The impact of private equity on IPO underpricing in the DACH region

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Abstract

This research provides a study to the difference in underpricing between private equity backed initial public offerings and non-private equity backed initial public offerings in the DACH region between 2003 and 2017. The results show that PE-backed IPO underpricing does not differ from non-PE backed IPO underpricing. Common aspects such as the size of the company, the age of the company or the rank of the underwriter could not explain various influences on underpricing. The aftermarket shows no discrepancy as well up to the first twelve months after the IPO. This implies that it is possible to gain from investing in PE-backed IPOs from one year after the IPO.

Keywords: IPO underpricing, asymmetric information, private equity, stock return

JEL-Codes: C12, C21, C58, D81, D82, G11, G12, G24, L33, O52

Preface

This master thesis marks the end of my time as a student on the Erasmus University in Rotterdam. I would like to use this part to thank the people who helped me to reach this point. First, I would like to thank Dr. Joris Kil for helping me during this thesis process. Whenever I needed, Joris was so generous to help me with my questions and to provide feedback on my work. Second, I would like to thank my family for the support during my university era. Last of all, I would like to thank the whole University for their facilities, lectures, professors and other staff members that made my time outstanding to develop my skills.

I became more interested in the concept of private equity in the financial world during the seminar Advanced Corporate Finance: Private Equity, which I took at Erasmus. My knowledge about this subject was not very broad at the beginning of the seminar, but during the seminar, the idea emerged to use this particularly area for my thesis and combine it with my interest in stocks. Since I was young, I was always willing to know the process behind the value of a stock price and the motivation behind price fluctuations. The bachelor course Stock Pricing and Corporate Events encouraged my curiosity to the price fluctuations on the first trading day after a public offering on an exchange. During my research to this subject, I discovered there was not much research done to this field of expertise so this encouraged me to work on this.

Finally, do I solemnly declare that the work presented in this thesis is original and no other sources than mentioned in the text and the references have been used.

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1. Introduction

The readers of Bild am Sonntag were in the spring of 2003 confronted with an interview of the chairperson of the Sozialdemokratische Partei Deutschlands, Franz Müntefering. The German politician accused anonymous financial investors of locusts' behavior and compared it with a plague:

"Some financial investors do not waste their thoughts on the people whose jobs they are destroying - they remain anonymous, have no face, fall like swarms of locusts over businesses, they graze and move on. We fight against this form of capitalism." [1]

Without giving examples, he immediately clarified that this kind of behavior was directed towards a specific group of companies. Two weeks later a blacklist of names including all big private equity companies was published on behalf of the SPD. One of the squeezed lemons by these companies was the German chemical company Celanese. At the end of 2003, Celanese was taken private by The Blackstone Group. In January 2005, Blackstone brought the company back on the market through an IPO and made 4.6 times its investment. In about one year, the enterprise value rose with about 50%. However, the investors in the IPO did not profit from the floatation on the market. Despite the rising enterprise value, the issue price of $16 per share fell to $13.54 per share. This example shows how the financial performance does not always improve in the period of the involvement of a private equity firm (von Drathen, 2007).

Although his opinion was not shared by everyone, the Deutsche Bundestag accepted in 2008 the law to limit the risk associated with financial investments. According to this law, the investors of listed companies should disclose their objectives and source of their assets when they have a stake of at least 10% in the firm. This objective should include whether the companies are trying to achieve some strategic goals with the firm or rather achieve trading profits (Buzer, 2008). Despite the political debate and legislation changes, it does not seem to have an effect on the development of private equity in the German market.

Where other countries in Europe happen to see a stagnation in the number of acquisitions by private equity firms, the acquisitions in the DACH region (Germany, Austria and Switzerland) increased with 28% in 2016. The value of all investments in these countries rose with 83% up to €25 billion. According to Steve Roberts, the German market has seen a significant boost in the market due to the decision of the United Kingdom to leave the European Union. Germany is attractive because of its strong, small and medium sized companies and the 'safe haven argument', which reflects the idea of value retention or even increasing during economic recessions (Roberts, 2017). This trend could be supported by the

[1] Franz Müntefering in *Bild am Sonntag*, 17 April 2005.

expansion from Swedish private equity firm Altor to the DACH region. Normally investing in the Nordic region, the firm raised a €2.5 billion fund for the German speaking part of Europe because of the interesting value-adding investment options (Mendoza, 2019).

Although the critique on private equity funds seems to be ambiguous, it is seen that the exit of a fund through a public offering is not quite a success the latest years. Private equity backed initial public offerings receive a bad name due to worse performances in the period afterwards. Some flops in the European market faced a massive decline in performance and returns for investors. The British insurer Saga lost 68% of their value since their IPO in 2014, The French car rental company Europcar saw a decline of 43% in the stock price since the IPO in 2015 and ConvaTec, a British medical devices group going public in 2016, went down by 40%. Therefore, uncertainty arises under investors and these firms become a takeover target for a new buyout by a financial sponsor. This might be due to either the worse governance of the public companies or the mispricing of the offering in the first case (Hughes, 2019).

1.1 Relevance

The growing influence of private equity in Germany and the public debate about the role in the market requires an analysis of the performance on both the short- and long term. The criticism is focused on the increasing risk related to the debt-incurred deals and the impact on employment. It further suggests that the private equity industry rather destroys value than creating it, because the private equity firms only focus on short-term returns (Müntefering, 2005). Since the DACH region is becoming more important in Europe this is an interesting area to investigate. The argument that the same institutions invest in publicly traded claims, choose to participate in a limited partnership and private equity raised the question why there is not more research done. At the same time should the different firm characteristics between public and privately owned firms be interesting to investigate in order to explain a possible difference.

Over the years there is a lot of theoretical and empirical work done on the concept of IPO underpricing, trying to explain the phenomenon. The empirical evidence shows that the information conflicts between different parties is the first-order effect on underpricing. Looking at the lack of information available from private equity backed companies, and so the increasing asymmetric information, it could be an interesting factor in understanding the underpricing phenomenon. The different underpricing effects found by Levis (2011) for the UK and Mogilevsky & Murgulov (2012) for the US shows the importance of research to private equity backed IPOs. Given these results you would expect a hugh contribution for the still unsolved underpricing effects for private equity firms. However, this concept hasn‘t been widely expressed in the literature. Most research is focused on the ordinary public

IPOs and venture capital backed IPOs. This is surprising because private equity firms take, in contradiction to the specific form of venture capital firms, a controlling stake in the firm and the fund managers are often skilled and active monitors of the decisions being made by the company managers. This is due to the great deal of process knowledge they bear, particularly in the financing area (Sahlman, 1990). Sahlman argues as well that the private equity model is an interesting concept since the same institutions that invest in publicly traded residual claims also choose to participate in a limited partnership of private equity. This claim therefore leads to the main purpose of this research; to investigate whether private equity backed initial public offerings differ from IPOs from ordinary public firms. This is followed by the next research question:

Do private equity backed initial public offerings differ in stock returns from non-funded offerings?

The economic relevance of this research is the return investors might obtain from investing in an IPO. If the first-day return of an offering is extremely positive and has no corrections on the short- or long term, this could affect investors' behavior on the market. Especially when the return of private equity backed IPOs appears to be significant different from the return of non-private equity backed IPOs, this could lead to a divergent perspective on the floating of both assets.

1.3 Summary

This research gives an insight in the IPO underpricing of private equity (PE)-backed and non-PE backed firms in the DACH region. The DACH region is an upcoming area in terms of private equity. The always-debatable term private equity is an interesting and not widely investigated area in the literature of IPO underpricing, because it is argued that private equity rather destroys value than creates value for the investors of a company. Using standard OLS regressions, this paper seeks to answer possible explanations for the difference in underpricing between PE-backed and non-PE backed IPOs. In addition does this paper investigate the effect of the aftermarket stock return up until one year based on two methods, CARs and BHARs.

The results of the research provide no statistical proof of a difference in underpricing between PE-backed and non-PE backed IPOs. This is in line with earlier research in Europe. Effects such as the size of the company, the age of the company or the rank of the underwriter could not explain the return on the first trading-day. Adding the P/E ratio of the firm into the model does not explain the difference in underpricing between PE-backed and non-PE backed IPOs as well. With this expansion changes the p-value of the underwriting rank, this variable becomes significant.

Looking at the period after the IPO, the market displays a negative performance from the first week to a year after the IPO. The CAR and BHAR methods demonstrate different results in the significance of this negative performance. The returns between PE-backed and non-PE backed IPOs are significantly

different from each other one year after the IPO, which makes it possible to generate excess returns after one year when you invest in PE-backed IPOs compared to non-PE backed IPOs.

This thesis is structured as follows. The next section will elaborate the theory behind IPOs and explanations for underpricing. In additions does it describe the existing literature on IPO underpricing, and in particular, the difference between PE-backed and non-PE backed underpricing. Chapter 3 shows the hypotheses set for this research and clarifies the underlying concepts. Chapter 4 illustrates how the dataset for this research is gathered and constructed and will explain the methodological treatment of the dataset. Chapter 5 covers the results of this research where chapter 6 and 7 give space for the conclusion and discussion of the research.

2. Literature review

This chapter describes the term IPO and the benefits and costs of an IPO. The IPO and private equity market in Europe and specially Germany is described to show the facts and numbers that endorse the chosen subject. In addition, this part explains the theory behind IPO underpricing and the theory behind private equity and hedge funds. The chapter ends with a discussion of the existing literature on the subject of IPO underpricing and the difference between private equity backed firms and non-private equity backed firms.

2.1 Initial public offering

An initial public offering (IPO) refers to the moment "when a security is sold to the general public for the first time, with the expectation that a liquid market will develop" (Ritter, 1998). During this offering, the stocks of the company are sold to a large number of diversified investors because the firm desires an additional amount of equity capital. These extra funds can be used for the financing of new investments, takeovers or the repayment of debt. The first company with an initial public offering in the modern period was the Dutch East India Company. In 1602, they offered in several cities in The Netherlands bonds and shares of stock of the company to the general public to finance their activities and voyages to East India. Because of the high profits of the ships, the additional return of the initial investment after twelve years became 100%. With the introduction of the Exchange of the Hendrick de Keyser in 1608 the first merchant exchange was born. It took until 1792 with the signing of an agreement at Wall Street to trade securities for the formation of the New York Stock Exchange, currently the biggest stock exchange in the world (Stringham, 2015).

The decision whether to trade your security on an exchange is based on a trade-off between the costs and benefits of going public. A firm offers their securities when the benefits outweigh the costs and remains private if the costs of going public are larger than the benefits.

2.1.1 Costs of an initial public offering

The costs of going public are according to Ritter (1987) related to direct costs and indirect costs. The direct costs include the gross underwriter spread and other expenses, such as legal, printing and auditing fees. The indirect costs are covered by the initial underpricing. The over-allotment option was added as extra cost incurred with going public (Hansen, Fuller, & Janjigian, 1987).

The indirect costs incurred due to initial underpricing exist when the firm has a problem concerning the true value of the firm. This is because, in general, the managers of the firm have more information about the value of the firm than the investors have. This adverse selection affects the price of the security at the offering (Pagano, Panetta, & Zingales, 1998). The costs of adverse selection are

according to Chemmanur and Fulghieri (1995) larger for young and small firms because of their little track record and low visibility compared to old and large firms. The underpricing of an IPO will be discussed further later in this chapter.

The gross underwriter spread consist of the fee for the underwriter, registration fees and selling fees. These direct compensation costs are associated with the total cost of going public. According to Ritter (1987) the average spread of an offer is 8,67% for listings between 1977 and 1982. For IPOs issued from 1983 to 1987 this gross spread range is from 6,96% to 10% (Barry, Muscarella, & Vetsuypens, 1991). On top of these expenses there are yearly costs for auditing, certification and dissemination of information. Dissemination of information is part of the rules for listed firms. Sometimes they are forced to reveal confidential information that they don't want to unveil. Secrets like the strategy of the firm or investments in R&D might be crucial for maintaining a competitive advantage (Campbell, 1979).

When the underwriter is granted a right to purchase additional shares beyond the number of registrered shares is this called an over-allotment option. These additional shares can be purchased at the offering prices and is therefore considered as upside-risk for a potential rise in the share price. This over-allotment option is often included to lower the initial underwriter spread and is associated with a higher uncertainty of the value of the firm (Hansen, Fuller, & Janjigian, 1987).

2.1.2 Benefits of an initial public offering

As mentioned before the access to new capital is the most prominent benefit of going public. It is considered as an alternative for borrowing debt from banks. At the same time does it open the doors for cheaper and more readily borrowing at the banks, because the costs of borrowing increase with the information asymmetry. Banks face more information asymmetry with private companies because the lack of information available and link this to their credit worthiness. Banks do extract rents for this private information about the credit worthy of the firm. When going public, a firm must disclose accounting information, which opens the negotiations for lower interest rates (Rajan, 1992).

