Aalto University
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The role of buyout backing in the mitigation of IPO-related information asymmetries

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Abstract
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THE ROLE OF BUYOUT BACKING IN THE MITIGATION OF IPO-RELATED INFORMATION ASYMMETRIES

PURPOSE OF THE STUDY

The purpose of the study is to examine whether professional buyout investors are able to alleviate information asymmetries associated with initial public offerings (IPO). Based on the signaling theory, buyout backing can be viewed as a positive signal of the value and quality of an IPO. I use post-issue abnormal stock returns to measure the degree of information asymmetry related to an IPO. I investigate whether buyout-backed IPOs, in general, are associated with a lower degree of information asymmetry relative to non-buyout-backed offerings. In addition, I assess the factors that determine the ability of a buyout investor to alleviate IPO-related information asymmetries. More specifically, I examine how the reputation of the buyout investor and the duration of the value-adding buyout process are related to the degree of information asymmetry.

DATA

The sample used in the study consists of 449 buyout-backed IPOs and 3,875 non-buyout-backed IPOs issued in the US during 1990-2008. The data is obtained from SDC Platinum, Center for Research in Security Prices (CRSP) and Compustat.

RESULTS

I find no evidence of buyout investors, in general, being able to overcome information asymmetries related to IPOs. Although buyout-backed IPOs, as such, are associated with less extreme abnormal returns compared to the other IPOs in the sample, the difference appears to be explained by firm-specific factors that are characteristic to a leveraged buyout, namely firm size and age, industry, and leverage.

The results show that buyout investment duration is negatively associated with the level of post-IPO abnormal returns. The finding is in line with the argument that buyout duration signals the degree to which the financial sponsor has mitigated informational asymmetries and agency problems faced by the new owners in an IPO. Reputational differences among the buyout firms, on the other hand, appear to play no role in the mitigation of information asymmetries.

KEYWORDS

Leveraged buyouts, initial public offerings, information asymmetries, signaling theory

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THE ROLE OF BUYOUT BACKING IN THE MITIGATION OF IPO-RELATED INFORMATION ASYMMETRIES

TUTKIELMAN TAVOITTEET

Tutkimuksen tavoitteena on selventää pääomasijoittajien kykyä lieventää listautumisanteihin liittyvää informaatio asymmetriaa. Signalointi teorian perusteella pääomasijoittajan omistusta listattavassa yhtiössä voidaan pitää positiivisena signaalina listautumisannin arvosta ja laadusta. Käytän informaatio asymmetrian määrän mittaamisessa listautumisannin jälkeisiä epänormaaleja osaketuottoja. Tutkin liittyykö pääomasijoittajien listaamiin yhtiöihin yleisesti vähemmän informaatio asymmetrioita kuin muihin listautumisanteihin. Lisäksi tarkastelen tekijöitä, jotka määrittävät pääomasijoittajan kykyä lieventää informaatio asymmetrioita. Nämä tekijät ovat pääomasijoittajan maine sekä listautumisantia edeltävään pääomasijoitukseen liittyvä arvonluontiprosessi.

LÄHDEAINEISTO

Tutkimusaineisto koostuu Yhdysvalloissa vuosina 1990–2008 suoritetuista listautumisanneista. Aineistossa sisältää 449 pääomasijoittajan listaamaa yhtiötä ja 3,875 muuta listautumisantia. Tieto on peräisin SDC Platinum, Center for Research in Security Prices (CRSP) ja Compustat tietokannoista.

TULOKSET

Tulokset osoittavat, että pääomasijoittajat eivät yleisesti ottaen pysty lieventämään listautumisanteihin liittyvää informaatio asymmetriaa. Pääomasijoituskohteelle tyypilliset yrityskohtaiset tekijät selittävät pitkälti eroa pääomasijoittajien listaamien yhtiöiden ja muiden listautumisantien epänormaalien osaketuottojen välillä. Näihin tekijöihin kuuluvat yrityksen koko ja ikä, toimiala sekä velkaantuneisuus.

