a dummy variable which equals 1 if the IPO is backed by a private equity firm and 0 if otherwise. Female- and independent directors are the proportion of directors following the criteria with respect to total board size. Board size is the total number of directors on the board. LN_age is the natural logarithm of age, which is calculated as the difference in years between the year the IPO occurred and the firm was founded. LN_Assets is the natural logarithm of assets, which equals the total assets the year the IPO occurred. DE is the debt-to-equity ratio, which is calculated by dividing total liabilities by shareholders' equity in the year the IPO occurred. ROA is the return-on-assets, which is calculated by dividing net income by total assets in the year the IPO occurred. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age is the average age of the total number of directors at time the IPO occurred, D_Qualifications the average number of qualifications the total number of directors have earned and D_Tenure the average time spend within the board prior to the IPO. The values represent the corresponding correlation coefficient, the corresponding t-statistic (within parentheses) and the level of significance, where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Underpricing	1.000												
(2) PE	-0.077**	1.000											
	(0.033)												
(3) Female_directors	0.046	0.103***	1.000										
	(0.202)	(0.004)											
(4)Independent_directors	-0.037	0.121***	0.283***	1.000									
	(0.307)	(0.001)	(0.000)										
(5) Board_size	-0.013	-0.067*	-0.031	-0.240***	1.000								
	(0.718)	(0.062)	(0.389)	(0.000)									
(6) LN_Age	0.055	-0.010	0.025	-0.051	0.164***	1.000							
	(0.197)	(0.821)	(0.552)	(0.238)	(0.000)								
(7) LN_Assets	0.045	0.117***	0.258***	0.068*	0.196***	0.092**	1.000						
	(0.211)	(0.001)	(0.000)	(0.058)	(0.000)	(0.032)							
(8) DE	0.003	-0.052	0.029	0.012	0.059*	0.106**	0.201***	1.000					
	(0.929)	(0.147)	(0.419)	(0.740)	(0.102)	(0.013)	(0.000)						
(9) ROA	0.072*	-0.007	0.065	-0.023	0.024	0.023	0.219***	-0.022	1.000				
	(0.099)	(0.875)	(0.136)	(0.598)	(0.584)	(0.613)	(0.000)	(0.620)					
(10) Underwriter	-0.040	0.219***	0.073**	0.130***	0.060*	0.058	0.436***	0.038	0.092**	1.000			
	(0.271)	(0.000)	(0.042)	(0.000)	(0.097)	(0.178)	(0.000)	(0.290)	(0.035)				
(11) D_Age	-0.032	0.089*	-0.218***	0.103**	0.093*	0.052	-0.011	-0.008	-0.158***	0.216***	1.000		
	(0.538)	(0.084)	(0.000)	(0.047)	(0.072)	(0.364)	(0.839)	(0.882)	(0.006)	(0.000)			
(12) D_Qualifications	0.020	0.135***	0.117**	0.133***	0.014	-0.037	0.159***	-0.010	0.066	0.077	-0.024	1.000	
	(0.685)	(0.006)	(0.016)	(0.006)	(0.768)	(0.486)	(0.001)	(0.843)	(0.218)	(0.115)	(0.712)		
(13) D_Tenure	-0.029	0.024	-0.120**	-0.167***	-0.028	0.069	-0.183***	0.099*	-0.040	-0.091*	0.080	0.023	1.000
	(0.593)	(0.657)	(0.028)	(0.002)	(0.610)	(0.234)	-(0.001)	(0.069)	(0.488)	(0.097)	(0.204)	(0.700)	

**** p<0.01, ** p<0.05, * p<0.1*

4.2.1. The differences in board composition between PE-backed and non-backed issuers

Table 7 and 8 present the results regarding the univariate analysis of the variables of interest. First, Levene's test is executed and indicates unequal variances between PE and NB IPOs concerning underpricing and board size (table 7). Similar with Rodvang and Ulsrud (2019), I compare the variances of PE-backed IPOs and non-backed IPOs via a variance ratio. In case the variances between PE-backed and non-backed issuers significantly differ (Levene's test < 0.1), Welch tests for unequal variances are performed to compare the means of both groups. If differences in variance between the two groups are found to be insignificant, which is the case for female- and independent directors, two-sample T-tests are appropriate. All results with respect to Levene's test can be found in table 7.

Table 7. *Reports Levene's test of variables of interest between private equity backed and non-backed IPOs. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. Underpricing is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. Female- and independent directors are measured as proportion of total board size, where board size represents the total number of directors within the board. Levene's Test indicates inequality of variances between private equity backed and non-backed sample with respect to underpricing and board size. N represents the observations within the sample,* σ^2 *equals the variance ratio where the fourth column provides the corresponding t-statistic and the level of significance (within parentheses), where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

Levene's test	N	σ^2	T-statistic
Underpricing			
NB / PE	621/150	1.437	3.001 (0.084)*
Female_directors			
NB / PE	621/150	1.072	1.119 (0.290)
Independent_directors			
NB / PE	621/150	0.994	0.016 (0.899)
Board_size			
NB / PE	621/150	1.892	11.908 (0.001)***

As can be seen in table 7, PE-backed and non-backed issuers differ significantly in variance in terms of underpricing. Namely, the variance ratio for underpricing NB / PE is 1.437, indicating that non-backed IPOs experience almost 1.5 times more variance than PE-backed IPOs, giving rise to higher uncertainty. As mentioned in section 2.2.3., Beatty and Ritter (1986) argued that the greater the ex-ante uncertainty about the intrinsic value of the IPO, the greater the expected underpricing will be.

Furthermore, table 7 highlights a significant difference in variance between PE-backed and non-backed issuers in terms of board size. As can be seen, the variance within non-backed boards is almost twice as high (1.892) than PE-backed boards. This indicates that the board size of PE-backed issuers fluctuates significantly less than non-backed boards, in line with the theory described to formulate hypothesis 4.2 stating that private equity firms may be superior compared to the current management of a (portfolio) firm in determining how to effectively monitor the company, as they learn from experiences within previous (portfolio) firms (De Clercq and Dimov, 2008). In contrast to non-backed issuers, issuers backed by private equity unambiguously choose for a particular board size, where the size between non-backed issuers differ, as mentioned, almost twice as much. As the variances for respectively underpricing and board size differ significantly between PE-backed and non-backed issuers, Welch tests are performed for unequal variances to compare the means of both samples. With respect to female and independent directors, two-sample T-tests are appropriate.