When the shares of the company are sold to the public this affects the liquidity of the stock and the scope for diversification of the initial investors of the company. In most Europe countries do companies, more often than in the US, have one large shareholder or a small group of shareholders with a controlling stake. These controlling shareholder(s) often has an intensified interest in the operations of the company. When more shareholders take a part in the company this is costly, since all these shareholders have to put effort in analyzing the company. Beyond a specific number of shareholders, it therefore becomes effective to go public, because the spread of information is centralized at one point for all shareholders (Pagano & Röell, 1998). In a private company, the shares

can only be traded among the current holders and an institution they want to sell it to. When a firm is listed on a public and organized exchange this makes it easier and more accessible for small shareholders to trade their stake, specifically in the short-term. This benefit of being on an exchange is priced as liquidity benefit, because the liquidity of a share is a function of their trading volume. The liquidity of selling stock provides also opportunities for diversification to the existing shareholders. The received amount for their stake can directly be invested in other assets (Pagano, Panetta, & Zingales, 1998).

Another benefit of a listing firm is the possibility to issue stock or stock options to their employees. When employees are rewarded, beside salary, also with stock compensation this would increase their incentive to increase the value of the firm, because this will consequently increase the value of their stocks. The form of compensation does rather motivate employees to increase firm value than the level of compensation. Beside the increase in firm value, equity compensation does also mitigate conflicts of interest between managers and shareholders (Mehran, 1995).

Apart from financial motives are there also non-financial motivations for going public. An offering at a listing increase the publicity associated with the firm, and can increase the reputation or the image of the firm. Both the attention of analysts and ordinary people are attracted by a listing firm. This can have a positive effect on the willingness of employees to work for the firm and the collaboration with other firms, products or services (Meluzín & Zinecker, 2014).

2.2 IPO market across the years

The IPO market in Europe is booming since the crisis of 2008. The total number of IPOs with raised proceeds of at least €50 million is not increasing every year but has grown from 10 in 2009 to 93 in 2017. The highest number of IPOs in this period was in 2015 with 111 IPOs. The money raised from these IPOs rose from €5 billion in 2009 to €33 billion in 2017. The top year was again 2015 with an amount raised of €55 billion. More interesting is to see the growing percentage of private equity backed IPOs in this period, which is denoted in figure 1. In 2009 the private equity backed IPOs contributed for 20% (2 out of 10) of the total IPO activity and this grew to 46% (43 out of 93) in 2017. This was no exception as documented in figure 1 below, in the period 2009-2012 the PE-backed activity ranged between 14% and 27%, whereas this was 43% to 52% in the period from 2013 to 2017. This does not only apply to the number of IPOs, but also for the money raised from the IPO. From 2009-2012 did the PE-backed IPOs account for 11% to 25%, while this was 39% to 53% between 2013 and 2017 (van den Bos, et al., 2018).

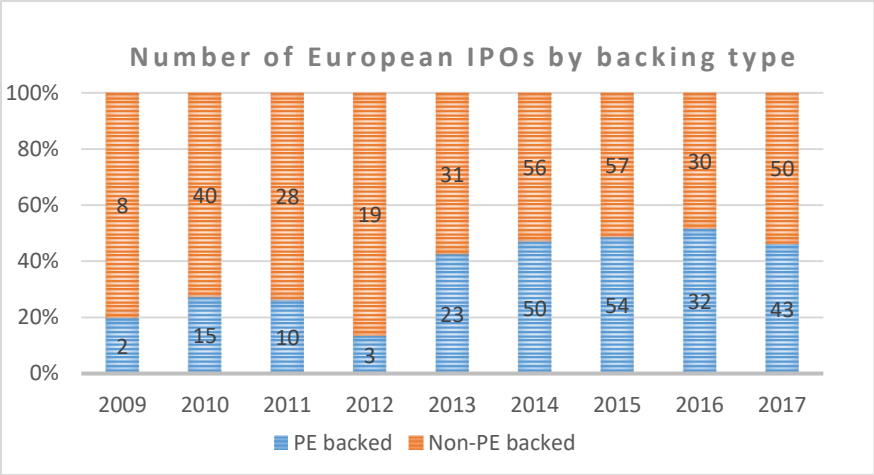

Figure 1: The number of European IPOs between 2009 and 2017 specified by backing type.

The leading stock market for IPOs in Europe for this period, with an activity of 36% of total IPOs, is the London Stock Exchange. Second is the Nasdaq Stockholm in Sweden with 12% and the German Deutsche Börse completes the top three with an activity of 10%. The IPO activity in the United Kingdom is mostly driven by PE-backed IPOs. In 2015, the number of PE-backed IPOs were 70% of the total IPO activity in the UK, the value of the PE-backed IPOs contributed even for 90% of the total value. Both numbers decreases however to a percentage of 40% in 2017. This contradicts to the overall increasing trend in Europe (Buckley, Hughes, & Tarleton, 2018). This relation cannot be dissociated with the uncertainty created by the decision of the UK to leave the European Union.

The Brexit has caused some firms to postpone or withdraw their offering. For instance, food manufacturer Bakkavor announced, cancelled and re-announced their 1 billion pounds flotation on the London Stock exchange within 4 weeks. TMF Group intended in October 2017 to raise 300 million pounds on a listing in London but sold their business a few days later to a private equity group. British telecommunication company Arqiva withdrew their plans in 2017 to float a portion of the company for 1.5 billion pounds on the London Stock Exchange. While waiting for conditions in the UK to improve they still have not gone public at the start of 2019. The offering of Siemens Healthineers can be seen as the major confirmation for this Brexit trend in the UK. Siemens listed their medical business Healthineers on the Frankfurt Stock Exchange instead of the London Stock Exchange due to the uncertain conditions in the UK. Michael Sen, chairmen of Siemens Healthineers supervisory board, favored Germany above the UK because “Frankfurt is one of the world’s leading trading centers for securities, and its importance will continue to increase due to Brexit” (Burg, 2017).

In 2018, the Deutsche Börse in Frankfurt has raised 30% of the total IPO value in Europe. With a value of €10.7 billion from 17 IPOs, they ended closely behind the London Stock Exchange that raised €10.8 billion from 82 IPOs. The Nasdaq Stockholm was thrown away from spot three by the Swiss exchange.

From the four largest IPOs in Europe were three on the German market and one on the Swiss market. The absence of major UK listings shows the touched 'pause' button by UK firms because of the Brexit shadow (Tarleton & Whelan, 2019).

2.3 Theory of IPO underpricing

Underpricing is estimated as the percentage difference between the price at which the IPO shares were sold to investors and the price at which the shares subsequently trade in the market (Ljungqvist A., 2007). The underpricing effect has been documented for the first time by Ibbotson (1975). He suggests that new issue offerings are underpriced because of the positive initial performance without departures from efficiency in the aftermarket. However, he couldn't give any adequate explanation for the underpricing effect. A follow-up research by Ritter (1984) tests the validity of this underpricing and comes with the conclusion that the underpricing effect has continued. The explanation he investigated, about the underpricing being associated with natural resources as oil and gas, is found to be insufficient. In a later paper Ritter indicates that this underpricing comes of a too high first aftermarket price, and not of a too low offering price. It is still a mystery why some offerings have extremely high initial returns when the offering price reflects the firm's underlying fundamental value. This articles also adds the finding of a 3 year long underperformance after going public. However, this long-run underperformance is not find to eventually end and its relation with the short-run underperformance also remains unsolved. Therefore the existence of extremely high initial returns becomes even more a mystery (Ritter, 1991).

Over the years, several people tend to examine a explanation for IPO underpricing. The theories can be divided under four explanatory models: asymmetric information, institutional explanations, control and behavioral (Ljungqvist A. , 2007).

2.3.1 Asymmetric information

Looking at the concept of asymmetric information it is seen that the key parties to an IPO transaction are the issuing firm, the bank and the investors. The most established theory of asymmetric information suppose that one of these parties has superior information available compared to the other parties. Rock (1986) documents this advantage on the basis of the so-called *winner's curse*. A group of investors has superior information to that of the issuing firm and all the other investors. This group of investors supplants the other investors when new shares are priced at a good price of their expected value and withdraw from the market when this is a bad issue. Therefore, the uninformed investors face a winner's curse: when they get all the shares they asked for, this is the result of informed investors have turned them down. Since uninformed investors know this advantage of the informed investors, they will only purchase the offered shares at a discount. This is possible because

the market is according to Rock dependent on the participation of uninformed investors, because the demand for informed investors is insufficient to take up all the shares offered.

Another contribution to the asymmentric information model is the presence of ex ante uncertainty about the value of the firm. There is a positive relation between the ex ante uncertainty and the expected return, so this will increase the underpricing. An implication of this relation is that firms have an incentive to enlarge the information available to the public (Beatty & Ritter, 1986). A contrary information assumption is the asymmetry between issuing firms and investors. If firms have superior information about the present value of their future cash flows and risk than investors, underpricing may be a successful technique to signal the company's true high value. This *signalling hypothesis* is done to distinguish the high-quality firms from the low-quality firms because the marginal costs of underpricing are lower for high-quality firms. To imitate the high-quality firms, low-quality firms incur signalling costs and have to expend their resources. These imitation costs plus the loss in firm value due to underpricing increase their marginal costs, since high-quality firms don't face imitation costs. This leads to low-quality firms revealing themselves as low-quality and gives high-quality firms the possibility to compensate the lower IPO price by a higher price in a seasoned equity offering. For low-quality firms the risk of detection means that they are not able to compensate the costs of the signal in a later stadium (Welch, 1989).

At the same time does the information asymmetry lead to an agency problem between the issuing firm and the underwriting bank. Underwriting fees are typically seen as an incentive to keep underpricing low, because the fees are often proportional to the proceeds of the IPO. However, it is imaginable that sometimes the private benefits of underpricing for a bank are greater than the implied loss of underwriting fees. When the bank is better informed about the demand than the issuer is, the issuer will delegate the pricing decision to the bank by entering a delegation contract where the issuer depends also on the advising services of the bank. Since the selling effort of the underwriting bank is unobservable, this makes it possible for the bank to select the price based on a trade-off between the demand and the effort costs. The superior information about demand allows the bank to lower the price and the effort and take advantage of the positive rents in the form of below-first-best effort costs (Baron, 1982).

Beside the uncertainty about the value of the firm, there's also uncertainty about the market involved. During the bookbuilding period the underwriter needs to set the price of the IPO at the true value. In order to arrive at the fair price, the underwriter induces the investors to reveal information. This is called *the market feedback hypothesis* (Ritter, 1998). The underwriting bank only allocates shares to investors who are willing to reveal positive information and bid aggressively and none or only a few

shares to the investors that bid conservatively. This revelation raises the price of the IPO and as incentive for this information; the underwriter needs to compensate the investors with an underpriced stock (Benveniste & Spindt, 1989).

When there is discrepancy between the managers of the firm and the investors concerning the value of the firm this could be solved by the involvement of a private equity fund or a lead manager. According to *the certification hypothesis* does the participation of a PE fund at an IPO has a certification effect on the quality of the issuing stock, which creates additional economic value (van Frederikslust & van der Geest, 2000). This certification can also be given by the lead manager of the underwriting bank. A lead manager with a good reputation should implicate a better quality of the issue and less underpricing (Carter, Dark, & Singh, 1998). The value of the firm can be increased with bonding agreements that certify the issue price. The benefits of this certification are larger when specialists like investment banks are involved in the process. Private equity firms are often either the buyers or the sellers in an IPO process. They benefit from the presence of investment banks and therefore provide substantial fees. This makes private equity firms important clients for the investment banks and in return, the investment bank will provide considerable power over the pricing process to the private equity firm. (Booth & Smith II, 1986).

2.3.2 Institutional explanations

The institutional explanation supports on the idea that companies deliberately offer their stocks at a discount to reduce the likelihood of future lawsuits of shareholders who are disappointed with the performance afterwards (Ibbotson & Jaffe, 1975). This explanation of *the lawsuit avoidance hypothesis* is only insufficient to declare the underpricing effect because regulations differ across the world. For most countries, except the US, this risk of being sued is not founded economically significant. Although, it is is still possible that the avoidance of a lawsuit is a second-order driver of underpricing (Ljungqvist A. , 2007).

A legal form of institutional interference is price support in the way of *price stabilization*. Prices are stabilized for a couple of days or weeks to reduce drops in prices in the after-market. These stabilizations reduces the observations of overpricing and increases the mean return of a stock. The last institutional explanation is that of possible tax advantages of IPO underpricing. Capital gains are taxed differently than personal income which gives managers an incentive to underprice the IPO. It is, due to differences across countries around the world, hard to say that tax alone can explain underpricing. Despite, it may help to explain the cross-section of underpricing returns. It is seen that IPOs are more underpriced when they rely more on managerial and employee stock options to protect themselves from the dilution of their existing shares (Taranto, 2003).