Listautumisantia edeltävän pääomasijoituksen kesto vaikuttaa negatiivisesti listautumisantia seuraavien epänormaalien tuottojen tasoon. Tulos tukee väitettä, jonka mukaan pääomasijoituksen kesto kuvastaa pääomasijoittajan vaikutusta informaatio asymmetrian sekä agentti ongelmien määrän listautumisannissa. Pääomasijoittajan maineella ei sen sijaan ole näyttäisi olevan merkitystä informaatio asymmetrioiden lieventämisessä.

AVAINSANAT

Pääomasijoitus, listautumisanti, asymmetrinen informaatio, signalointi teoria

Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

1.1 Background

Leveraged buyouts first emerged as an important phenomenon in the 1980s (Kaplan and Strömberg, 2009). In a typical leveraged buyout (LBO) transaction, a private equity (PE) firm acquires majority control of a mature firm through funds that it has raised from third party investors[1]. The private equity firm then actively monitors and develops the company before exiting its investment. During the past 30 years, the buyout industry has become an important source of capital for firms and a major player in the global M&A market. The total enterprise value of leveraged buyout transactions completed during 1970-2007 amounts to $3.6 trillion globally of which $1.6 trillion represents LBOs undertaken in 2005-2007 (Kaplan and Strömberg, 2009). In the peak years of the early twenty-first-century, buyout funds were responsible for approximately one-quarter of global M&A activity (Metrick and Yasuda, 2010a). Therefore, it is no wonder that the role of buyout investors has become a topic of considerable interest in the academic literature as well as in the business press.

Academics, investors and financial press all seem to have developed a keen interest on the performance of buyout-backed initial public offering. While academic literature generally views private equity backing as a sign of IPO quality and a factor that contributes to the mitigation of information asymmetries (e.g., Barry et al., 1990; Megginson and Weiss, 1991), the financial press tends to be a little more skeptic. News articles addressing the performance of buyout-backed IPOs regularly appear in the business press. For example, in September 2011, Dagens Industri published an article about the large variation in the performance of several such IPOs on the Stockholm Stock Exchange[2]. A year earlier, examples of extreme stock market performance of buyout-backed offerings were brought up by a Financial Times article[3]. Some critics claim that rather than creating value in the LBO restructuring process, buyout sponsors simply exploit favorable market conditions and time the market by buying low and selling high (Cao, 2011). A fairly recent case example of a buyout-backed IPO that turned out to be an unpleasant surprise for its investors is provided by Pandora, a Danish jewelry maker and the largest private equity-backed IPO in 2010 (raised $1.9bn).

[1] Leveraged buyout investment firms nowadays generally refer to themselves as private equity firms (Kaplan and Strömberg, 2009). However, as my thesis examines buyout-backed IPOs in the US market, I follow the definition of the National Venture Capital Association of the United States and use the term private equity as a hypernym for venture capital, buyout (LBO) and mezzanine investing (http://nvca.org)

[2] Dagens Industri: http://di.se/Artiklar/2011/8/31/243849/Riskkapitalets-daliga-noteringar.

[3] Financial Times: http://www.ft.com/intl/cms/s/0/479ab54c-d556-11df-8e86-00144feabdc0.html#axzz1jvroJSp5.

Pandora was taken public by a Danish buyout group Axcel in October 2010 and, only one year later, a single profit warning wiped out two-thirds of the company's market value.

On the other hand, majority of academic studies suggest that private equity backed IPOs generally fare better or at least as well as other IPOs and the market. Brav and Gompers (1997) find that venture capital-backed (VC) IPOs issued in the US in 1972-1992 outperform non-VC-backed IPOs over a five-year period when using equally-weighted returns. Bergström et al. (2006) provide similar results by examining the long-term stock price performance of buyout-backed IPOs listed on the London and Paris stock exchanges. In a more recent study, Cao and Lerner (2009) investigate the performance of reverse leverage buyouts (RLBOs) in the US market and find that RLBOs perform as well as or better than other IPOs and the stock market as a whole[4]. However, contrary results have also been presented in the academic literature. For instance, Audretsch and Lehmann (2002) find that the likelihood of firm survival decreases as the ownership share of venture capitalists increases. Rindermann (2004), on the other hand, finds no evidence of abnormal stock market performance being associated with VC-backed IPOs in Europe. Furthermore, other researchers argue that post-IPO long-term performance can be influenced by the quality of the private equity firm backing the IPO. For example, Tykvova and Walz (2007) find that IPOs backed by highly reputable VCs outperform other IPOs.