Table 8 highlights the outcomes of respectively the Welch and two-sample T-tests between PE-backed and non-backed issuers with respect to underpricing, female, independent and total directors. The left column points out the mean, standard deviation and number of observations of respectively underpricing, female, independent directors and board size with respect to PE- and non-backed issuers. The table showcases that PE-backed IPOs experience significant less underpricing than non-backed counterparts, 3.448% compared to 5.325%, which is significant on a 5% level and provides a preliminary indication to reject the null hypothesis of hypothesis 1. The average underpricing found equals 4.960%, which is similar to the average underpricing level found by Megginson and Weiss (1991), but significantly lower than the average level of underpricing found by authors such as Badru, Ahmad-Zaluki and Wan-Hussin (2019), Filatotchev and Bishop (2002), Handa and Singh (2015), Levis (2011) and Yatim (2011) (ranges from 14.120% to 29.600%). The multivariate analysis will investigate the difference in underpricing between PE-backed and non-backed issuers further.

Furthermore, approximately 1/5th of all non-backed board members is female (22.323%), which expands to 1 out of 4 if the IPO is PE-backed (25.428%). This difference is found to be statistically significant at a 1% level. The results indicate that private equity firms appoint significantly more female directors compared to non-backed counterparts, thereby rejecting the null hypothesis of hypothesis 2.1 stating that there is no difference in the proportion of female directors between PE-backed and non-backed issuers. Private equity firms might value the positive influence of women on board strategic control, increasing both the level of cooperation and activeness within the board. Furthermore, private equity firms might acknowledge that female directors signal higher firm performance, managerial competence and earnings quality. In order to put the results regarding female directors in a perspective, the influence of female directors on underpricing and the influence of private equity backing on the concerning relationship are investigated within the multivariate analysis.

Table 8. *Reports the univariate study of variables of interest between private equity backed and non-backed IPOs. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. Underpricing is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. Female- and independent directors are measured as proportion of total board size, where board size represents the total number of directors within the board. Levene's Test indicates inequality of variances between private equity backed and non-backed sample with respect to underpricing and board size. Values within the column "Welch Test" and "Two-sample T-test" represent the corresponding t-statistic and the level of significance (within parentheses), where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	Total	PE	NB	Welch Test	Two-sample T-test
Underpricing					
Mean	4.960	3.448	5.325	2.384	
Std. Dev	9.683	8.307	9.959	(0.018)**	
N	771	150	621		
Female_directors					
Mean	22.323	25.428	21.573		-2.862
Std. Dev	14.876	14.393	14.905		(0.004)***
N	771	150	621		
Independent_directors					
Mean	56.842	62.840	55.394		-3.372
Std. Dev	24.437	24.338	24.259		(0.001)***
N	771	150	621		
Board_size					
Mean	9.093	8.647	9.201	2.264	
Std. Dev	3.264	2.485	3.418	(0.024)**	
N	771	150	621		

With respect to the proportion of independent directors and similar to Darmadi and Gunawan (2013), I find that firms already appoint more independent than dependent directors on average. Namely, the average firm consists for 56.842% out of independent directors. As expected, the results indicate that PE-backed issuers appoint significantly more independent directors than non-backed counterparts, 62.840% compared to 55.394%, which is found to be significant at a 1% level and thereby rejects the null hypothesis of hypothesis 3.1. Similar to VC-backed companies (Baker and Gompers, 2003), private equity might prefer independent directors as they decrease agency problems by putting constrains to managers' influence. The multivariate analysis will disclose whether independent directors are able to mitigate the level of underpricing and if private equity backing strengthens the relationship observed.

Last and as mentioned in section 4.1., the average board size consists out of approximately 9 board members. Contrary to my expectations, the results indicate that non-backed issuers appoint more directors to the board (9.201 over 8.647), a difference which is found to be significant at a 5% level and thereby rejects the null hypothesis of hypothesis 4.1 stating that there is no difference between PE-backed and non-backed issuers in board size. PE-backed issuers have a significantly smaller board size compared to non-backed issuers, indicating that the interference of private equity firms might result in a reduction of the number of free-riders, thereby reducing agency costs. Furthermore, similar to venture capital firms, private equity firms might replace tasks normally performed by board members. Ultimately, this would result in a smaller board size at IPO, as private equity firms give up their board position when exiting. However, while statistical significantly different, whether the difference in board size between PE-backed and non-backed issuers is economic significant too is questionable, as the board sizes of both PE-backed as well as non-backed issuers turn out to comprehend approximately 9 positions. The multivariate analysis will put the results regarding board size in perspective, as the influence of board size on underpricing and the impact of private equity backing on this relationship are further investigated.

Therefore, I conclude that PE-backed issuers experience significantly less underpricing than non-backed counterparts, providing preliminary evidence to reject the null hypothesis of hypothesis 1. Additionally, issuers backed by private equity have significant more females and independent directors appointed to the board, while total board size is statistical significantly smaller but comprehend approximately 9 positions for both PE-backed as well as non-backed issuers. The following section will test whether the difference in underpricing between PE-backed and non-backed issuers persists, as well as reveal if the three board compositions,

female, independent and total directors, significantly influence the perceived level of underpricing and if private equity backing respectively mitigate or amplify the effect observed.

4.3. Multivariate study

Following the univariate analysis regarding underpricing and differences within board composition between PE-backed issuers and non-backed issuers, multiple multivariate regressions are performed to reveal the relationship between several board determinants (i.e. female, independent and total directors, also called board size) and underpricing. Furthermore, the influence of private equity backing on the founded relationship of female, independent and total directors on the one hand and underpricing on the other is investigated. All regressions are controlled for industry-, year- and country-fixed effects and robustness terms, such as White's robust standard errors, are applied if necessary. Namely, in order to perform OLS regressions accurately, several assumptions must be met.

The Breusch-Pagan test is executed in order to test the homoskedasticity of the error term. Based on the outcome of the Breusch-Pagan test, White's robust standard errors are applied if necessary. Furthermore, the Shapiro-Wilk test is executed to guarantee normality of the error term. As can be seen in table 5A, the p-value of the Shapiro-Wilk test exceeds the threshold of 0.05. Therefore, the null hypothesis assuming a normal distribution cannot be rejected. Moreover, the executed Pearson correlation revealed no mutlicollinearity between chosen variables, as can be seen in table 6. In addition, VIF (variance inflation factor) tests on the regressions conducted to test multicollinearity revealed no disturbing results, as the executed VIFs had a value below the threshold value of 10 (Badru, Ahmad-Zaluki and Wan-Hussin, 2019; Filatotchev and Bishop, 2002; Handa and Singh, 2005; Marquardt, 1980). Hence, OLS regressions can be performed accurately, the findings of all regressions and their implications will be discussed underneath.