Taranto's empirical results also show that companies that rely on stock options for managers and employees are associated with more underpricing. This builds on the suggestion from Rydqvist (1997) that tax benefits from underpricing may explain the underpricing effect. *The tax hypothesis*, which he put forward, comes from the modification in the tax wedge between employment income and capital gains in Sweden. In 1990, the tax on wages became taxed relatively higher compared to capital gains and this relates to a tax-induced initial return of 10.1% (Rydqvist, 1997).

2.3.3 Ownership and control

One of the major issues within most companies is the relation between ownership and control. Jensen & Meckling (1976) mentioned this agency problem between non-managing and managing shareholders when the separation between ownership and control is incomplete. The process of going public is a step into an eventual separation between these parts. Managers who are upfront the IPO in control of the firm seek to divide small stakes of the shares to a large amount of different shareholders, because this increases the liquidity of the stock and reduces both the external monitoring and the threat of a hostile takeover. This gives managers the opportunity to allocate shares strategically in an IPO to remain in control of the firm. Since monitoring will only occur in case it is optimal for a large shareholder this is not likely to happen when shares are allocated across a lot of parties. The role of underpricing in this *ownership dispersion hypothesis* is to generate excess demand and end up with a large number of shareholders (Brennan & Franks, 1997).

This above described strategy might be affected when the underwriting bank has maintained special relationships with their customers from the past. According to the *investment banker's monopsony power hypothesis,* the investment bank will intentionally underprice the stock to cater their large customers who regularly purchase issues at their bank. Allocating these issues only to these customers are associated with excess earnings for the investment bank (Ritter, 1984). For the less sophisticated investors the banks take advantage of their superior knowledge of market conditions and convince them that underpricing is normal for IPOs and that the underpricing is similar to IPOs of the same size (Ritter, 1998).

2.3.4 Behavioral models

Behavioral explanations assume irrational investors to misprice the young and immature firms which are often involved in an IPO. Since these firms are hard to price, they are interesting to study the effect of irrational investors on stock prices. By combining mental accounting with the prospect theory at the reference point, Loughran & Ritter (2002) argue that issuers integrate the wealth loss of underpricing with the wealth gain they receive from the jump in stock price in the after-market on their existing shares. Conform *the signalling hypothesis* this underpricing at the initial issue "leaves a

good taste" with investors, which allows firms to issue a new or additional stocks, for example in a seasoned equity offering, at a higher price (Ritter, 1998).

Since investors are not always able to value a stock, the market is subject to mimicking effects among investors. When an investor does not only rely on his own information but also watches at other investors that might create mimicking behavior. If an investor has positive information about a stock, he or she might wait when no one else wants to purchase the stock. This is called *the bandwagon hypothesis* and could be prevented by underpricing the stock to get more investors that would step in the asset. The more investors subscribe for the underpriced stock, the more investors want to imitate them disregarding their own information (Welch, 1992).

Already in the interwar period in the 20th century, John Maynard Keynes tried to explain price fluctuations in the equity market by introducing the term speculation for the activity of forecasting the psychology of the market (Keynes, 1936):

"It is not a case of choosing those which are really the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees."[2]

The speculative bubble hypothesis expects investors that could not subscribe to a stake of shares directly at the offer price forced a boom in the stock price by speculating on future price risings. Therefore, the offering prices are fair compared to their underlying fundamental value but are pushed temporarily above the intrinsic value. The hypothesis implies that the initial excess returns should be corrected by negative returns on the long term (Tiniç, 1988).

2.4 Theory of private equity funds

A private equity fund is typically a financial intermediary that invests the capital of investors in a portfolio. The fund is organized as a limited partnership, where the venture capitalist or buyout firm operates as general partner (GP) and the investors act as limited partner (LP). These investors are often pension funds, endowments and other institutional investors. The LPs commit to a certain investment for GPs of the fund to run the company. When a divestment occurs, the GPs distribute the proceeds to the LPs (Phalippou & Gottschalg, 2009). PE funds are close-end funds, typically 10 years, with a term that is determined at the time of the start of the fund, while both hedge and mutual funds are open-ended. For these open-ended funds, returns can be outlaid to the investors on demand, while the investors of the PE fund are committed to the illiquidity of the fund (Metrick & Yasuda, 2011).

[2] Quote of Keynes in The General Theory of Employment, Interest and Money (1936), chapter 12: page 156.

Within private equity, there are four main subclasses; venture capital, mezzanine, buyout and distress, of which venture capital and buyout are the two largest and most important ones. The buyouts are by far the largest. Of all fundraising in 2016, buyouts contributed for 75%, while venture capital raised 10% of the total (Invest Europe, 2018). For all groups, the private equity funds invest in private companies with little public information available or takes a public company private again. In comparison to public companies, private companies do not have to file regular reports and they generate less attention from analysts. As a result of this lack of information, the values of the portfolio are not daily settled and the fund returns are not realized until the end of the lifetime of the fund. When hedge funds invest in private equity transactions, they invest primarily in publicly trade assets such as stocks and bonds. Their portfolios are, instead of the PE fund, marked to the market. Both funds select their stocks with the goal to gain profits, but they do not equally influence the GPs of the invested companies. The influence of investors in public companies, the large block holders that have seats on the boards excepted, is often limited, while private equity investors often negotiate contractual provisions, such as board seats, veto rights and other control rights that influences the actions of the management, as consequence of their large stake in the firm (Metrick & Yasuda, 2011).

2.4.1 Venture capital and buy-out

Both venture capital and buyout companies raise capital to invest in individual projects. These projects tend to be early-stage ventures for venture capitalists, while more mature businesses with a substantial debt capacity are often in the interest of leveraged buyout firms. In an LBO most of the capital is typically raised as debt rather than equity. The use of heavy debt burdens can be seen as a response to the agency problem earlier reported by Jensen and Meckling (1976). The management of the firm has greater incentives to create value due to the reallocation of equity. The remuneration of the managers is often rewarded in the form of equity, whose value depends on the efforts and skills of the manager. The firms acquired by LBO firms have typically modest growth rates and stable cash flows. These cash flows are used to pay down debt and form an incentive to increase the value of the equity. The value in the venture capital model is created by offering more resources to growth firms with little cash flows (Sahlman, 1990).

Without the intermediary of private equity new projects needs to be financed by the internal funds. Compared to the GPs, the management team will not receive a share of the extra value it creates for the firm. The managers are more prone to an increase in their rank in the company or current compensation when a project is successful (Baker, Jensen, & Murphy, 1988). Other members of the management monitor the actions and performance of the management to lead the project to a success. These members are generally not compensated for their advice; this is different to the PE fund. In the PE fund, the fund managers are active in the operation of the company and are therefore

directly involved with the project, because it influences their own return. This requires a great amount of knowledge and close contacts with financial institutions. The PE fund managers are skilled and active monitors of the decisions made by the company managers (Sahlman, 1990).

2.5 Private equity market trends

Over the last couple of years, the private equity market has taken over a more dominant position in the world of IPOs. A dramatic shift in value creation is noticed from the public to the private markets. In fact, over the past four years private IPOs have raised three times more capital than public tech firms have (Kulkarni, 2018). This pattern is not only noticed in the US but also in Europe. The total number of deals have been more than doubled in this period to 2.183 deals in 2017. The same applies to the DACH region where in 2017 436 deals were made (Bernard, Naydenova, Roberts, Schmidt, & Tilgner, 2018). The major increase seen in 2016 with a growth of 26% in deal volume can presumably be ascribed to the Brexit referendum that took place in 2016. This increase also meant that the value of buyouts in the DACH region was responsible for 23% of the total European value of buyouts (Bernard, Naydenova, Roberts, Schmidt, & Tilgner, 2017).

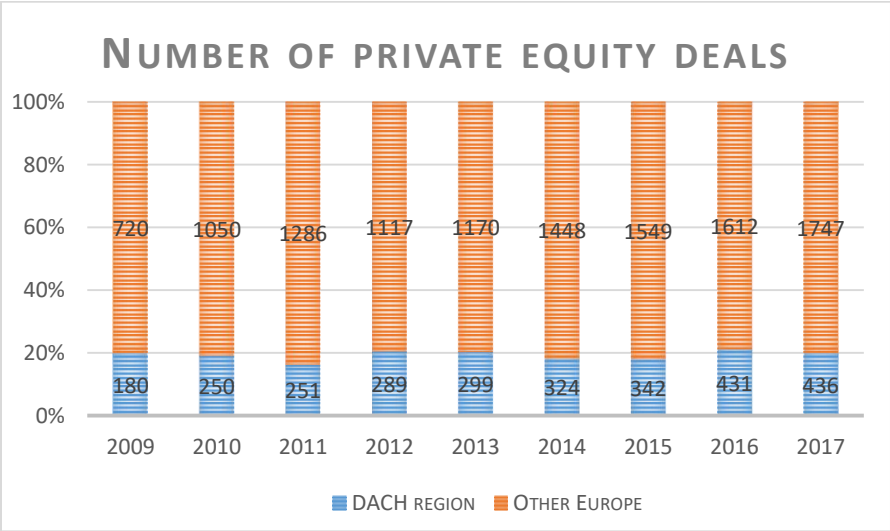

Figure 2: The number of private equity deals in Europe, specified by the DACH region and other Europe countries.

The critique addressed before of private equity firms putting too much debt in the companies is nowadays not seen any more in Germany. Only 8% of the German PE firms financed the majority of their deals with debt in 2016, while this was 22% on a global level. In addition, the debt ratio in Germany of 40% is below that of the 60% worldwide (Roberts, 2017).

Although the number of deals increased, this is not the case for the number of PE firms in Germany. The amount of firms even decreased, after an initial increase, from 1.228 to 1.124 in 2017. These firms invested more in the market with a value of €11.313 million in 2017 compared to €3.065 million in 2009 (BVK, 2018). The 2017 investments exceeded the level of 2016 by 67%. This high amount is

mainly drive by some large transactions that took place. The status of the economy, global and European interest rate policies have a fundamental impact on the PE market. The large amount of money committed to PE funds leads to higher valuations and an increasing demand for PE firms.

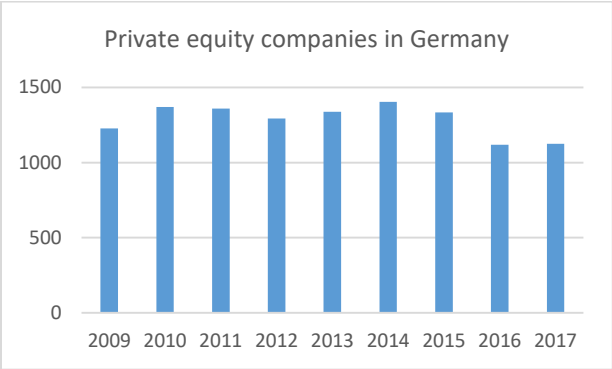

Figure 3: Number of private equity companies in Germany

Figure 4: Value of private equity investments in Germany.

2.6 Previous literature

2.6.1 Overview of IPO underpricing

The first one to report the underpricing effect was Roger Ibbotson (1975). Introducing the returns across time and securities (RATS) model he finds an initial performance for the first month after an issue of 11.4% between 1960 and 1969. However, it cannot conclusively be determined whether an investor in a new issue has a greater chance than 50% to make a profit. Despite this hypothesis is not rejected, the likelihood of extreme large positive performance is higher than a corresponding large negative performance. Since this positive initial performance is not corrected in the aftermarket, Ibbotson suggests that new issue offerings are underpriced. No adequate explanation is given for this underpricing process. The follow-up research of Ritter (1984) examined whether the theory of Rock (1982) could explain underpricing and he found an initial return of 16.3% for cold issues between 1977 and 1982. He found support for Rock's hypothesis that high-risk firms have substantially higher average initial returns than lower-risk firms do. In a sample of 13,134 firms over the period 1960-2018 Ibbotson, Sindelar & Ritter (1988) found an average initial return of 16.8% for the US[3]. For the countries in Europe, a similar pattern is found. The average initial return in the UK for 1959-2016 is 15.8% (Dimson; Levis; Doukas & Hoque).

Underpricing in DACH region

The earlier discussed DACH region show somewhat varied results. Over the period from 1971-2018 a positive initial return is found for the main stock market in Austria, but this is with 6.2% one of the countries with the lowest underpricing in their market (Aussenegg; Loughran, Ritter, & Rydqvist). In

[3] All country-specific research summarized in Loughran, Ritter, & Rydqvist (1994) are updated by Jay R. Ritter on his website until 2019.

Switzerland Drobetz, Kammermann, & Wälchli (2005) found an average market adjusted initial return of 34.97% for Swiss IPOs between 1983 and 2000. When this is updated to 2013, the underpricing declined to 27.3%. Before World War II the Berlin Stock Exchange, and not the Frankfurt Stock Exchange, was the main stock exchange in Germany. Burhop (2010) found for 1870-1896 an underpricing of only 2.5% on the Berlin Stock Exchange. Including the IPOs from six German stock exchanges, this underpricing slightly increased to 4.8% before World War I (Schlag & Wodrich, 2001). With an extended sample and the use of all eight German stock exchanges, Wasserfallen & Wittleder (1994) find that IPOs, on average, are underpriced by 17.58% for a period of almost thirty years after World War II. With a larger sample and a partially different time frame, Ljungqvist (1997) found a lower amount of underpricing. According to him the initial return for German IPOs is related to a return of 9.2% on the first day. With the late nineties included in the extended sample this weighted average increased to 27.7%. For the full period from 1978 till 2014 the initial first-day return of a sample of 779 German IPOs is, on average, 23%.