The growing importance of the buyout industry in the capital and M&A markets, the public debate concerning the performance of buyout-backed IPOs, and the ambiguous empirical results make buyout-backed offerings an interesting and timely topic to study. Could buyout firms actually be taking advantage of asymmetric information and push squeezed lemons to the public market? Or are the examples brought up by the critics and the media merely marginal cases of extreme stock market performance? My thesis addresses these questions by examining the role of buyout backing in the mitigation of information asymmetries related to initial public offerings.

1.2 Research question and objectives

The research question of my thesis is to investigate whether professional buyout investors are able to reduce the degree of information asymmetry associated with initial public offering. Academic literature suggests that initial public offerings are characterized by asymmetric information between corporate insiders and public investors (e.g., Allen and Faulhaber, 1989; Megginson and Weiss, 1991; Brau et al., 2005). As a means of alleviating the problem of asymmetric information, the

[4] Reverse leveraged buyouts are initial public offerings of firms that had previously been taken private in a leveraged buyout transaction.

concept of signaling has been proposed in the literature (Brau and Stanley, 2006). The signaling theory states that information asymmetries can be mitigated by the insiders revealing a relevant piece of information to the other party in the form of a specific signal. In this context, buyout backing can be viewed as a positive signal of the value and quality of an IPO. The objective of my thesis is to provide insights into the role of buyout backing in the mitigation of IPO-related information asymmetries by investigating the post-IPO stock market performance of buyout-backed IPOs issued in the US in 1990-2008.

As the first step in achieving the research objective, I examine the general impact of buyout backing on the degree of information asymmetry related to an IPO. The motivation for the role of buyout backing in the mitigation of informational asymmetries is based equally on reputational concerns (e.g., Megginson and Weiss, 1991; Neus and Walz, 2005) and the characteristics of the LBO model (see Barry et al. 1990; Espenlaub et al., 1999). More precisely, I predict that through their reputation, the pre-LBO screening of companies and the value-adding LBO process, buyout specialists are able to certify the value of the IPO and the quality of the information disclosed by the company at flotation[5]. This, on the other hand, leads to buyout-backed IPOs being priced closer to their intrinsic value compared to non-buyout-backed offerings, an assumption that is consistent with the hypothesis of reputational certification proposed by Megginson and Weiss (1991)). As a consequence, I expect buyout-backed IPOs to be associated with less extreme post-IPO abnormal returns, i.e. abnormal return surprises, relative to other IPOs.

As the second step in assessing the role of buyout backing in the mitigation of IPO-related information asymmetries, I focus on examining the factors that determine the ability of a buyout sponsor to alleviate information asymmetries. More precisely, I investigate the effect of buyout firm's reputation and the value-adding LBO process on the degree information asymmetry related to an IPO. Previous literature suggests that differences in the perceived level of reputation determine the extent to which a given private equity investor is able to mitigate information asymmetries (e.g., Gompers, 1996; Jelic et al., 2005; Tykvova and Walz 2007). More reputable buyout sponsors are expected to be more efficient in reducing information asymmetries because investors acknowledge that they have more reputational capital at stake. Regarding the impact of the value-adding LBO process, I follow the logic of Cumming and MacIntosh (2001) who argue that venture capital investment duration signals the degree to which the venture capitalist has mitigated informational asymmetries and agency problems faced by the new owners in an IPO.

[5] The value-adding process refers to the changes that the buyout firm implements in the portfolio company during the LBO investment period. A detailed description of the process is provided in subchapter 2.2.

Consequently, a buyout-backed IPO with a longer LBO holding period should be associated with lower information asymmetry and a lower degree of valuation risk.

1.3 Contribution of the study

Given the increasing presence of buyout firms in the M&A market and the controversy surrounding the performance of buyout-backed initial public offerings; I find it both interesting and important to investigate the effect of buyout backing on the performance of a newly listed firm. My thesis addresses both the ambiguous empirical findings presented in the previous literature as well as the general concerns raised about the performance of buyout-backed initial public offerings. The topic of my thesis is closely related to research on the certification role of private equity firms and studies on the long-term stock price performance of private equity-backed IPOs. The main contribution of my study is based on the use of a novel approach to assess the effect of buyout backing on the degree of IPO-related information asymmetry. In addition, as majority of previous research on private equity-backed IPOs focuses on the implications of venture capitalist backing, my thesis contributes by extending the literature on the role of buyout investors in initial public offerings.