4.3.1. The effect of board composition on underpricing

Table 9 illustrates the results of the three executed multivariate regressions of equation 2. A hierarchical approach is used where regression 1 solely presents the influence of board composition on underpricing without control variables. All firm-specific control variables are added in regression 2, whereafter all individual controls are included in regression 3.

Table 9. *Reports the results of three executed multivariate regressions. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The dependent variable, underpricing, is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. PE is a dummy variable which equals 1 if the IPO is backed by a private equity firm and 0 if otherwise. Female- and independent directors are the proportion of directors following the criteria with respect to total board size. Board size is the total number of directors on the board. LN_age is the natural logarithm of age, which is calculated as the difference in years between the year the IPO occurred and the firm was founded. LN_Assets is the natural logarithm of assets, which equals the total assets the year the IPO occurred. DE is the debt-to-equity ratio, which is calculated by dividing total liabilities by shareholders' equity in the year the IPO occurred. ROA is the return-on-assets, which is calculated by dividing net income by total assets in the year the IPO occurred. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age is the average age of the total number of directors at time the IPO occurred, D_Qualifications the average number of qualifications the total number of directors have earned and D_Tenure the average time spend within the board prior to the IPO. All variables are adjusted for normality and heteroskedastic standard errors are applied if necessary. Furthermore, all regressions are controlled for industry-, year- and country-fixed effects. The values represent the corresponding correlation coefficient, the corresponding t-statistic (within parentheses) and the level of significance, where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	(1)	(2)	(3)
PE	-2.721***	-2.926***	-3.825**
	(-3.090)	(-2.707)	(-2.245)
Female_directors	0.064**	0.081**	0.019
	(2.234)	(2.053)	(0.278)
Independent_directors	-0.025	-0.025	0.016
	(-1.482)	(-1.217)	(0.412)
Board_size	-0.111	-0.293**	-0.010
	(-0.966)	(-2.037)	(-0.035)
LN_Age		0.503	0.104
		(1.367)	(0.184)
LN_Assets		0.150	0.448
		(0.426)	(0.779)
DE		-0.115	-0.097
		(-1.253)	(-0.972)
ROA		1.151	4.052
		(1.135)	(0.693)
Underwriter		-0.083	-0.065
		(-0.361)	(-0.169)
D_Age			-0.089
			(-0.612)
D_Qualifications			-1.269
			(-1.030)
D_Tenure			0.103
			(0.350)
Constant	3.508	2.575	-2.407
	(0.740)	(0.356)	(-0.162)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.099	0.151	0.196

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The dummy variable PE is negative and significant at a 5% level in all three regressions, where statistical significance of 1% is found in regression 1 and 2. The negative coefficient suggests that private equity backing causes significantly lower levels of underpricing, thereby rejecting the null hypothesis of hypothesis 1. Namely, if the issuer is backed by private equity, the level of underpricing is reduced by respectively 2.721% (regression 1), 2.926% (regression 2) and 3.825% (regression 3). This finding is consistent with Mogilevsky and Murgulov (2012), Rodvang and Ulsrud (2019) and Levis (2011), who found support for the certification hypothesis by finding lower underpricing for PE-backed issuers in the US, Nordic region and United Kingdom respectively. The certification hypothesis states that the active involvement of a financial sponsor, in this case the private equity firm, indeed mitigates the level of information asymmetry and therefore the perceived level of underpricing.

Moreover, the proportion of female directors is found to be positive and significant at a 5% level in regression 1 and 2, indicating that a higher proportion of female directors causes higher levels of underpricing. That is, if the proportion of female directors would increase by 1% underpricing would rise with 0.064% (regression 1) and 0.081% (regression 2) respectively. In other words, if the board solely consists out of female directors, so the proportion of female directors with respect to total directors equals 100%, the level of underpricing would increase with approximately 6% (regression 1) and 8% (regression 2) respectively. Therefore, the coefficient of female directors is both statistical as well as economical significant. These results are similar to the findings of Reutzel and Belsito (2015), who found higher IPO underpricing due to female board represention in the US. They claim the existence of a gender bias, primariliy due to investors relying on female stereotypes when evaluating female board members and their performance. Female directors may be seen as less capable in executing board related tasks, such as monitoring the firm and bringing in external resources (Adams and Ferreira, 2009; Hillman et al., 2007). Furthermore, Jensen and Meckling (1976) and Olsen and Cox (2001) provide reasonable explanations by stating that female directors often show more risk-averse behaviour than men, thereby unable to fully maximize shareholders' return. Overall, female representation in the board room might increase uncertainty regarding the IPO due to investors' perception about female capabilities. As Beatty and Ritter (1986) already stated, the greater the uncertainty is, the greater the underpricing of the IPO. However, as the finite sample covers from 2000 until 2019, caution needs to be taken. As illustrated in section 2.3.1., female representation within the board room rises primarily in recent years.

Since our finite sample covers 19 years, 2000 until 2019, the effect of upcoming female board members on IPO underpricing might not be fully incorporated or influenced by investors' female stereotypes in more dated years.

The proportion of independent directors is found to be insignificant in all three models. These results correspond most with Yatim (2011), who found no significant relationship between independent directors and underpricing. The coefficient of independent directors is negative in 2 of 3 models, pointing towards the fact that independent directors are able to mitigate information asymmetry. However, as statistical significance has not been achieved, the results are not in line with the negative relation found by Lin and Chuang (2011) and Filatotchev and Bishop (2012), nor the positive relation found by Darmadi and Gunawan (2013). Therefore, there is no evidence that independent directors mitigate the level of underpricing.

With respect to board size, the coefficient is found to be significant at a 5% in regression 2, similar to the findings of Certo, Daily and Dalton (2001) and Darmadi and Gunawan (2013) and contrary to Hearn (2011). If the size of the board increases with 1 board member, the level of underpricing decreases with 0.293%. As this outcome can be interpreted as reasonable, the coefficient of board size is both statistically as well as economically significant. The regression result obtained in regression 2 regarding board size turned out to have a negative sign, providing support that larger board size successfully mitigate information asymmetry and reduce uncertainty by monitoring more effectively, a result similar to the findings of Harris and Raviv (2008) and Boone, Field, Karpoff and Raheja (2007). Certo, Daily and Dalton (2001) appointed the larger opportunities larger boards have to attract additional resources from an investors point of view, providing valid reasoning why larger boards are able to mitigate the level of underpricing.