2.6.2 Ownership

With the wide variety of ownership structures for firms this different structures could have some implications on the performance. Within a study of 435 of the largest European companies, the relationship between ownership concentration and performance is found nonlinear. The effect of the ownership share on the market-to-book (MB) value is a bell-shaped effect with a maximum share of 83% to be ideal. The MB value for a company is significantly larger when the largest owner is an institutional owner, while corporate, family and government ownership causes a significant lower MB. For the return on assets, the maximum share in the bell-shape is at 60% ownership. The same identity effects tend apply to ROA, except that the results are not found significant. For sales growth, a significant relationship is found when the largest owner is a family or non-financial company. These results imply that the goal of the firm (profit maximization versus growth objectives) should be an important factor on the ownership structure (Thomsen & Pedersen, 2000). This ownership concentration is easily affected by the use of debt. A large amount of debt in the company shrinks the equity part without the requirement of large investments. This is associated with a significant larger increase in shareholder value (Jensen, 1989).

To measure the effect of private equity involved in firms, several papers have investigated this on the performance of the firm. Croce & Martí (2014) studied the impact of 257 PE-backed family firms with a control group of 358 non-PE backed family firms and another control group consisting of 1315 non-family firms (both PE and non-PE backed) on the total factor productivity growth. The results show that before the PE investment, PE-backed family firms exhibit a lower growth and PE-backed non-family firms a higher growth than their non-PE backed counterparts' do. After the PE investment the

productivity growth and total FCF for PE-backed family firms is significantly higher than non-PE backed family firms are. This result is not found significant for non-family PE-backed firms. The increase in financial cash flow after the involvement of PE for PE-backed family firms is due to a significant higher capital productivity and significant higher sales than their non-PE backed counterparts.

Looking at the operating income divided by the total assets the performance of companies that were acquired by a LBO firm have outperformed their peers prior to an IPO. Degeorge & Zeckhauser (1993) suggest therefore in their article that managers are able to time IPOs by using their private information and/or manipulate performance. With this ability, LBOs wait for an exceptionally good year to go public.

2.6.3 Overview of private equity backed IPOs

While the existing literature to IPO underpricing is much extended for several countries and time periods, the research to ownership involvement in the IPO and corresponding explanations is less profound. Barry et al. (1990), Megginson & Weiss (1991), Brav & Gompers (1997) and Ljungqvist (1999) studied the difference between venture capital backed and non-VC backed IPOs. While Barry et al. (1990) do not find a significant difference in average initial return, do Megginson & Weiss (1991) find significant results. With a return of 7.1%, VC-backed firms do have a significant lower return than non-VC backed firms that face an average return of 11.9%. This is associated with a significant lower age, greater median book value of assets and higher quality underwriters. Ljungqvist (1999) finds significant lower underpricing of 5 percentage points for VC-backed firms in the 1980s, but no significant difference in the 1990s. These results are consistent with the assumption that the impact of VC-backing on underpricing varies over time Gompers & Lerner (1997).

Muscarella & Vetsuypens (1989), Ang & Brau (2002) and von Drathen & Faleiro (2007) researched the difference between IPOs from firms that underwent a LBO before the IPO and firms that did not. Muscarella & Vetsuypens (1989) find that previous LBOs have an average underpricing of 2.04%, while the control sample of non-LBO IPOs have underpricing of 7.97%. However, they could not answer the question if lower asymmetric information leads to lower underpricing. Ang & Brau (2002) could answer this question and show that firm transparency affects the costs of a firm undertaking an IPO. The significant difference in mispricing in their paper relates to 5.47% on the first day for the LBO sample and 8.04% for the control sample. Both papers focus on the US market. Von Drathen & Faleiro (2007) focused their research on the largest market in Europe, the United Kingdom. The outperformance of LBO-backed IPOs is however only found on the long-term; they did not test the first-day return.

Since VC sponsors usually have a minority interest in the company, while other PE sponsors have a controlling interest does Levis (2011) make a distinction between these two in his investigation of the

London Stock Exchanges from 1992 to 2005. He shows that, both equally- and value-weighted, PE-backed firms experience lower underpricing than VC-backed firms do and both lower than non-backed firms. This appearance is even far stronger during the dotcom bubble period. These results are supported by Mogilevsky & Murgulov (2012), who find a significant difference between PE-backed, VC-backed and non-sponsored firms in the US. PE-backed IPOs have a mean initial return of 7%, but VC-backed IPOs experience a larger return (23.4%) than non-sponsored IPOs (14.3%).

If the VC-backed firms are ignored in the research and the model is focused on PE-backed vs non-PE backed IPOs, van Frederikslust & van der Geest (2000) could not find a significant difference between PE-backed and non-PE backed IPOs for the Netherlands. The same applies to the stock markets of the UK and France, where value-weighting returns strongly affect the underpricing, especially on the smaller listings. This supports the theory that smaller IPOs are subject to the highest degree of underpricing (Bergström, Nilsson, & Wahlberg, 2006).

Private equity backed IPOs in the DACH region

The relation for the specific German speaking perspective remains unclear. Franzke (2003) and Elston & Yang (2010) find opposite results when comparing VC-backed IPOs with non-VC backed IPOs. Franzke (2003) find that German VC-backed IPOs are prone to more underpricing than their non-backed counterparts, while Elston & Yang (2010) could not find a significant result in their regression. They blame the outcomes to the late emerging of venture capital in the German market. In the US and UK venture capital plays a considerable greater role in financing the technological firms. The minor role of venture capital support the insignificant results. Von Drathen (2007) looked into the-long term performance of PE-backed IPOs in Germany and found a significant outperformance of the these offerings compared to non-PE backed IPOs.

3. Hypotheses

As described above, the theory about underpricing does seem to conclude a one-side effect towards a positive initial return on the first day. However, the discrepancy between PE-backed and non-PE backed IPOs does not provide us with a conclusive answer. Therefore, this research is meant to attribute to this effect. The certification hypothesis stated that the involvement of a PE-backed firm should lead to lower underpricing. The previous mentioned literature about VC-backed and non-VC backed IPOs shows some different results with insignificant and significant results of lower underpricing for VC-backed IPOs, both in the US as well as Germany specific (Megginson & Weiss, 1991; Ljungqvist A. P., 1999; Franzke, 2003; Elston & Yang, 2010). The LBO market shows more significant results towards the LBO-backed IPOs, while PE-specific research in Europe could not find any significant results (Levis; van Frederikslust & van der Geest; Bergström, Nilsson, & Wahlberg). The paper of Mogilevsky and Murgulov (2012) does find significant results in the US between 2000 and 2009. Since the market in the DACH region is similar to that of most European countries these insignificant results should also apply to the DACH region. The theory states further that private equity firms are prone to more involvement in the daily management of the issuing firm and have a higher level of financial expertise compared to non-sponsored firms. This is due to the characteristic of continuously investing in companies and through managing divestments from the realized investments. Therefore private equity backed issuers should be more skilled and informed than non-backed issuers (Robbie & Wright, 1998). The described influence of asymmetric information on underpricing can be measured by several factors such as size, age and underwriter quality. Mogilevsky and Murgulov (2012) show that PE-backed IPOs are significant larger in size than non-sponsored IPOs, but could not find a significant difference in age. Elston and Yang could not find a difference in age as well, but find larger proceeds for VC-backed IPOs in Germany than non-VC backed IPOs. This is in line with the theory that smaller issues have greater ex-ante uncertainty than larger issues and therefore tend to be more underpriced (Beatty & Ritter; Baron). The signaling and certification hypotheses argue that the quality of the underwriter leads to less asymmetric information and therefore lowers underpricing (Welch; Carter & Manaster). Elston & Yang (2010) and Franzke (2003) could not both find a significant relation between underpricing and underwriter reputation in Germany. Based on these results it is expected that this will be the same for the DACH region and that PE-backed firms exhibit a lower level of asymmetric information. Therefore, the following hypotheses are constructed:

Hypothesis 1. PE-backed IPOs in the DACH region face a lower first-day return than their non-PE backed counterparts.

Hypothesis 2: The difference in underpricing between PE-backed and non-PE backed IPOs in the DACH region can be explained by a lower level of asymmetric information.

The behaviroral aspects could be linked with the ability of managers to time the exit with an IPO. PE sponsors plan the exit when the firm has reached an optimal level of growth and maturity. On average, PE sponsors time the exit when earnings are high and the growth level has reached the maximum level, indicating an outperformance compared to other firms. PE-backed firms are even more prone to this trend than non-PE backed firms, because of the involvement of their sponsor (Degeorge & Zeckhauser, 1993). The profitability of a firm affects the price-to-earnings-ratio when determining the offer price of the IPO. The P/E ratio is the most frequently cited justification for the valuation of a firm and stock recommendations by analysts. Typically a low P/E ratio could indicate that a firm has a low price compared to their earnings and might imply undervaluation (Bradshaw, 2002; Bradshaw, 2002). If the offer price is set right to the value of the firm would this be justified by the P/E ratio. When there is uncertainty present among analysts the firm could be mispriced. The literature shows that this is less likely to happen with PE-backed firms. If the P/E ratio is a frequently used indicator for a justified stock price this could affect the return on the first day, especially for non-PE backed firms. A high P/E ratio causes more risk and uncertainty for investors about the true value of the firm. Therefore firms with a high P/E ratio are expected to exhibit higher underpricing (Cao, 2008). Therefore the P/E ratio for non-PE backed firms should have a higher effect on the first-day return than PE-backed firms. To test whether this behaviroral aspect of timing the IPO does affect underpricing among the backing types the next hypothesis is composed:

Hypothesis 3: The first-day return of PE-backed and non-PE backed firms in the DACH region is positively related to the P/E ratio of a firm.

In a longer term view, Tiniç (1988) suggests a behavioral implication on underpricing with the speculative bubble hypothesis. In this hypothesis the aftermarket pushes the stock prices temporarily above their intrinsic value due to speculation. Tiniç (1988) suggests that the excess return on the first day should be corrected with a negative return in the following period. To test the validaty of these claims is the following hypothesis proposed:

Hypothesis 4: The first-day return in the DACH region is corrected with negative returns in the future.

4. Research design

This part provides the foundation for this research. The first part will discuss the sample selection of the used dataset and the second part will explain the methodological treatment of this dataset with the foundation of the regressions and the corresponding variables. The second part covers also the CAR and BHAR models for the aftermarket results.

4.1 Sample selection

4.1.1 Data collection

For the collection of the sample of this research, a multi-stage data gathering procedure is applied. First of all the offering data for the DACH region is collected from Thomson ONE, so this includes all sectors in the countries Germany, Austria and Switzerland. The Thomson ONE database contains worldwide IPO transactions since 1970. The collected dataset contains three sources of information: IPO related data, stock price data and accounting data of the last fiscal year available before the offering. The IPO related data is focused on the offering itself, the date and place where the IPO took place and who (single or multiple underwriters) was involved. The stock price data contains the offer price of the IPO, the closing price on the first trading day and stock prices up until one year after the IPO. The initial sample of IPOs consist of 580 firms going public between 2003 and 2017. This 15-year period is chosen to cover as well the economic recession of 2007 as the surrounding periods of recovery and boom until the earlier described boom of the latest years in private equity in the DACH region. The period ends at December 2017 to cover aftermarket effects for several periods. For every IPO is checked whether the company is PE-backed or not with the private equity backed flag in the database. This is done to differentiate between companies that were subject to a leveraged buyout or sold with a controlling stake to private equity investors. This was the case for 69 IPOs. Second, Wharton Research Data Service (WRDS) CRSP is used to obtain daily stock prices of all firms in the data to complement blank spots in the dataset. The World Indices database from WRDS is as well consulted to obtain the daily market index returns for the corresponding countries. Finally, the website of Jay Ritter is consulted to obtain underwriter ranks to rank the underwriters of the IPOs in the dataset on their reputation.