Literature on the certification role of private equity sponsors has traditionally focused on the relation between PE backing and IPO underpricing. The certification hypothesis predicts that private equity investors are able to use their reputational capital to reduce the information asymmetries related to the value and quality of securities issued by relatively unknown firms in capital markets (Megginson and Weiss, 1991). In an early study, Megginson and Weiss (1991) find a negative relation between first-day returns and venture capital backing. The finding is attributed to venture capitalists ability to certify the offering which allows companies to reduce underpricing, a more costly way of signaling IPO quality to potential investors. More recent studies, however, observe a reversal in the relation between underpricing and VC backing in the 1990s. For example, Franzke (2004) finds that German VC-backed IPOs appear to be more underpriced than their non-VC-backed counterparts.

Numerous explanations have been proposed for the reversal phenomenon in the academic literature (e.g., Lee and Wahal, 2004; Loughran and Ritter, 2004)[6]. The multitude of competing explanations and the fact that underpricing itself remains an anomaly in the finance literature imply that focusing on the initial returns might not be a suitable approach for studying the impact private equity backing

[6] Loughran and Ritter (2004) present three non-mutually exclusive explanations for the phenomenon: the changing risk composition hypothesis, the realignment of incentives hypothesis, and the changing issuer objective function hypothesis. Lee and Wahal (2004), on the other hand, argue that the effect is explained by the grandstanding hypothesis proposed by Gompers (1996).

on the information asymmetries related to an IPO. Furthermore, it seems unreasonable to assume that information asymmetry would subside immediately after the offering so that already the first day's closing price would reflect the intrinsic value of the company. For example, Purnanandam and Swaminathan (2004), Derrien (2005) and Ljungqvist et al. (2006) show that, due to investor sentiment, IPO shares can be overpriced relative to their long-run intrinsic value and still exhibit positive initial returns. In an unpublished working paper, Chemmanur and Loutskina (2007) arrive at the same conclusion of underpricing not being the most appropriate measure to evaluate the role of private equity backing. Accordingly, my approach is to examine a buyout sponsor's ability to alleviate IPO-related information asymmetries by observing post-IPO abnormal stock market performance over a longer horizon. The assumption is that true quality and intrinsic value of an IPO is gradually revealed to the market as more information about the newly listed company becomes available.

Prior studies on the impact of private equity backing on the long-run performance of IPOs provide mixed results. Researchers have presented evidence of PE-backed IPOs being associated with positive abnormal performance (e.g., Brav and Gompers, 1997; Bergström et al., 2006) as well as negative abnormal performance (e.g., Audretsch and Lehmann, 2002; Bruton et al., 2010). Some studies, on the other hand, find PE-backed IPOs to be no different from any other newly listed companies in terms of post-IPO performance (e.g., Rindermann, 2004; Jelic et al., 2005). The typical approach in these long-term performance studies is to examine if PE-backed IPOs are associated with either superior or inferior stock market performance relative to a selected benchmark. In my thesis, I adopt a different approach by examining the level of abnormal returns, both positive and negative, associated with buyout-backed IPOs. Accordingly, my approach acknowledges that information asymmetries can lead to either under- or overvaluation of an IPO relative to its intrinsic value. The degree of information asymmetry related to an IPO is reflected by the magnitude of post-IPO abnormal returns relative to the other offerings in the sample.

As previously discussed, I expect professional buyout sponsors to alleviate IPO-related information asymmetries by certifying the value of the offering and the quality of the information disclosed in the prospectus. Consequently, buyout-backed IPOs are priced closer to their intrinsic value which, in turn, leads to less extreme post-issue abnormal returns compared to non-buyout-backed offerings. The approach used in my thesis follows the logic of the theoretical model developed by Neus and Walz (2005) in which VCs with high reputation are able to exit at prices that reflect the intrinsic value of the company. Accordingly, the authors predict that in the aftermath of a VC-backed IPO, there will be less adjustment towards the "true" market price, thus leading to lower post-IPO firm-

specific volatility of returns relative to non-VC-backed IPOs. While Neus and Walz (2005) base their model solely on reputational certification, I also acknowledge the potential role of the LBO process in the mitigation of information asymmetries (see Barry et al. 1990; Espenlaub et al., 1999).