The control variables within all regressions (table 9) are not significant and therefore not significantly different from zero. The regressions performed in the next section will have the inclusion of an interaction term between private equity backing (PE) and the three different components of board composition, namely female, independent and total directors. Section 3.2.2. pointed out that the interpretation of the interaction term is related to the stand-alone effect observed in table 9. Therefore, as section 4.3.1. discussed the main effect of the four independent variables on underpricing, section 4.3.2. will reveal the influence of private equity backing on the observed effect of female, independent and total directors found on underpricing (section 4.3.1.).

4.3.2. The effect of private equity backing on board composition and underpricing

Table 10 provides the results regarding the three regressions with interaction term. The interaction term will reveal the impact of private equity backing on the relationship between female, independent and total directors on the one hand and underpricing on the other. For example, the interaction term between independent directors and PE can be read as Independent_directors * PE, where PE equals one if private equity backing occurs and zero otherwise. The interaction term can be interpreted as follows (Hogan, Olson and Kish, 2001). If the coefficient of the interaction term between independent directors and PE is significantly negative within the regression, I can conclude that the effect of independent directors on underpricing is more negative related to PE-backed IPOs than non-backed IPOs. In other words and in that case, private equity firms are able to strengthen the negative effect of independent directors on underpricing. Similar to the build-up used in section 4.3.1., regression 1 solely consists out of independent variables and interaction terms. In regression 2 and 3 control variables on a firm and individual level are added.

As can be seen in table 10, the coefficient of female directors is, similar to table 9, positive in all three models, where the coefficient is significant at a 5% level in regression 1 and 2. Compared with the stand-alone coefficient of female directors, the interaction term between female directors and PE changed from positive to negative within regression 1 and 2, implying that PE-backed are able to mitigate the positive effect of female directors on underpricing. However, the interaction term is not significant, hence not significantly different from zero. Therefore, I cannot reject the null hypothesis of hypothesis 2.2. Although the PE and female directors coefficients signal significancy in table 9 and the sign of the interaction term between female directors and PE compared with the significant female directors coefficient changes from positive to negative in table 10, it cannot be demonstrated that private equity backing mitigates the positive effect of female directors on IPO underpricing.

Table 10. *Reports the results of three executed multivariate regressions. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The dependent variable, underpricing, is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. PE is a dummy variable which equals 1 if the IPO is backed by a private equity firm and 0 if otherwise. Female- and independent directors are the proportion of directors following the criteria with respect to total board size. Board size is the total number of directors on the board. Female_directors * PE, Independent_directors * PE and Board_size * PE represent the interaction effect of private equity backing on the relationship between female-, independent and total directors (Board_size) on the one hand and underpricing on the other hand. LN_age is the natural logarithm of age, which is calculated as the difference in years between the year the IPO occurred and the firm was founded. LN_Assets is the natural logarithm of assets, which equals the total assets the year the IPO occurred. DE is the debt-to-equity ratio, which is calculated by dividing total liabilities by shareholders' equity in the year the IPO occurred. ROA is the return-on-assets, which is calculated by dividing net income by total assets in the year the IPO occurred. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age is the average age of the total number of directors at time the IPO occurred, Qualifications the average number of qualifications the total number of directors have earned and D_Tenure the average time spend within the board prior to the IPO. All variables are adjusted for normality and heteroskedastic standard errors are applied if necessary. Furthermore, all regressions are controlled for industry-, year- and country-fixed effects. The values represent the corresponding correlation coefficient, the corresponding t-statistic (within parentheses) and the level of significance, where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	(1)	(2)	(3)
PE	-6.076	-4.985	-5.595
	(-1.436)	(-1.155)	(-0.688)
Female_directors	0.078**	0.099**	0.019
	(2.507)	(2.208)	(0.246)
Independent_directors	-0.037**	-0.041*	-0.005
	(-2.020)	(-1.687)	(-0.097)
Board_size	-0.140	-0.310*	-0.010
	(-1.096)	(-1.904)	(-0.032)
Female_directors * PE	-0.076	-0.083	-0.002
	(-1.157)	(-0.935)	(-0.015)
Independent_directors * PE	0.061	0.067	0.046
	(1.531)	(1.401)	(0.613)
Board_size * PE	0.175	-0.003	-0.119
	(0.477)	(-0.009)	(-0.207)
LN_Age		0.520	0.116
		(1.426)	(0.201)
LN_Assets		0.186	0.470
		(0.527)	(0.808)
DE		-0.119	-0.102
		(-1.281)	(-1.010)
ROA		1.075	3.302
		(1.068)	(0.552)
Underwriter		-0.092	-0.055
		(-0.394)	(-0.139)
D_Age			-0.094
			(-0.625)
D_Qualifications			-1.294
			(-1.042)
D_Tenure			0.111
			(0.373)
Constant	4.480	3.439	-0.884
	(1.117)	(0.471)	(-0.056)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.103	0.157	0.198

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As for independent directors, the coefficients of regression 1 and 2 in table 10 display significant negative signs compared to the non-significant results in table 9. Furthermore, compared to regression 3 performed in table 9, the coefficient of regression 3 in table 10 switched from a positive to a negative sign. The changes can be attributed to the fact that, due to the inclusion of interaction terms, the starting point of the model differs with the model performed in table 9. As Hogan, Olson and Kish (2001) mentioned and reasoning behind the rationale why the interpretation of the interaction term is related to the stand-alone effect observed in table 9, due to the inclusion of interaction terms non-backed IPOs are used as control sample to capture the differential impact of private equity backing on female, independent and total directors. Meanwhile, the regressions performed in table 9 does not make that distinction, as it uses all firms to observe the effect of female, independent and total directors on underpricing. The interaction term between independent directors and PE is found to be insignificant. Therefore, the null hypothesis of hypothesis 3.2. cannot be rejected. It cannot be proved that private equity backing strengthens the negative effect of independent directors on underpricing.

Regarding board size, the (significant) negative signs in table 10 are similar to those in table 9. As the interaction term between board size and PE is insignificant, the null hypothesis of hypothesis 4.2. cannot be rejected. Evidence that private equity backing significantly strengthens the negative effect of board size on underpricing is lacking. Although the dummy variable PE, as well as board size signal significancy in table 9, it cannot be verified that private equity backing plays a role in strengthening the observed effect between board size and underpricing.