4.1.2 Data construction

The initial sample of IPOs is manipulated with some requirements to obtain the final sample. Firms of which their offer price or closing price at the first trading day are not available are excluded from the sample, because without these numbers is it not possible to measure the level of underpricing. This reduces the sample to 200 firms, of which 39 are PE-backed. These 200 firms are matched with the underwriter rank data and their market indices return. The underwriter ranks from Ritter's website is an updated version from the initial equally-weighted European underwriter ranking from Migliorati &

Vismara (2014) and ranks underwriters on a scale of 0,000 to 1,000. They claim that most European IPOs are underwritten by domestic banks. The European market is, different from the US market, segmented and therefore characterized by specific underwriters for each market. Migliorati & Vismara (2014) provide two rankings for underwriters: the equally-weighted ranking, based on the number of IPOs underwritten, and the proceeds-weighted ranking, based on the value underwritten at the IPO. The equally-weighted ranking is assumed to be the best indicator because it gives a higher visibility to local banks, which are the primarily involved underwriters in a European IPO. The proceeds-weighted ranking does not deal well with underwriters in the second-tier markets and underestimates therefore the reputation for underwriters of smaller issues. Since not all of the underwriters in the dataset could be matched with the dataset of Migliorati & Vismara some adjustments need to be made. Offerings that are completed with multiple underwriters are assumed to be larger and more difficult, so therefore these are scaled high in ranking as 'prestigious' (Migliorati & Vismara, 2014). The market index returns from World Indices are matched with each firm to construct cumulative abnormal returns and buy-and-hold abnormal returns for each time period in the aftermarket.

4.2 Methodology

4.2.1 Variable description

Dependent variable

The dependent variable of the regressions in this research is the first-day return. The first-day stock returns are used as proxy to measure the level of IPO underpricing,. According to the existing literature in underpricing is the initial first-day return (UP_i) in a public offering calculated as follows:

$$UP_i = \frac{P_{i,1} - P_{i,0}}{P_{i,0}} \quad (1)$$

where $P_{i,1}$ is denoted as the closing price of day 1 and $P_{i,0}$ as the offer price of the IPO, both received from Thomson ONE. To minimize outliers the first-day return will be winsorized at levels of 5% and 10%. Winsorizing implies that the most extreme values at the upper and lower bound will be modified and take the value of the nearest value in the dataset. This method makes the dataset better suited for regressions and increases the robustness.

Independent variables

The independent variables for this research are the variables that will be tested in hypothesis 1, 2, and 3. This are the following variables: PE, LN_{assets}, LN_{age}, UW rank and P/E ratio. *PE* is a dummy variable that represents the involvement of private equity in the IPO. The dummy takes the value 1 if the IPO was private equity backed and 0 if the IPO was not PE-backed. LN_{assets} is the natural logarithm of the value of the assets before or at the time the IPO took place. LN_{assets} is set as a proxy for the size of the company. LN_{age} represents the natural logarithm of the age of the company and is used to test the

degree of information asymmetry. An older firm is expected to have more information available because it operates longer than a firm that is recently founded. At the same time is the age related to the size of the company. An older firm is expected to grow over a certain time period because it is able to establish a better reputation (Mogilevsky & Murgulov, 2012). Both variables are denoted as natural logarithm of the absolute variables in order to change the distribution of the variables. The variables Assets and Age are not normally distributed which makes it unable to fit the model. By taking the natural logarithm of the variables, the scale of the variable is altered and makes the variable more normally distributed. The variable *UWrank* represents the ranking of the corresponding underwriter of the IPO from the list of underwriters of European IPOs from Migliorati & Vismara (2014). They scale the underwriters on their quality and activity from a ranking from 0,000 to 1,000. The variable *P/E ratio* contains the value of the price of a certain stock divided by the earnings per share of the corresponding firm and can be seen as a value measure for the firm. The ratio shows what an investor is willing to pay for a stock based on the earnings per share and could indicate an overvalued or undervalued stock.

Control variables

Some of the variables in the regressions need to be taken into the model because of their impact on underpricing, but are worth investigating separately. $LN_{proceeds}$ is a variable that represents the natural logarithm of the proceeds of the offering and is used to control for the degree of information asymmetry. Beatty and Ritter (1986) document the relation with underpricing and show that smaller issues are more speculative and therefore have higher returns. The variable *over-allotment option* is a dummy variable that takes the value 1 if the firm has exercised an over-allotment option and 0 if the firms has not. The over-allotment option is the ability of the underwriter(s) to sell an additional amount of shares to the market within 30 days of the IPO. This is done when the demand for the shares is high. Ritter (1987) states that the execution of the option for oversubscribed offers is a helpful measure for the information asymmetry problem and is related to a reduction in the level of underpricing. *Integer offer price* is a dummy-variable that represents the value 1 if the offer price of the IPO is whole number and 0 if the offer price is fractional. Bradley et al. (2004) show that integer offer prices are more underpriced than non-fractional offer prices, presumably due to negotiation between the issuer and underwriter. The variable *ROA* contains the value of the return on assets of the firm which proxies for the profitability of the firm prior to the IPO. The return on assets measures in what way the assets are used to generate income. Profitable firms are favored by both investors and the market, because they are considered less risky. This should lower the underpricing (Xu & Zhao, 2014). Last, the variables *year* and *country* are used to control for the contra-year and country effects of the different years and countries present in the sample.

4.2.2 Empirical foundation

This research will follow the structure of the paper of Mogilevsky & Murgulov (2012) on underpricing and will use ordinary least squares (OLS) regressions to statistically test the drafted hypotheses. This is possible due to the cross-sectional scope of the dataset and the continious scope of the dependent variable underpricing.

The computed return of formula (1) is used to estimate the parameters of a regression to test hypotheses 1 and 2. On the basis of the paper of Mogilevsky & Murgulov (2012) the following OLS regression equition is estimated:

$$UP = \alpha + \beta_1 * PE\ dummy + \beta_2 * LN_{Age} + \beta_3 * LN_{Assets} + \beta_4 * LN_{Proceeds} + \beta_5 * UWrank + \beta_6 * ROA + \beta_7 * Integer\ offer\ prize + \beta_8 * Overallotment\ option + \beta_9 * Year_i + \beta_{10} * Country_i + e_i \quad (2)$$

where PE dummy is a dummy variabele that takes 1 if the IPO was PE-backed and 0 if the IPO was not PE-backed. Integer offer prize and overallotment option are also dummy variables. If some variables appear to be highly correlated with each other will this formula be adjusted. With correlated variables will the regression be compared to a regression with the exclusion of (one of) the correlated variables to check whether this differs from the original regression model.

Formula (2) includes the independent variables LN_{age}, LN_{assets}, and UWrank. The impact of these corresponding variables to the asymmetric information model on underpricing will be compared for both the PE-backed IPOs and the non-PE backed IPOs. If these parameters appear to be significant, this could possibly explain the difference in underpricing between PE-backed and non-PE backed IPOs (hypothesis 2). As mentioned above this hypothesis will be viewed by different models if some variables turn out to be correlated.

To test the potential presence of behavioral implications on underpricing hypothesis 3 will be tested also with an OLS regression. Compared to formula (2) does this regression include the price to earnings ratio of the firms:

$$UP = \alpha + \beta_1 * \frac{P}{E} ratio + \beta_2 * PE\ dummy + \beta_3 * LN_{Age} + \beta_4 * LN_{Assets} + \beta_5 * LN_{Proceeds} + \beta_6 * UWrank + \beta_7 * Integer\ offer\ prize + \beta_8 * ROA + \beta_9 * Overallotment\ option + \beta_{10} * Year_i + \beta_{11} * Country_i + e_i \quad (3)$$

The effect of the P/E ratio will be measured over the two samples of PE-backed and non-PE backed firms to test the hypothesis. With the possibility of correlated variables will the regression be adjusted to a regression without the correlated variables if this is the case.

For testing the validity of hypothesis 4, formula (1) will be adjusted to calculate the abnormal returns for 1 week, 1 month, 2 months, 3 months, 6 months and 1 year after the IPO. Instead of the offer price, the closing price on day 1 will be used as benchmark point. This leads to the following formula:

$$Re_{it} = \frac{P_{it,1} - P_{it,0}}{P_{it,0}} \quad (4)$$

where $P_{i,1}$ is denoted as the closing price after 1 week, [1, 2, 3, 6 months and 1 year] and $P_{i,0}$ as the closing price on day 1.

The aftermarket results will be tested with the CAR method and BHAR method. First of all the CAR method will be explained. The returns of formula (4) will be corrected against the index return of the country, because otherwise they might be biased towards the economic period. Therefore the index return (R_{mi}) is subtracted from the period return (Re_i) to retain the abnormal return (AR_i):

$$AR_{it} = Re_{it} - R_{mit} \quad (5)$$

The daily abnormal portfolio returns are accumulated over the different time periods to derive at the cumulative abnormal returns (CAR_{it}):

$$CAR_{it-T} = \sum_{t=1}^{T} AR_{it} \quad (6)$$

The cumulative abnormal returns is a short-term model that should give insight in the development of the stock price after the IPO and whether this differs for PE-backed firms compared to non-PE backed firms.

A second measure to test the after market results is the use of long-term buy-and-hold abnormal returns. The difference between the models is that BHAR compounds the returns, whereas CAR sums the returns. CARs are therefore arithmetric and BHARs geometric. BHARs are more often used in studies to long-term returns, because they are likely to grow with the return horizon. However, these long-term models are not more reliable than simpler models as CAR and long-term returns should actually be calculated based on short-term models. Both models will be covered in the analysis and checked whether there are differences between the models (Fama, 1998). The formula for the buy-and-hold abnormal return of a firm is as followed:

$$BHAR_{it} = \prod_{t=1}^{t}[1 + Re_{it}] - \prod_{t=1}^{t}[1 + R_{mit}] \quad (7)$$

5. Results

This section reports the results of this research. First of all a description of the statistics is given with tables including the distribution between years, countries and industries and an overview of the summary statistics. Furthermore, the regression results are displayed and discussed. Finally, an analysis is given for the aftermarket performance of IPOs.

5.1 Descriptive statistics

Table 1 shows the distribution of the total number of IPOs in the sample. The 200 IPOs are divided in subsamples of backing type. One-fifth of the sample is offered by a PE-backed firm and four-fifth by a non-PE backed firm. This is lower than the 36% contribution of the PE-backed IPOs to the total European IPOs between 2009 and 2017 (see Section 2.2 for more details), but this should not be a problem. The IPO market reaches a peak in the years 2006 and 2007; especially 2007 was driven by a large amount of offerings from non-PE backed firms. The market decreases drastically after the start of the Global Financial Crisis. Although we have seen that both the IPO market and the private equity market are booming in the years after the crisis (see Section 2.2 and 2.5), this is not the case for the IPO market in this sample. The PE-backed IPOs do not rise above two after 2012, while this occurred more than once before 2012. The non-PE backed IPOs do not grow evenly with the overall European IPO market as well. The volume of these IPOs for the years 2016 and 2017 is the same as the volume of 2009 and 2010.

Table 1: Distribution of PE-backed and non-PE backed IPOs

Year	PE	(%)	Non-PE	%	Total
2003	0	(0%)	5	(100%)	5
2004	3	(33%)	6	(67%)	9
2005	5	(36%)	9	(64%)	14
2006	11	(22%)	38	(78%)	49
2007	5	(10%)	47	(90%)	52
2008	2	(25%)	6	(75%)	8
2009	0	(0%)	4	(100%)	4
2010	3	(43%)	4	(57%)	7
2011	5	(45%)	6	(55%)	11
2012	0	(0%)	8	(100%)	8
2013	2	(29%)	5	(71%)	7
2014	1	(10%)	9	(90%)	10
2015	1	(14%)	6	(86%)	7
2016	0	(0%)	4	(100%)	4
2017	1	(20%)	4	(80%)	5
Total	**39**	**(19,5%)**	**161**	**(80,5%)**	**200**

Table 2 reports the volume distribution across the countries in the DACH region and the distribution

across the industries. The majority of the IPOs are from German origin, they represent almost two-third of the complete sample. Austria and Switzerland account for respectively 11,5% and 25% of the sample. The distribution between PE-backed and non-PE backed IPOs per country is in line with the overall distribution. The PE-backed IPOs account for 20% in Germany, 17% in Austria and 18% in Switzerland.

Table 2: Distribution of PE-backed and non-PE backed IPOs by country and industry

Country	**PE**		**Non-PE**		**Total**	
Germany	26	(20%)	101	(80%)	127	(63,5%)
Austria	4	(17%)	19	(83%)	23	(11,5%)
Switzerland	9	(18%)	41	(82%)	50	(25%)
Industry					**200**	
Consumer Products and Services	1	(10%)	9	(90%)	10	(5%)
Consumer Staples	1	(10%)	9	(90%)	10	(5%)
Energy and Power	0	(0%)	11	(100%)	11	(5,5%)
Financials	2	(9,5%)	19	(90,5%)	21	(10,5%)
Healthcare	0	(0%)	22	(100%)	22	(11%)
High Technology	9	(32%)	19	(68%)	28	(14%)
Industrials	15	(41%)	21	(59%)	36	(18%)
Materials	2	(11%)	16	(89%)	18	(9%)
Media and Entertainment	3	(50%)	3	(50%)	6	(3%)
Real Estate	2	(9,5%)	19	(90,5%)	21	(10,5%)
Retail	2	(22%)	7	(78%)	9	(4,5%)
Telecommunications	2	(25%)	6	(75%)	8	(4%)

The results in table 2 further show that industrial firms, with a volume of 36 IPOs, offer the majority of IPOs. High technological and Healthcare firms complement the top three. The lowest volume of IPOs are in the sector of Media and Entertainment, with only six IPOs. These six IPOs are however distributed equally among PE-backed and non-PE backed. This is certainly not the case for Energy and Power, Financials, Healthcare and Real Estate where less than 10% of the IPOs are PE-backed.