In the course of the literature review, I found only one empirical study that adopts an approach similar to my thesis. In this article, Tykvova and Walz (2007) investigate the performance of venture capital-backed IPOs in the German Neuer Markt. In addition to examining the typical one-sided relation between VC backing and post-IPO abnormal stock returns, the authors test the prediction of the model presented by Neus and Walz (2005) and assess the impact of VC backing on the volatility of firm-specific abnormal returns. Tykvova and Walz (2007) use a dummy variable to capture the general effect of VC backing and show that the participation of a venture capitalist decreases the abnormal idiosyncratic volatility of an IPO in the two-year post-IPO period. The authors attribute the finding to the ability of venture capitalists' to overcome IPO-related information asymmetries. Although this approach is similar to mine, there are some important differences between my thesis and the article concerned. First of all, the authors examine venture capital-backed IPOs while my focus is on buyout-backed IPOs. Secondly, the German venture capital and IPO markets are much younger than their US counterparts. And finally, the abnormal return volatility of an individual stock is potentially a noisier measure of information asymmetry than the level of post-IPO abnormal return as such. While both measures are equally subject to the challenges of estimating abnormal returns, volatility could be partly driven by differences in the liquidity of the IPO shares.

The literature review also reveals that majority of existing research on private equity backing and the performance of IPOs is focused on the role of venture capitalists instead of buyout firms. This has also been noticed by other researchers (e.g., Bruton et al. 2010). Furthermore, studies that employ US data seem to concentrate on reverse leveraged buyouts which is only a subgroup of leveraged buyout transactions (e.g., Holthausen and Larcker, 1996; Cao and Lerner, 2009). Therefore, in addition to adopting a novel approach to the topic, my thesis contributes to previous literature by extending the research on buyout-backed IPOs in the US market.

1.4 Main results and limitations of the study

I find no evidence of buyout investors, in general, being able to alleviate the problem of asymmetric information related to initial public offerings. The results are robust to three different approaches used in estimating abnormal returns, namely the market-adjusted model, the control firm method and the Fama-French-Carhart four-factor model. In addition, the choice of method used for

calculating abnormal returns does not affect my results[7]. Furthermore, the finding remains robust in a test based on alternative methodology. A direct comparison of my results with the findings presented in prior studies is complicated by the novel approach used in my thesis. However, my finding can be considered analogous to studies that find no significant negative or positive relation between PE backing and post-IPO abnormal returns (e.g., Holthausen and Larcker, 1996; Rindermann, 2004; Jelic et al., 2005; Cao, 2011).

Regarding the impact of LBO duration, I find evidence of buyout-backed IPOs with longer LBO duration being associated with less extreme post-IPO abnormal returns. The results provide support for the argument that the value-adding LBO process has an impact on the degree of information asymmetry related to an IPO. The finding is in line with Cao and Lerner (2009) and Cao (2011) who show that reverse leveraged buyouts with shorter LBO duration experience greater deterioration of operating performance and slight underperformance in the stock market compared to RLBOs with a longer LBO duration. According to the authors, these offerings are also associated with a higher probability of bankruptcy.

Finally, the empirical tests conducted in my thesis show no evidence of buyout firm reputation being associated with the degree of information asymmetry related to an IPO. The finding is in line with Cao and Lerner (2009) and Levis (2011) who find no significant relation between buyout firm's reputation and post-IPO stock price performance. The result, however, appears to contradict Tykvova and Walz (2007) who provide weak evidence of high VC reputation being associated with lower post-IPO abnormal return volatility. The effect reported in their article is more pronounced for a subset of independent venture capitalists[8]. Possible explanations for the seemingly opposite findings derive from methodological choices and differences in data. These are discussed in detail in the analysis of the results in chapter 7.

The main limitations of my thesis relate to methodological issues and the data used in the empirical tests. The greatest challenge of all studies examining long-term abnormal stock price performance is that the results are sensitive to the choice of methodology (Ritter and Welch, 2002). To mitigate this problem, I use different specifications in estimating long-term abnormal returns. A detailed description of the approaches used in my thesis is provided in chapter 6. Furthermore, extensive data requirements result in the exclusion of a significant proportion of IPOs from the final sample.