Altogether, the observed effect that private equity firms experience significantly less underpricing than non-backed counterparts is similar to the findings of Levis (2011), Mogilevsky and Murgulov (2012) and Rodvang and Ulsrud (2019). As mentioned, these differences can be attributed to the certification hypothesis, where the active involvement of a financial sponsor, in this case the private equity firm, can mitigate information asymmetry about the true value of an IPO. In particular, certification by a third party would mitigate the information asymmetry between issuer and outside investor, either informed or uninformed, thereby reducing the level of underpricing. Due to the certification hypothesis, I would expect that private equity backing significantly reduces the positive influence female directors have on underpricing by diminishing the uncertainty surrounding the IPO. Due to the critical assessment of private equity firms with respect to the quality and size of the board of directors of the issuing

firm, it was expected that private equity backing significantly strengthens the negative influence of independent and total directors on underpricing. However, despite significant differences found within the univariate analysis regarding female, independent and total directors between PE-backed and non-backed issuers, as the multivariate analysis indicates, there is no evidence that private equity firms significantly influence the relationship of respectively female, independent and total directors on underpricing. Hence, statistical foundations are lacking and the null hypothesis of hypotheses 2.2, 3.2 and 4.2 cannot be rejected. A possible explanation could be that private equity backing indeed mitigate nor amplify the effect of female, independent and total directors on underpricing. However, another possibility is that significant results are not observed due to the composition of the sample or the powerfulness of executed tests due to too limited observations.

4.3.3. Robustness checks

In order to verify the robustness of the results obtained with the univariate and multivariate study, alternative measurements of female, independent and total directors are considered as well. In the main analysis, variables for female and independent directors were defined as the proportion of female and independent directors with respect to total board size. In this section, female and independent directors are measured as respectively the total number of female and independent directors instead of the proportional measure used in the main analysis. With respect to board size, the natural logarithm of total number of directors is taken instead of the total number of directors used in the main analysis.

Table 11 showcases the regression results regarding the robustness checks of the variables of interests. Robustness checks are executed for regression 1, 2 and 3, where the model build-up is similar as the build-up used in the main multivariate analysis. Hence, regression 1 solely presents the influence of board composition on underpricing without control variables, regression 2 extends with all firm-specific control variables, whereafter all individual controls are added in regression 3. Full regression results can be observed in the appendix, where respectively table 6A outlines the robustness check with the total number of female directors, table 7A the robustness check with the total number of independent directors and table 8A the robustness check with the natural logarithm of board size included.

As can be seen, the results are consistent with the results obtained in table 9. Similar to the proportional measure used in the main analysis, the number of female directors illustrates the significant positive influence of female directors on the level of underpricing. Regarding

independent directors, both measures display negative insignificant results, implying that independent directors indeed are unable to mitigate the level of underpricing. Last, the significant negative coefficient of the natural logarithm of board size is consistent with the result found in table 9, presenting the negative influence of the size of the board on underpricing. Overall, the robustness of the founded results can be confirmed.

Table 11. *Reports the results of the executed robustness checks. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The alternative measurements involve the total number of female directors, instead of the preceding proportion of female directors relative to total board size, the total number of independent directors, instead of the preceding proportion of independent directors relative to total board size and the natural logarithm of total board size, instead of the preceding total number of directors. Model 1 solely presents the influence of board composition on underpricing without control variables, model 2 extends with all firm-specific control variables, whereafter all individual controls are accessed in model 3. All variables are adjusted for normality and heteroskedastic standard errors are applied if necessary. Furthermore, all regressions are controlled for industry-, year- and country-fixed effects. The values represent the corresponding correlation coefficient, the corresponding t-statistic (within parentheses) and the level of significance, where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	(1)	(2)	(3)
Number_of_female_directors	0.625**	0.884**	0.605
	(2.134)	(2.178)	(0.820)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.099	0.151	0.199
Number_of_independent_directors	-0.194	-0.231	0.087
	(-1.188)	(-1.120)	(0.226)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.098	0.151	0.195
LN_boardsize	-1.067	-2.457*	-0.488
	(-0.953)	(-1.880)	(-0.207)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.099	0.150	0.196

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

This section briefly describes the implications of the uncovered results. The most important results are defined in relation with existing literature, whereafter limitations of the research conducted are clarified. Afterwards, suggestions for future research are introduced based on both the limitations of this paper and remaining gaps within literature regarding this topic.

This paper tried to answer the following research question: What is the influence of private equity backing on the issuers board composition and the degree of underpricing? To answer the formulated question, I first looked whether there exists a significant difference in underpricing between PE-backed and non-backed issuers, whereafter I looked at the differences in board composition between PE-backed and non-backed issuers, the influence of the board components on the underpricing found and the influence of private equity backing on the relationship observed.

Hypothesis 1 investigated whether PE-backed issuers experience significant lower underpricing compared to non-backed counterparts. As it turns out and in line with the certification hypothesis, there is a significant difference in underpricing between PE-backed and non-backed, PE-backed IPOs ending up with considerably and significantly less underpricing than non-backed IPOs. The evidence presented corresponds with the findings of Levis (2011), Moglivesky and Murgulov (2012) and Rodvang and Ulsrud (2019).

To investigate the foundation of the difference in underpricing, I looked into differences within board composition between PE-backed and non-backed issuers. Hypothesis 2.1 investigated whether PE-backed issuers have significantly less female directors appointed compared to non-backed counterparts. The results indicate that, contrary to our expectations and thereby rejecting the null hypothesis of hypothesis 2, it appears that PE-backed issuers have significantly more female directors appointed than non-backed counterparts. It might be that private equity firms value the positive influence of women on board strategic control, increasing both the level of cooperation and activeness within the board, as stressed by Nielsen and Huse (2010). Furthermore, private equity firms might acknowledge that female directors cause higher firm performance, managerial competence and earnings quality, as already stated by Terjesen, Couto and Francisco (2015), Mcguiness (2018) and Gul, Srinidhi and Ng (2011). As the research conducted shows, the proportion of female directors have a significant positive influence on underpricing, which is in line with research conducted by Reutzel and Belsito (2015). Outside investors might rely on female stereotypes when evaluating female board

members and their performance. Hypothesis 2.2 investigated whether private equity backing mitigates the positive relationship between female directors and underpricing. There is no proof that the inclusion of private equity backing, investigated by including an interaction term between female directors and private equity backing, mitigates the positiveness of the relationship. Therefore, the null hypothesis of hypothesis 2.2 cannot be rejected.