Table 3 provides an overview of the winsorized summary statistics of the first-day return. We expect PE-backed IPOs to be less underpriced because of lower uncertainty about their true value of the firm. This is due to the characteristic of more involvement in the daily management and the higher level of financial expertise (Robbie & Wright, 1998). The table shows that this is the case for the mean of all three countries. The overall mean underpricing for PE-backed IPOs is 24,98%, while this is 57,33% for non-PE backed IPOs. The largest difference is seen in Switzerland where PE-backed firms are priced 1,6% higher at the end of the first trading day and non-PE backed firms 89,5% larger. For the largest subsample, Germany, this difference is smaller with 36,3% and 48,7% respectively. The median underpricing is even larger for non-PE firms (33,6%) than PE firms (37,3%). The median first-day return

for PE-backed firms in Switzerland report a negative return, which indicates overpricing. The Swiss sample is highly affected by one or some outliers, because Q3 displays an underpricing of 18,7% for the non-PE backed firms, while the average underpricing is 89,5%. This is supported by the standard deviation of 510,7% for Swiss non-PE backed IPOs, whereas the deviation of the PE-backed IPOs is only 18,2%. When the data is corrected for outliers, this deviation is minimized. The mean underpricing lowers to 10.1% and the standard deviation to 23.1%.

Table 3: Summary statistics for dependent variable First-day return

First-day return						
	Austria		**Germany**		**Switzerland**	
	PE	**non-PE**	**PE**	**non-PE**	**PE**	**non-PE**
Mean	7,5%	33,9%	35,4%	36,5%	2,0%	10,1%
Min	-14,8%	-3,2%	0,0%	-14,8%	-14,8%	-14,8%
Median	9,2%	31,2%	37,3%	33,6%	-5,9%	6,2%
Max	26,4%	70,2%	78%	78%	30,7%	78%
Std. Dev.	19,7%	20,6%	16,5%	20,7%	17,7%	23,1%
N	4	19	26	101	9	41

Note: The first-day return is winsorized on each tale at a level of 5%

The summary statistics for firm characteristics are demonstrated in table 4. Panel A reports the statistics for non-PE backed firms, Panel B the results for PE-backed firms and Panel C the results for the whole sample. The average offer price is higher for PE-backed firms ($33.15) than for non-PE backed firms ($25.66). The lowest offer price is with $7.75 also far higher than that of the non-PE backed firms ($0.8), while the highest offer price in both samples is higher for the non-PE backed firms ($152 against $130). Surprising to see is the difference in mean of the total assets between the samples. The average assets is 2.5 times as large for non-PE backed firms. This could be explained due to the major difference in the upside part. The maximum value of total assets is $183,068 million for non-PE backed firms and $45,206 for PE-backed firms. These results disappear when the data is winsorized at a level of 5%. This has the effect that the mean assets of PE-backed firms prior to the IPO ($1822.98 million) become larger than the assets of the non-PE backed firms ($1148.64 million). The differences in proceeds and age between the groups indicate that PE-backed firms are on average 12 years older than non-PE backed firms are and observe almost twice as much proceeds from the offering. The oldest firm in the sample is 217 years old at the time of the IPO, while the youngest firm going public is only 100 days old. The average time between the founding of a firm and the moment to get a listing on a stock exchange is more than 31 years. The P/E ratio and return on assets are larger for non-PE backed firms, which could indicate that non-PE backed firms are more profitable than PE-backed firms at the IPO are, but that they also have a relative high stock price compared to their earnings.

Table 4: Winsorized summary statistics for firm characteristics

Panel A: non-PE backed firms					
Variable	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Offer Price in $	161	25.67	27.04	0.8	152
Total Assets in $ mil	145	1147.69	2903.17	3.7	11829.9
Proceeds in $ mil	161	199.68	331.95	5.37	1265.68
Age	159	27.06	40.89	0.78	158.41
P/E ratio	115	28,1%	78,2%	-138,1%	266,4%
ROA	72	16.44	14.71	1.43	50.82
Panel B: PE-backed firms					
Variable	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Offer Price in $	39	33.15	27.05	7.75	130
Total Assets in $ mil	39	1822.98	2987.10	9.2	11829.9
Proceeds in $ mil	39	408.88	414.68	15.32	1265.68
Age	39	40.83	42.98	0.78	158.41
P/E ratio	33	21,8%	84,6%	-138,1%	266,4%
ROA	27	9.84	10.18	1.43	46.74
Panel C: All firms					
Variable	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Offer Price in $	200	27.12	27.14	0.8	152
Total Assets in $ mil	184	1290.82	2926.02	3.7	11829.9
Proceeds in $ mil	200	240.47	358.24	5.368	1265.68
Age	198	29.78	41.56	0.78	158.41
P/E ratio	147	26,7%	79,4%	-138,1%	266,4%
ROA	99	14.64	13.89	1.43	50.82

The results of the statistical differences between these variables are reported in table 5. This table confirms whether the differences between the PE-backed firms and the non-PE backed firms are statistical significant or not. It shows that, in contrast to our first hypothesis, there is no difference between the first-day return. The difference in return of 5.0% is not statistically significant at a level of 5%. This is consistent with the earlier findings in Europe of Levis; van Frederikslust & van der Geest and Bergström, Nilsson & Wahlberg. The table further shows that PE-backed firms raise significant more money than non-PE backed firms and are represented by significant more prestigious underwriters. This results in a significant more often usage of the overallotment option by these firms. As well is the difference in return on assets significant at a level of 5% and the variable age at a level of 10%.

Table 5: Difference in mean tests for firm characteristics

Variable	t-statistic (PE, non-PE)
First-day return	1,1054
Assets	-1,2800
Proceeds	-3,3585***
Age	-1,9195*
UWrank	-3,3463***
ROA	2,4149**
Int. price	-1,0631
Overall. option	-2,7678***
P/E ratio	0,4041

Note: t-statistics and p-values are for the difference in means between PE-backed and non-PE backed IPOs. *, **, *** indicate significance at 10%, 5%, 1% level, respectively.

The Pearson bivariate correlations between the dependent and explanatory variables are displayed in table 6. The variables that are significant at a level of 5% are followed with a star (*). None of the variables is highly correlated with the dependent variable first-day return. PE dummy, LN_{assets} and $LN_{proceeds}$, LN_{age}, UWrank, integer offer price, Overallotment option and P/E ratio show a negative linear correlation with the first-day return, while ROA is the only variable that is positively correlated. $LN_{proceeds}$ and return on assets experience a high correlation with LN_{assets} apparent from the significant coefficients of 0.78 and -0.63. The independent variables LN_{assets}, LN_{age}, and UWrank are significantly correlated with the PE dummy, although this correlation does not rise above 0.30. There is also a significant correlation between all the variables and $LN_{proceeds}$. The other variables show little or almost no correlation with each other. This means that these variables do not have a strong linear relationship with each other.

Table 6: Correlation matrix (Pearson bivariate correlations)

Variable	First-day ret.	PE dummy	LN_{assets}	$LN_{proceeds}$	LN_{age}	UWrank	Int. price	ROA	Overall. option	P/E ratio
First-day ret.	1,000									
PE dummy	-0.078	1,000								
LNassets	-0.131	0.273*	1,000							
LNproceeds	-0.125	0.327*	0.785*	1,000						
LNage	-0.091	0.202*	0.370*	0.318*	1,000					
UWrank	-0.030	0.218*	0.381*	0.484*	0.172*	1,000				
Int. price	-0.206*	0.072	0.039	0.147*	0.102	-0.028	1,000			
ROA	0.060	-0.204*	-0.632*	-0.354*	-0.328*	-0.103	-0.017	1,000		
Oa option	-0.005	0.195*	0.269*	0.396*	0.155*	0.373*	0.093	-0.071	1,000	
P/E ratio	-0.175*	-0.033	-0.132	-0.183*	0.044	-0.088	-0.083	0.074	-0.142	1,000

5.2 Regression results

Table 7 reports the results of the standard underpricing model. The regression model is a standard OLS regression subdivided in three models. Model 1 is a model without the variables $LN_{proceeds}$ and ROA to avoid any collinearity with the variable LN_{assets}, whereas model 2 is a model with $LN_{proceeds}$, ROA included, and LN_{assets} excluded. The complete model with all variables included is reported in model 3. Beside the complete sample have all models been applied to the PE-backed sample and the non-PE backed sample as well. The regression is controlled for year and country fixed effects. To perform an OLS regression is it important to first test the sample on the assumptions of the OLS model. Appendix, table 15 and 16, demonstrate the tests for heteroscedasticity in the variances of the error term and normality of the error term. Both the Breusch-Pagan and White's test display a p-value > 0.05, indicating homoscedasticity of the error terms in the sample. The Shapiro-Wilk test in table 16 displays a p-value of 0.273 for the residuals. Therefore, the null hypothesis of a normal distribution cannot be rejected and is normality of the error term assumed.

Table 7 shows that model 1 has with a R^2 below 10% a very low ability to explain the first-day return, while model 2 and 3 score above 30%. The PE-backed variable has in all three models an insignificant negative effect of on the dependent variable. In model 1 is this about 10% and in model 2 and 3 approximately 6,5%. This negative relation indicates that a PE-backed IPO has a lower first-day return than a non-PE backed IPO, although this could not statistically be proven. From the other variables is seen that LN_{assets} and $LN_{proceeds}$ both have a partially significant impact on the first-day return in model 3. This relation for LN_{assets} is negative, while it is positive for $LN_{proceeds}$. These results are only significant at a level of 10% and disappear when one of the variables is excluded from the regression. The results in the PE-backed and non-PE backed sample excel as well in insignificance. Only ROA and the overallotment option show significance below 5%. A major difference between the samples is seen in the intercept, the intercept in the PE-backed sample is negative, while this is positive for the non-PE backed sample. This implies that if all other variables are equal to zero the value of the dependent variable is equal to the intercept. Only for model 1 of the PE-backed sample is this intercept significantly different from zero at a level of 5%.

Table 7: Regression results first-day return

	All			PE-backed			non-PE backed		
Variable	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Intercept	0.276 (1.16)	0.168 (1.10)	0.320 (1.70)	-0.507 (-2.26)**	-0.588 (-1.88)*	-0.578 (-1.72)	0.241 (1.57)	0.264 (0.69)	0.464 (1.02)
PE-backed	-0.106 (-3.77)	-0.066 (-2.55)	-0.064 (-2.63)						
LNassets	-0.028 (-1.50)		-0.025 (-7.39)*	0.028 (1.57)		-0.014 (-0.29)	-0.005 (-0.42)		-0.031 (-0.82)
LNproceeds		0.016 (2.51)	0.044 (7.30)*		0.089 (2.17)*	0.102 (1.60)		0.014 (0.45)	0.046 (0.92)
LNage	-0.027 (-1.46)	0.003 (1.48)	0.006 (2.72)	0.038 (1.27)	0.036 (1.35)	0.0377 (1.29)	-0.011 (-0.68)	0.003 (0.11)	0.012 (0.36)
UWrank	0.213 (3.01)	0.078 (3.67)	0.069 (3.34)	0.121 (1.09)	-0.005 (-0.05)	-0.003 (-0.03)	0.003 (0.05)	0.082 (0.59)	0.075 (0.55)
Integer price	0.112 (4.04)	-0.111 (-3.01)	-0.112 (-2.59)	-0.120 (-1.87)*	-0.073 (-1.22)	-0.071 (-1.10)	-0.059 (-1.39)	-0.139 (-1.47)	-0.144 (-1.51)
Overall. opt.	-0.084 (-2.03)	0.050 (0.66)	0.048 (0.62)	-0.050 (-0.80)	-0.082 (-1.19)	-0.075 (-0.98)	0.124 (2.62)***	0.102 (0.98)	0.102 (0.97)
ROA		-0.000 (-0.22)	-0.000 (1.75)		0.008 (2.40)**	0.007 (1.46)		0.000 (0.19)	-0.000 (-0.29)
R^2	0.071	0.338	0.346	0.844	0.924	0.925	0.411	0.340	0.350
Observations	161	88	88	36	24	24	125	64	64

Note: Cell values represent unstandardized regression coefficients for individual variables, with corresponding t-statistics in parenthesis. Dependent variable is the initial return measured as the percentage return between the offer price and the first trading day closing price. *, **, *** indicate significance at 10%, 5%, 1% level, respectively. The regression is controlled for year and country effects.