Along female directors, the impact of the proportion of independent directors on underpricing is tested as well. Hypothesis 3.1 tested whether PE-backed have a significantly higher proportion of independent directors than non-backed counterparts. Conform our expectations and similar to the reasoning proposed by Boone, Field, Karpoff and Raheja (2007), the results indicate that PE-backed issuers have significanlty more independent directors than non-backed issuers. Private equity firms might prefer independent directors as they decrease agency problems by putting constrains to managers' influence. However, as our research indicates, there is no evidence that independent directors reduce the information asymmetry between issuer and outside investor, as no significant relationship between the proportion of independent directors and underpricing is found, exhibiting similarity to the findings of Yatim (2011). Hypothesis 3.2 tested whether private equity backing signicantly strengthens the relationship observed. In my research, it has not been established that private equity backing strenghtens the relationship between the proportion of independent directors and underpricing.

Last, hypothesis 4.1 investigates whether PE-backed issuers have significantly larger boards than non-backed counterparts. The results indicate that, ccontrary to our expectations, PE-backed issuers end up with significantly smaller boards compared to non-backed issues. Similar to venture capital firms, private equity firms might replace tasks normally performed by board members. Ultimately, this would result in a smaller board size at IPO, as private equity firms give up their board position when exiting. Furthermore, the relationship between the size of the board and the level of underpricing is investigated. Alike researches conducted by Certo, Daily and Dalton (2001) and Darmadi and Gunawan (2013), a significant negative relationship between board size and the level of underpricing is found, implying that larger boards have larger opportunities to attract additional resources from an investors point of view and reduce the level of information asymmetry between issuer and investor. Hypothesis 4.2 tests whether private equity backing strengthens the negative relationship observed between board size and underpricing. Based on my research, there is no evidence that private equity backing strengthens the negative relationship found between board size and underpricing.

Overall, although significant differences in board composition between PE-backed and non-backed issuers persist, there are no signs that these differences explain the difference found in underpricing between PE-backed and non-backed IPOs. These results suggest that private equity firms are able to occupy the certification role, but it has not been proven that the differences within board composition and the influence of private equity backing on those board determinants induce the differences found in underpricing.

This research contributed to existing literature, as research regarding the differences in board composition between PE-backed, contrary to VC-backed, and non-backed issuers are not examined before. Furthermore, the impact of private equity backing on the relationship between female, independent and total directors on the one hand and underpricing on the other hand is not investigated up to this point. Last, research regarding female directors and their influence on the level of underpricing is limited. As both the attractiveness for private equity firms to exit a portfolio firm by going public and the social awareness for board diversity and composition in general increased, improved understanding concerning this topic is from increased importance.

5.1. Limitations

This paper faced several different limitations during the research conducted. In order to interpret the findings rightfully, those limitations need to be accounted for.

First, limitations related to the data availability. Private equity firms generally don't, and are not required to, share their data regarding their portfolio firms. In other words, due to the private environment private equity firms operate in, is it hard to build-up a representative sample. As a result, the sample contains more non-backed issuers (621) than PE-backed issuers (150), due to the more sufficient data availability regarding non-backed issuers. Consequently, drawing conclusions with respect to the influence of private equity firms needs to be with discretion, as most private equity firms are not represented within the sample.

Second, the differences found between PE-backed and non-backed issuers can have their foundation due to variables and conditions that are not observed within this paper. This paper primarily focuses on the differences between PE-backed and non-backed issuers within board composition and the influence of private equity backing on the founded relationship between female, independent and total directors and underpricing. To observe where the differences found in female, independent and total directors between PE-backed and non-backed issuers come from, a different research framework is needed. As this paper primarily

focuses on the relation with underpricing, the foundation of the identified differences regarding board composition between PE-backed and non-backed issuers are outside the scope.

5.2. Future Research

As the paper executed has several limitations within execution and scope, future research can fill the gaps this paper let untouched. As the limitations section displayed (section 5.1), data availability could be improved. A more enhanced dataset could lead to significant different results and insights. As Europe was the region of interest, extending research to different regions around the world could lead to a more general understanding regarding this topic.

Furthermore, as institutions as EQT and Goldman Sachs illustrate, the increasing attention for social issues such as board diversity just led to a change in policy. As for EQT, and all other private equity firms around the globe, it is yet to see what the implications of these changes are and how it will affect the board composition of the portfolio firm in the future. As our data range covers 2000-2019, these changes are not fully reflected within the dataset used. Therefore, conducting the same research within a decade could be valuable in order to investigate whether board compositions have changed and what the results of the adjusted policies are over time.

Third, long-term performance is not taken into consideration within this paper. As investigated by Cornelli and Karakas (2008), the board size and number of outside directors significantly decreased after public companies were taken private. However and the other way around, significant changes within board composition after a company is taken public are not investigated before. Differences between PE-backed and non-backed firms over time can be investigated in order to get a better understanding of the differences regarding board composition.

Fourth, future research could investigate the issue of cherry picking. The purpose of the executed paper is to explain the difference in underpricing between PE-backed and non-backed by differences in board composition. However, the foundation of the differences showed remain unclear. One could investigate whether the differences found arise from cherry picking, an issue that occurs in case the private equity firm picks the firms with the desired board composition instead of implementing the desired changes within management of the portfolio firm during the holding period. One could apply Heckman's selection model (Heckman, 1979), similar to

research conducted by Aktas, Bodt and Roll (2010) and Boone and Mulherin (2001), to correct for biases that appear due to non-random samples.

Fifth, as the limitations section illustrates, observed differences within board composition between PE-backed and non-backed issuers can come from variables and conditions that are unobserved. Therefore, one could ignore the level of underpricing between PE-backed and non-backed issuers and solely focus on the differences concerning female, independent or total directors with respect to PE-backed and non-backed issuers. Analysing those differences even further could provide several insights in addition to the present paper conducted.

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7. Appendix

Table 1A. *Reports the specifications of the variables included in the sample. The databases consulted to collect the sample are Bloomberg, BoardEX, Compustat and ISS. The definition of a specific variable can be found under "description", where the "source" column displays wherefrom the variable is consulted.*

Variable specification	Description	Source
Dependent variable		
Underpricing	Percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price	Bloomberg
Independent variables		
PE	Dummy variable which equals 1 if the IPO is backed by a private equity firm and 0 if otherwise	Bloomberg
Female_directors	Proportion of female directors with respect to total board size	Bloomberg / BoardEX / ISS
Independent_directors	Proportion of independent directors with respect to total board size	Bloomberg / BoardEX / ISS
Board_size	Total number of directors on the board	Bloomberg / BoardEX / ISS
Control variables - firm specific		
LN_Age	Natural logarithm of age, which is calculated as the difference in years between the year the IPO occurred and the firm was founded	Bloomberg
LN_Assets	Natural logarithm of assets, which equals the total assets the year the IPO occurred	Bloomberg / Compustat
DE	Debt-to-equity ratio, which is calculated by dividing total liabilities by shareholders' equity in the year the IPO occurred	Bloomberg / Compustat
ROA	Return-on-assets, which is calculated by dividing net income by total assets in the year the IPO occurred	Bloomberg / Compustat
Underwriter	The underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated	Bloomberg
Control variables - individual		
D_Age	Average age of the total number of directors at time the IPO occurred	BoardEX
D_Qualifications	The average number of qualifications the total number of directors have earned prior to the IPO	BoardEX / ISS
D_Tenure	The average time spend within the board prior to the IPO	BoardEX

Table 2A. *Descriptive statistics of the industry composition of the sample. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The sample yields 9 different industry specifications, which are specified and collected in Bloomberg. The number of IPOs with respect to total IPOs within the selected subgroup is given in parentheses.*

Business sector	Total	PE	NB
Basic Materials	46	5	41
	(0.060)	(0.033)	(0.066)
Communications	78	19	59
	(0.101)	(0.127)	(0.095)
Consumer, Cyclical	99	31	68
	(0.128)	(0.207)	(0.110)
Consumer, Non-cyclical	160	39	121
	(0.208)	(0.260)	(0.195)
Energy	44	2	42
	(0.057)	(0.013)	(0.068)
Financial	153	27	126
	(0.198)	(0.180)	(0.203)
Industrial	123	14	109
	(0.160)	(0.093)	(0.176)
Technology	46	11	35
	(0.060)	(0.073)	(0.056)
Utilities	22	2	20
	(0.029)	(0.013)	(0.032)

Table 3A. *Reports results of Levene's test to assess the equality of variances of the descriptive statistics of characteristics on a firm and individual level. Fluctuations within the number of observations can be attributed to the data available. The descriptive statistics for Offer Size and Market Capitalization are presented in EURm, where Offer Size represents the total value of shares offered and Market Capitalization the value of total equity of the issuer. The variable Age is measured as the difference between the year the IPO occurred and the year the issuer was founded. DE and ROA are calculated as respectively Total Liabilities / Total Shareholders' Equity and Net Income / Total Assets. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age, D_Qualifications and D_Tenure represent individual characteristics, where the average with respect to age, number of qualification and time within the board of all board members is taken at time the IPO went public. The N represents the number of observations within the selected subgroup. The values represent the corresponding t-statistic and the level of significance (within parentheses), where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

Levene's test	N	σ^2	T-statistic
Offer Size (€M)			
NB / PE	621/150	2.620	3.253 (0.072)*
Market Cap (€M)			
NB / PE	447/129	5.494	4.252 (0.040)**
Age			
NB / PE	432/115	2.226	1.957 (0.162)
DE			
NB / PE	620/150	1.433	0.591 (0.442)
ROA			
NB / PE	424/105	9.618	5.584 (0.018)**
Underwriter			
NB / PE	614/150	1.531	31.078 (0.000)***
D_Age			
NB / PE	278/95	1.060	0.286 (0.593)
D_Qualifications			
NB / PE	320/102	2.069	8.556 (0.003)***
D_Tenure			
NB / PE	234/102	0.590	12.091 (0.001)***

Table 4A. *Reports the results of the Welch and two-sample T-tests conducted on the descriptive statistics of characteristics on a firm and individual level. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed and is presented in the columns "Total", "PE" and "NB" respectively. Fluctuations within the number of observations can be attributed to the data available. The descriptive statistics for Offer Size and Market Capitalization are presented in EURm, where Offer Size represents the total value of shares offered and Market Capitalization the value of total equity of the issuer. The variable Age is measured as the difference between the year the IPO occurred and the year the issuer was founded. DE and ROA are calculated as respectively Total Liabilities / Total Shareholders' Equity and Net Income / Total Assets. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age, D_Qualifications and D_Tenure represent individual characteristics, where the average with respect to age, number of qualification and time within the board of all board members is taken at time the IPO went public. Values within the column "Welch Test" and "Two-sample T-test" represent the corresponding t-statistic and the level of significance (within parentheses), where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	Total	PE	NB	Welch Test	Two-sample T-test
Offer Size (€M)					
Mean	602	719	574	-2.213	
Std. Dev	956	629	1018	(0.028)**	
N	771	150	621		
Market Cap (€M)					
Mean	2131	2083	2145	0.189	
Std. Dev	4888	2308	5411	(0.850)	
N	576	129	447		
Age					
Mean	27.307	23.974	28.194		0.899
Std. Dev	44.717	31.879	47.547		(0.369)
N	547	115	432		
DE					
Mean	2.687	1.756	2.913		1.452
Std. Dev	8.758	7.534	9.020		(0.147)
N	770	150	620		
ROA					
Mean	0.043	0.038	0.044	0.268	
Std. Dev	0.313	0.111	0.345	(0.789)	
N	529	105	424		
Underwriter					
Mean	3.645	4.853	3.350	-7.060	
Std. Dev	2.723	2.225	2.753	(0.000)***	
N	764	150	614		
D_Age					
Mean	58.977	59.847	58.679		-1.731
Std. Dev	5.692	5.554	5.718		(0.084)*
N	373	95	278		
D_Qualifications					
Mean	1.890	2.067	1.834	-3.339	
Std. Dev	0.740	0.546	0.785	(0.001)***	
N	422	102	320		
D_Tenure					
Mean	3.703	3.836	3.645	-0.401	
Std. Dev	3.624	4.295	3.298	(0.689)	
N	336	102	234		

Table 5A. *Reports results of the executed test to assess the OLS assumption assuming normality of the data. The variable of interest are the residuals. The N represents the number of observations within the sample. The probability of exceeding Z is 0.051, which is larger than the threshold of 0.05. Therefore, the null-hypothesis assuming a normal distribution of the error term cannot be rejected.*