Table 8 reports the robustness checks of the results above. Table 3&4 demonstrated a large influence of outliers on the data. With the elimination of this outliers by winsorizing the variables does this affect the outcomes as well. Panel A of table 8 shows results for winsorizing at 5% on each tail and Panel B for 10% on each tail. Winsorizing the variables increases the R^2 for most of the models. For example, in table 7 is the R^2 for model 1 with the complete sample 7,1%, while this becomes 39,4% and 42,4% in table 8. Model 1 of Panel A shows a highly significant coefficient for PE-backed, while this disappears in model 2&3 and in Panel B for all models. The insignificance at a level of 5% of the PE-dummy is consistent with earlier research. Bergström, Nilsson, & Wahlberg (2006) found an insignificant coefficient of 0.017 for the London Stock Exchange and an insignificant coefficient of -0.057 for the Paris Stock Exchange. Van Frederikslust & van der Geest (2000) found an insignificant coefficient of -0.053 for the Dutch market. The results in the DACH region have the same magnitude as the latter two and tend to have the lowest p-value of these European results. However, at a significance level of 5% it is not possible to assume that the influence of a PE-backed firm generates more or less return on the first trading day than a non-PE backed firm. Therefore is hypothesis 1 of a difference in return rejected.

In the UK was a significant negative coefficient of -0.025 noticed of $LN_{issue\ size}$, which is measured equally to the variable $LN_{proceeds}$ in this research. This significant variable is contradictory to results found in the French market (Bergström, Nilsson, & Wahlberg, 2006). Levis (2011) did not find any support in the UK for significance when measuring the logarithm of the market capitalization before the offer as proxy for size. In the United States significant coefficients are found for both LN_{assets} (-0.032) and $LN_{proceeds}$ (0.094), this remains significant (0.064) with the excluding of LN_{assets} (Mogilevsky & Murgulov, 2012). German specific research did not find any significance when using other proxies for assets. Elston & Yang (2010) used the logarithm of the market capitalization, while Franzke (2003) used the logarithm of the number of employees. The results in this research support these results, because both LN_{assets} and $LN_{proceeds}$ are in most models not significant. Panel A, model 3 shows a significant coefficient of 0.021 on the first-day return, but this could not be explained by the samples of PE-backed and non-PE backed IPOs. The insignificant coefficient of LN_{age} in all models is consistent with the findings of Mogilevsky and Murgulov. The variable age is also found insignificant in the German research of Elston and Yang. The Dutch investigation did find a significant effect for the age of the company, but this effect is very low. They found also a significant coefficient of -0.106 for the quality of the underwriter (van Frederikslust & van der Geest, 2000). Both German papers could not find any significant impact of the underwriter on the first-day return. This research supports these findings; none of the models could find a significant relation between the quality of the underwriter and the first-day return. Most important is the insignificant effect on the PE-backed and non-PE backed sample. Besides the intercept and the overallotment option do the variables have the same sign for the PE-backed and non-PE backed sample. Just like the results in table 7 is the difference in the intercept quite large. The difference in magnitude between the two backing types is large for the variables $LN_{proceeds}$, LN_{age} and UWrank, although the sign is the same. Therefore, it cannot explain the difference in underpricing between PE-backed and non-PE backed IPOs. None of the variables LN_{assets}, LN_{age} or UWrank, which are assigned to asymmetric information, is able to explain this difference. Therefore, hypothesis 2 is rejected.

Table 8: Regression results first-day return with robustness checks

Panel A	All			PE-backed			non-PE backed		
Variable	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	0.133 (0.76)	0.239 (1.34)	0.288 (1.14)	-0.358 (-1.63)	-0.568 (-1.78)	-0.558 (-1.63)	0.241 (1.57)	0.345 (1.16)	0.432 (1.21)
PE-backed	-0.042 (-117.65)...	-0.050 (-2.80)	-0.052 (-3.27)						
LNassets	0.002 (0.20)		-0.011 (-0.67)	0.025 (1.42)		-0.012 (-0.23)	-0.005 (-0.42)		-0.020 (-0.45)
LNproceeds		0.012 (0.95)	0.021 (15.87)**		0.081 (1.96)*	0.092 (1.42)		0.007 (0.29)	0.024 (0.53)
LNage	-0.009 (-1.86)	0.005 (1.02)	0.004 (0.69)	0.029 (0.94)	0.041 (1.38)	0.042 (1.32)	-0.011 (-0.68)	0.004 (0.15)	0.003 (0.12)
UWrank	0.008 (1.23)	0.043 (1.80)	0.043 (1.70)	0.114 (1.05)	0.003 (0.03)	0.004 (0.04)	0.003 (0.05)	0.050 (0.49)	0.053 (0.52)
Integer price	-0.040 (2.12)	-0.061 (-4.95)	-0.059 (-7.19)*	-0.114 (-1.83)*	-0.075 (-1.23)	-0.073 (-1.11)	-0.059 (-1.39)	-0.076 (-1.06)	-0.069 (-0.94)
Overall. opt.	0.079 (1.22)	0.032 (0.55)	0.035 (0.55)	-0.060 (-0.98)	-0.079 (-1.14)	-0.073 (-0.95)	0.124 (2.62)***	0.064 (0.82)	0.072 (0.90)
ROA		0.001 (0.89)	0.000 (0.20)		0.008 (2.28)*	0.007 (1.41)		0.001 (0.31)	-0.001 (-0.15)
R^2	0.394	0.418	0.419	0.810	0.919	0.920	0.411	0.410	0.412
Observations	161	88	88	36	24	24	125	64	64

Panel B	All			PE-backed			non-PE backed		
Variable	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	0.108 (0.81)	0.271 (1.68)	0.289 (1.39)	-0.241 (-1.18)	-0.506 (-1.52)	-0.502 (-1.38)	0.190 (1.55)	0.364 (1.42)	0.396 (1.31)
PE-backed	-0.031 (-7.86)*	-0.041 (-3.77)	-0.042 (-4.63)						
LNassets	0.004 (0.41)		-0.004 (-0.40)	0.021 (1.27)		-0.003 (-0.06)	-0.002 (-0.15)		-0.008 (-0.21)
LNproceeds		0.008 (0.76)	0.011 (6.76)*		0.071 (1.57)	0.074 (1.11)		0.005 (0.20)	0.011 (0.28)
LNage	-0.007 (-2.02)	0.002 (0.24)	0.002 (0.15)	0.022 (0.72)	0.041 (1.21)	0.041 (1.11)	-0.009 (-0.64)	0.002 (0.10)	-0.003 (-0.13)
UWrank	0.023 (5.59)	0.044 (1.86)	0.044 (1.88)	0.101 (1.01)	0.013 (0.14)	0.014 (0.13)	0.020 (0.38)	0.053 (0.62)	0.053 (0.61)
Integer price	-0.041 (2.39)	-0.048 (-5.24)	-0.047 (-8.70)*	-0.094 (-1.63)	-0.080 (-1.26)	-0.078 (-1.11)	-0.057 (-1.67)	-0.059 (-0.97)	-0.056 (-0.88)
Overall. opt.	0.060 (1.09)	0.031 (0.56)	0.032 (0.54)	-0.060 (-1.07)	-0.077 (-1.07)	-0.075 (-0.89)	0.098 (2.6)**	0.066 (0.99)	0.070 (1.00)
ROA		0.001 (1.24)	0.001 (0.59)		0.007 (1.80)	0.007 (1.08)		0.001 (0.44)	0.000 (0.11)
R^2	0.424	0.449	0.45	0.780	0.897	0.897	0.453	0.445	0.446
Observations	161	88	88	36	24	24	125	64	64

Note: Cell values represent unstandardized regression coefficients for individual variables, with corresponding t-statistics in parenthesis. The variables in Panel A are corrected for outliers by a winsorized level of 5% and in Panel B at a level of 10%. Dependent variable is the initial return measured as the percentage return between the offer price and the first trading day closing price. *, **, *** indicate significance at 10%, 5%, 1% level, respectively. The regression is controlled for year and country effects.

Table 9 reports the regression on the PE-backed and non-PE backed sample with the inclusion of the P/E ratio. Model 1 shows the results of the regression without $LN_{proceeds}$ and ROA, model 2 the results without $LN_{proceeds}$ and model 3 the results without ROA. Panel A reflects significant coefficients for the P/E ratio in model 1 and 2 of the non-PE backed sample, although this relation with the first-day return is very small. Panel A further displays that UWrank becomes significant for PE-backed firms in 2 of the 3 models when the P/E ratio is included in the regression. The coefficient of 0.3 implies a large influence on the first-day return. The explanatory percentage of the variance is quite high with a R^2 above 90% for the PE-backed sample. This might be due to the small sample size of the PE-backed sample, only 30 observations in combinations with the large amount of parameters. According to Freedman (1983) could this problem be solved by taking the adjusted R^2. The adjusted R^2 modifies the R^2 for the number of predictors in the model by the expected chances of contribution to the model. The adjusted R^2 of the models in the PE-backed sample are about 10% smaller than the unadjusted R^2. In Panel B changes the significance from the P/E ratio from the non-PE backed sample to the PE-backed sample. The regressions in model 1 and 2 show support of the hypothesis that the first-day return of PE-backed firms is related to the P/E ratio. However, the coefficients are with -0.002 and -0.003 not high. This means that a higher P/E ratio for a PE-backed firm lowers their first-day return. This significance is not found in panel B for the non-PE backed sample, which makes it unable to state that their first-day return is affected as well by the P/E ratio. UWrank and the overallotment option remain significant at a level of 5%, while LN_{assets} and $LN_{proceeds}$ have also a significant impact on the first-day return in model 2 of the PE-backed sample. The significant result of the PE-backed sample in panel B is in support of hypothesis 3 but it is not justified to accept that the first-day return of PE-backed firms is related to the P/E ratio of the firm, because this relationship does not exist in panel A.

Table 9: Regression results first-day return

Panel A	PE-backed			non-PE backed		
Variable	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Intercept	-0.072 (-0.29)	-0.220 (-0.94)	-0.308 (-1.44)	0.735 (2.58)**	0.731 (2.55)**	0.617 (1.54)
LNassets	-0.018 (-0.70)	-0.080 (-2.09)*	0.041 (1.60)	-0.022 (-1.53)	-0.025 (-1.14)	-0.012 (-0.39)
LNproceeds		0.109 (2.00)*			0.005 (0.17)	
LNage	0.005 (-0.15)	0.025 (0.81)	-0.019 (-0.61)	0.006 (0.29)	0.006 (0.31)	0.21 (0.60)
UWrank	0.290 (2.27)**	0.191 (1.55)	0.299 (3.16)**	-0.026 (-0.37)	-0.030 (-0.40)	-0.030 (-0.27)
Integer offer price	-0.069 (-0.83)	-0.060 (-0.82)	-0.128 (-2.25)*	-0.075 (-1.42)	-0.074 (-1.40)	-0.029 (-0.33)
Overallotment option	-0.044 -0.66	-0.033 (-0.56)	-0.129 (-2.19)*	0.132 (2.64)***	0.130 (2.54)**	0.138 (1.56)
PE-ratio	-0.001 (-1.46)	-0.001 (-1.44)	-0.000 (-0.44)	-0.001 (-2.08)**	-0.001 (-2.06)**	0.000 (0.35)
ROA			0.010 (2.90)**			0.001 (0.31)
R^2	0.908	0.934	0.980	0.493	0.494	0.492
Observations	30	30	21	99	99	55
Panel B	**PE-backed**			**non-PE backed**		
Variable	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Intercept	0.163 (0.80)	0.045 (0.26)	-0.231 (-0.95)	0.638 (2.90)***	0.642 (2.85)***	0.473 (1.38)
LNassets	-0.039 (-1.65)	-0.114 (-3.40)***	0.046 (1.33)	-0.012 (-0.96)	-0.013 (-0.72)	-0.003 (-0.10)
LNproceeds		0.120 (2.70)**			0.000 (0.02)	
LNage	0.009 (0.31)	0.037 (1.46)	-0.040 (-1.06)	0.003 (0.14)	0.004 (0.20)	0.007 (0.23)
UWrank	0.225 (2.24)**	0.113 (1.26)	0.311 (3.01)**	-0.036 (-0.65)	-0.033 (-0.56)	-0.035 (-0.39)
Integer offer price	-0.002 (-0.03)	0.033 (0.56)	-0.141 (-2.02)	-0.060 (-1.43)	-0.060 (-1.41)	-0.010 (-0.14)
Overallotment option	-0.019 (-0.39)	-0.014 (-0.36)	-0.130 (-2.01)	0.114 (2.88)***	0.115 (2.84)***	0.129 (1.85)*
PE-ratio	-0.002 (-2.55)**	-0.003 (-3.69)***	-0.000 (-0.35)	-0.001 (-1.61)	-0.001 (-1.59)	0.001 (0.60)
ROA			0.010 (2.39)*			0.002 (0.56)
R^2	0.923	0.956	0.974	0.516	0.52	0.544
Observations	30	30	21	99	99	55

Note: Cell values represent unstandardized regression coefficients and t-statistics for individual variables. The variables in Panel A are corrected for outliers by a winsorized level of 5% and in Panel B at a level of 10%. Dependent variable is the initial return measured as the percentage return between the offer price and the first trading day closing price. *, **, *** indicate significance at 10%, 5%, 1% level, respectively. The regression is controlled for year and country effects.

5.3 Aftermarket results

5.3.1 Cumulative abnormal returns

Figure 5 gives an overview of the performance of the firms of the sample up until one year after the IPO. The first-day return is disregarded in this performance. The overall performance after one year is negative (-8,7%) but a hugh difference is seen between the two samples. The cumulative abnormal return of non-PE backed firms becomes negative after one month (-0,7%) and this decreases to -12,8% after one year. For the PE-backed firms is seen that they do not generate excess returns in the first 6 months after the IPO. The return of PE-backed firms decreases from 0,9% after one month to 0,3% after six months and increases to 7,7% after one year. These results indicate that PE-backed IPOs clearly outperform non-PE backed IPOs in the period after the IPO.

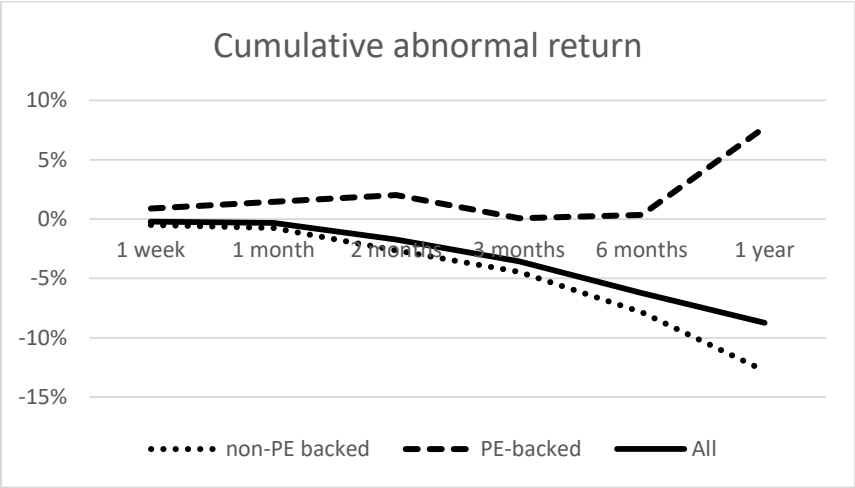

Figure 5: Cumulative abnormal return

Table 10 shows whether these results are significantly different from zero. The t-test for the CARs indicates that the returns becomes significant after three months and this continues to one year after the IPO. Therefore it is, based on the CAR method, possible to accept hypothesis 4 that there follows a negative correction after the IPO.

Table 10: T-tests for CAR periods

Variable	t-statistic
1 week CAR	-0,340
1 month CAR	-0,306
2 month CAR	-1,447
3 month CAR	-2,132**
6 month CAR	-2,595**
1 year CAR	-2,540**

Note: t-statistics and p-values are for the difference of the mean from zero. *, **, *** indicate significance at 10%, 5%, 1% level, respectively. Number of observations: 1 week CAR (N=199), 1 month CAR (N=198), 2 month CAR (N=199), 3 month CAR (N=199), 6 month CAR (N=199), 1 year CAR (N=193).

To test whether this outperformance is significant are the returns of the PE-backed and non-PE backed firms tested on their difference in mean. Table 11 report these results. The table shows that the average CAR becomes significantly different after one year on a level of 5%. This indicates that the returns of PE-backed firms one year after the IPO are significantly higher than the returns of non-PE backed firms. This makes it possible to generate excess returns after one year when you invest in PE-backed IPOs over non-PE-backed IPOs.

Table 11: Difference in mean tests for CAR periods

Variable	t-statistic (PE, non-PE)
1 week CAR	-0,829
1 month CAR	-0,450
2 month CAR	-0,745
3 month CAR	-1,303
6 month CAR	-1,355
1 year CAR	-2,396**

Note: t-statistics and p-values are for the difference in means between PE-backed and non-PE backed IPOs. *, **, *** indicate significance at 10%, 5%, 1% level, respectively. Number of observations: 1 week CAR (N=199), 1 month CAR (N=198), 2 month CAR (N=199), 3 month CAR (N=199), 6 month CAR (N=199), 1 year CAR (N=193)

5.3.2 Buy-and-hold abnormal returns

Figure 6 gives an overview of the performance based on BHAR. The figure shows a similar trend as the CAR with an outperformance of the PE-backed sample, although the overall performance is less extreme. The performance decreases from -0,02% after one week to -1,4% after one year. The PE-backed sample exhibits a jump from 1,4% after three months to 5,1% after six months to 18,0% after one year. The non-PE backed sample displays a trend from -0,2% after one week to -2,6% after six months to -6,1% after one year.

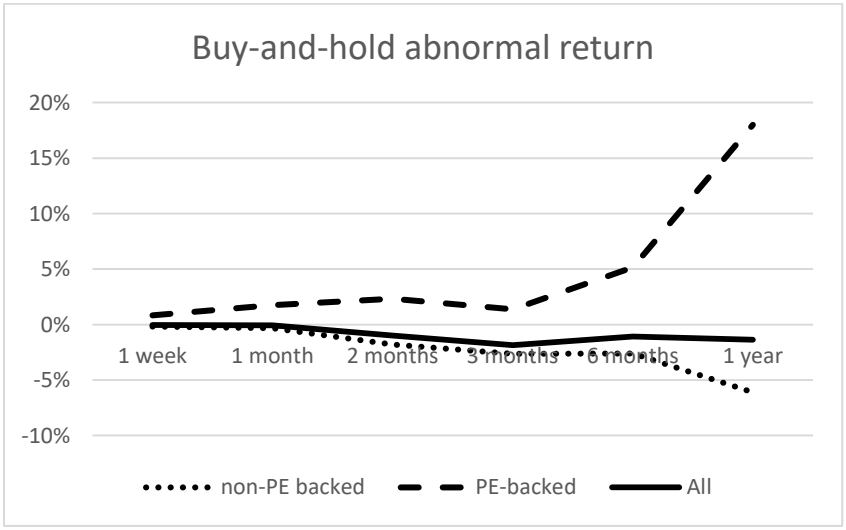

Figure 6: Buy-and-hold abnormal return

The average BHARs are less significantly different from zero than the CARs. Table 13 shows that none of the periods is significant different from zero, whereas this was the case from three months to one year for the CAR periods. Based on BHAR a negative correction after the IPO is not found and hypothesis 4 must be rejected.

Table 13: T-tests for BHAR periods

Variable	t-statistic
1 week BHAR	0,036
1 month BHAR	0,075
2 month BHAR	-0,790
3 month BHAR	-1,097
6 month BHAR	-0,421
1 year BHAR	-0,368

Note: t-statistics and p-values are for the difference of the mean from zero. *, **, *** indicate significance at 10%, 5%, 1% level, respectively. Number of observations: N=200.

Table 14 displays the difference in mean test for the BHAR periods. Just like in the CAR periods is seen that excess returns between the PE-backed and non-PE backed IPOs can be generated one year after the IPO. The t-statistic of -2,639 is significant at a level of 1% and indicates that the BHAR after one year is significant higher for PE-backed IPOs than non-PE backed IPOs.

Table 14: Difference in mean tests for BHAR periods

Variable	t-statistic (PE, non-PE)
1 week BHAR	-0,593
1 month BHAR	-0,965
2 month BHAR	-1,308
3 month BHAR	-0,945
6 month BHAR	-1,205
1 year BHAR	-2,638***

Note: t-statistics and p-values are for the difference in means between PE-backed and non-PE backed IPOs. *, **, *** indicate significance at 10%, 5%, 1% level, respectively. Number of observations: N=200.

6. Conclusion

This research examines the effect of the rising IPO market in Europe and shifting private equity market to the DACH region. With an average underpricing of 51,02% investors are able to profit from a subscription to an IPO. Based on the performed analysis, there is no proof of significant gains to be achieved from investing on the first trading day in a private equity backed IPO compared to a non-private equity backed IPO. Only in one of the models, the effect of this PE involvement is found significant. Examining the involvement of private equity gives the opportunity to re-examine some other previous stated explanations for underpricing. According to Gompers (1996) are venture-capital backed IPOs underpriced to "leave a good taste in the mouth" of investors. This research shows that this does not apply to PE-backed IPOs since PE-backed IPOs are less underpriced than non-PE backed IPOs. The certification hypothesis that the reputation of private equity firms should force lower underpricing could not statistically be determined, although the results show that it was the case in all three countries. This result changes for one model when the regression is controlled for outliers and collinearity problems. Therefore, does the outcome remain unclear and hypothesis 1 could not be rejected or supported.

The independent variables of the model could not explain this difference in underpricing. Neither the size of the firm, the age of the firm or the rank of the underwriter has a significant influence on the first-day return of PE-backed firms. The key results in the regressions are supported after controlling for outliers and potential collinearity problems. The ranking of the underwriter does have a significant positive effect in the first-day return when an extra factor is included in the model, but this is in an opposite direction than the common literature would suggest. The P/E ratio of a firm itself has a significant impact on the first-day return, but this is not different for PE-backed or non-PE backed firms.

The well-documented research to the long-term performance of IPOs demonstrate a negative return on the long-term for IPOs. This research shows that the negative performance starts from the first week after the IPO and continues to a period of one year. Using the CAR method, this negative performance after three months is significant from zero, whereas this is not the case for the BHAR method. A significant difference between PE-backed and non-PE backed IPOs is found one year after the IPO, which makes it possible to generate excess returns when you invest in PE-backed IPOs compared to non-PE backed IPOs.

7. Discussion

The research shows that there is no difference in the first-day return between PE-backed and non-PE backed IPOs for the DACH region. In the period after the IPO there is no difference as well between PE-backed and non-PE backed IPOs, there exists a dissimilarity in return only after one year. This indicates that there can't be achieved directly any gains from investing in PE-backed IPOs, but that PE-backed IPOs creates more value than non-PE backed IPOs after one year. Therefore, this research does not support the statements from Franz Müntefering (2005) and Chris Hughes (2019) of value destruction and worse performance in the aftermarket from PE-backed firms. The theoretical implication of this research implies that the size of the company, the age of the company or the rank of the underwriter does not have any effect on the level of underpricing and does not support differences between PE-backed and non-PE backed firms. The latter changes when the P/E ratio is included in the regression. UWrank becomes an explanatory variable for the first-day return of PE-backed firms.

An important limitation of this research are the uncovered industry effects in the regressions. The results are controlled for year- and country-fixed effects, but not for different industries. This is done because of the various aspects that could describe and influence an industry. It is hard to measure these differences among the firm characteristics and investigating all these aspects could take away the focus of the research. In addition, it is arguable that the industry effects should be covered, since the sample distribution across all industries is very low and this affects the influence of each industry. Another limitation is the use of an average market return for the various countries in the aftermarket results. The benchmark returns for the aftermarket CAR and BHAR results are based on the country-indices. An improvement for this research is to cover the return of the specific market in the corresponding country instead of the whole country-market return.

Because of the high explanatory power of the model is it not necessary to include other variables in the regression since this would affect the results with small samples. However, extending the term PE-backed gives the opportunity to develop the research to PE-backed IPOs. The literature part of this research subdivide private equity in various groups, of which venture capital and the leveraged buy-out were the most important. Due to data availability issues was it not possible to divide the PE-backed IPOs in LBO-backed IPOs and VC-backed IPOs. When this is feasible it might give some new insights in a possible difference in underpricing between LBO-backed, VC-backed and non-PE backed IPOs since earlier studies show different results. Levis (2011) found lower underpricing for PE-backed IPOs compared to VC-backed IPOs and non-sponsored IPOs in the UK, but also for VC-backed IPOs compared to non-sponsored IPOs. Mogilevsky & Murgulov (2012) also found that PE-backed IPOs exhibit lower

underpricing compared to VC-backed and non-sponsored IPOs, but they found higher underpricing for VC-backed IPOs compared to non-sponsored IPOs.

Another way to expand the literature about PE-backed IPOs is to investigate firms that went public, were subsequently taken private by a PE fund and went public again after several years. It may be interesting to check whether the underpricing differs from the 'first' IPO compared to the 'second' IPO and which factors might influence this potential difference. Clearly, this proposition requires empirical testing and is therefore an interesting case to consider in future IPO research. Future research might be interesting as well to investigate the impact of the Brexit troubles on the DACH region. Since this research runs until 2017 are these effects not captured yet. Future research might be affected by the Brexit.

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9. Appendix

Table 15: Breusch-Pagan and White's test for heteroscedasticity

Tests for heteroscedasticity			
Breusch-Pagan / Cook-Weisberg test		White's test	
Chi^2	0.59	Chi^2	68.94
P-value	0.443	P-value	0.254

Table 16: Shapiro-Wilk test for normal data

Normality test of residuals					
Shapiro-Wilk W test for normal data					
Variable	Obs.	W	V	z	P-value
Residual	161	0.989	1.303	0.603	0.273