Shapiro-Wilk W test for normal data

Variable	N	W	V	z	Prob > z
Residuals	771	0.996	1.950	1.636	0.051

Table 6A. *Reports the results of three executed multivariate regressions with robustness check. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The dependent variable, underpricing, is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. PE is a dummy variable which equals 1 if the IPO is backed by a private equity firm and 0 if otherwise. Number_of_female_directors are the total number of female directors appointed to the board and independent directors are the proportion of independent directors following the criteria with respect to total board size. Board size is the total number of directors on the board. LN_age is the natural logarithm of age, which is calculated as the difference in years between the year the IPO occurred and the firm was founded. LN_Assets is the natural logarithm of assets, which equals the total assets the year the IPO occurred. DE is the debt-to-equity ratio, which is calculated by dividing total liabilities by shareholders' equity in the year the IPO occurred. ROA is the return-on-assets, which is calculated by dividing net income by total assets in the year the IPO occurred. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age is the average age of the total number of directors at time the IPO occurred, D_Qualifications the average number of qualifications the total number of directors have earned and D_Tenure the average time spend within the board prior to the IPO. All variables are adjusted for normality and heteroskedastic standard errors are applied if necessary. Furthermore, all regressions are controlled for industry-, year- and country-fixed effects The values represent the corresponding correlation coefficient, the corresponding t-statistic (within parentheses) and the level of significance, where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	(1)	(2)	(3)
PE	-2.752***	-2.964***	-3.777**
	(-2.863)	(-2.735)	(-2.220)
Number_of_female_directors	0.625**	0.884**	0.605
	(2.134)	(2.178)	(0.820)
Independent_directors	-0.024	-0.025	0.011
	(-1.466)	(-1.203)	(0.280)
Board_size	-0.216*	-0.462***	-0.176
	(-1.661)	(-2.717)	(-0.510)
LN_Age		0.508	0.124
		(1.385)	(0.219)
LN_Assets		0.105	0.371
		(0.295)	(0.639)
DE		-0.114	-0.101
		(-1.247)	(-1.018)
ROA		1.122	3.947
		(1.100)	(0.676)
Underwriter		-0.090	-0.064
		(-0.391)	(-0.166)
D_Age			-0.074
			(-0.510)
D_Qualifications			-1.201
			(-0.975)
D_Tenure			0.115
			(0.392)
Constant	4.397	4.268	-2.207
	(1.120)	(0.577)	(-0.150)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.099	0.151	0.199

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7A. *Reports the results of three executed multivariate regressions with robustness check. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The dependent variable, underpricing, is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. PE is a dummy variable which equals 1 if the IPO is backed by a private equity firm and 0 if otherwise. Female directors are the proportion of directors following the criteria with respect to total board size and number_of_independent_directors are the total number of independent directors appointed to the board. Board size is the total number of directors on the board. LN_age is the natural logarithm of age, which is calculated as the difference in years between the year the IPO occurred and the firm was founded. LN_Assets is the natural logarithm of assets, which equals the total assets the year the IPO occurred. DE is the debt-to-equity ratio, which is calculated by dividing total liabilities by shareholders' equity in the year the IPO occurred. ROA is the return-on-assets, which is calculated by dividing net income by total assets in the year the IPO occurred. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age is the average age of the total number of directors at time the IPO occurred, D_Qualifications the average number of qualifications the total number of directors have earned and D_Tenure the average time spend within the board prior to the IPO. All variables are adjusted for normality and heteroskedastic standard errors are applied if necessary. Furthermore, all regressions are controlled for industry-, year- and country-fixed effects. The values represent the corresponding correlation coefficient, the corresponding t-statistic (within parentheses) and the level of significance, where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	(1)	(2)	(3)
PE	-2.703***	-2.896***	-3.758**
	(-2.811)	(-2.658)	(-2.207)
Female_directors	0.062**	0.080**	0.022
	(2.173)	(2.029)	(0.329)
Number_of_independent_directors	-0.194	-0.231	0.087
	(-1.188)	(-1.120)	(0.226)
Board_size	-0.012	-0.176	-0.073
	(-0.097)	(-1.088)	(-0.263)
LN_Age		0.506	0.117
		(1.377)	(0.206)
LN_Assets		0.162	0.427
		(0.460)	(0.741)
DE		-0.113	-0.097
		(-1.236)	(-0.979)
ROA		1.157	3.842
		(1.145)	(0.660)
Underwriter		-0.079	-0.056
		(-0.341)	(-0.144)
D_Age			-0.089
			(-0.610)
D_Qualifications			-1.242
			(-1.007)
D_Tenure			0.099
			(0.336)
Constant	2.245	1.219	-1.206
	(0.602)	(0.179)	(-0.083)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.098	0.151	0.195

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8A. *Reports the results of three executed multivariate regressions with robustness check. The total sample consists out of 771 observations, 150 private equity backed and 621 non-backed. The dependent variable, underpricing, is the percentual change calculated as the first day closing price minus the initial offer price, divided by the initial offer price. PE is a dummy variable which equals 1 if the IPO is backed by a private equity firm and 0 if otherwise. Female- and independent directors are the proportion of directors following the criteria with respect to total board size. LN_boardsize is the natural logarithm of the total number of directors on the board. LN_age is the natural logarithm of age, which is calculated as the difference in years between the year the IPO occurred and the firm was founded. LN_Assets is the natural logarithm of assets, which equals the total assets the year the IPO occurred. DE is the debt-to-equity ratio, which is calculated by dividing total liabilities by shareholders' equity in the year the IPO occurred. ROA is the return-on-assets, which is calculated by dividing net income by total assets in the year the IPO occurred. Underwriter equals the underwriter's market share. If multiple underwriters are assigned, the average of market shares is calculated. D_Age is the average age of the total number of directors at time the IPO occurred, D_Qualifications the average number of qualifications the total number of directors have earned and D_Tenure the average time spend within the board prior to the IPO. All variables are adjusted for normality and heteroskedastic standard errors are applied if necessary. Furthermore, all regressions are controlled for industry-, year- and country-fixed effects. The values represent the corresponding correlation coefficient, the corresponding t-statistic (within parentheses) and the level of significance, where * occurs when P < (0.1), ** when P < (0.05) and *** when P < (0.01).*

	(1)	(2)	(3)
PE	-2.701***	-2.897***	-3.803**
	(-2.815)	(-2.680)	(-2.229)
Female_directors	0.065**	0.082**	0.021
	(2.291)	(2.082)	(0.309)
Independent_directors	-0.025	-0.024	0.014
	(-1.494)	(-1.169)	(0.359)
LN_boardsize	-1.067	-2.457*	-0.488
	(-0.953)	(-1.880)	(-0.207)
LN_Age		0.485	0.116
		(1.322)	(0.205)
LN_Assets		0.150	0.461
		(0.429)	(0.800)
DE		-0.114	-0.098
		(-1.249)	(-0.983)
ROA		1.112	4.067
		(1.098)	(0.697)
Underwriter		-0.074	-0.064
		(-0.319)	(-0.164)
D_Age			-0.085
			(-0.591)
D_Qualifications			-1.251
			(-1.016)
D_Tenure			0.098
			(0.334)
Constant	4.763	5.040	-1.700
	(1.050)	(0.655)	(-0.112)
Industry, Year and Country FE	YES	YES	YES
Observations	771	493	234
R-squared	0.099	0.150	0.196

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1