[7] In my thesis, I apply two methods of calculating abnormal returns that are widely used in long-term event studies: buy-and-hold abnormal returns (BHAR) and cumulative abnormal returns (CAR).

[8] Independent venture capitalist refers to a stand-alone venture capital firm that is not part of another institution such as a bank or a corporation.

This could subject the empirical results to selection and/or survivorship bias. There also appear to be some quality issues regarding the data extracted from the Securities Data Company (SDC) database which is the primary source of IPO data used in my thesis. The mitigation of the problem is discussed in chapter 5.

1.5 Structure of the study

The remainder of the thesis is organized as follows. Chapter 2 provides an introduction to the private equity model and an overview of the US buyout industry. Chapter 3 discusses related literature and presents some of the key findings in previous studies. Chapter 4 presents and motivates the testable hypotheses. Chapter 5 describes the data collection process and the main characteristics of the sample. Chapter 6 presents the methodology used in testing the hypotheses. Chapter 7 reports and analyses the empirical results. The final chapter provides a conclusion of the study and suggestions for future research.

2 PRIVATE EQUITY INDUSTRY

The following chapter provides an introduction to the private equity model and the buyout industry. Subchapter 2.1 defines the key concepts of private equity and subchapter 2.2 describes the private equity model. Subchapter 2.3 provides a brief overview of the characteristics and development of the US buyout industry.

2.1 Definition of private equity

Private equity refers to medium to long-term equity or equity-related investments in non-public companies[9]. Private equity investments are characterized by low liquidity and low transparency. According to the US definition, the term private equity encompasses venture capital, buyout (LBO) and mezzanine investing. Based on an estimate by TheCityUK, private equity funds managed globally approximately $2.5 trillion of capital in 2010[10]. According to Metrick and Yasuda (2010b) one half to two-thirds of the capital is managed by buyout funds, where leverage can multiply the investment size by three or four times base capital.

Venture capital is a segment of the private equity industry which focuses on investing in new companies characterized by high growth potential and high risk. Venture capitalists typically do not

[9] Here, non-public refers to the state of the company after the private equity investment. A publicly listed company can also be target to an LBO in which case the company is taken private. This is known as a public-to-private transaction.
[10] TheCityUK: http://www.thecityuk.com/research/our-work/reports-list/private-equity-2011

obtain majority control in their investments (Kaplan and Strömberg, 2009). Venture capital investments can be classified into separate stages based on the development phase of the portfolio company: seed, early, expansion and late[11]. Seed-stage financing is provided to an entrepreneur to prove a business concept. This stage typically involves market research, product development, building a management team and developing a business plan. In the following early stage, financing is provided to companies near the commercial launch of a product or companies that have already started conducting business. Expansion-stage companies may already be profitable and require investments to finance working capital. Later-stage financing is provided to companies that have reached a fairly stable growth rate and generate a positive cash flow. According to the National Venture Capital Association, early, expansion and later stage investments each accounted for approximately 30% of total venture capital investments in the US in 2011[12].

Buyout (or LBO), the focus of my thesis, refers to a sector of the private equity industry which invests in mature firms or business units with relatively steady cash flows. A buyout fund typically acquires majority control of a company in a deal that is characterized by extensive use of debt relative to equity in financing the transaction. Another key difference that distinguishes buyout investing from venture capital is that buyout sponsors aim to create value by improving operations and governance of the portfolio company rather than by commercializing and growing new business concepts. Different types of leveraged buyouts include institutional buyouts (IBO) in which outside investors (i.e. the buyout fund) acquires a business from existing shareholders, management buyouts (MBO) in which the company is bought in partnership with the current management and management buy-ins (MBI) in which an outside management team invests with the buyout sponsor. Furthermore, segmentation could also be made between buyouts of distressed companies and other LBOs (Metrick and Yasuda, 2010b). However, any detailed classification of buyout deals is unnecessary for my thesis and, therefore, the term buyout simply refers to all transactions with buyout sponsor involvement.

Mezzanine financing refers to financial structures that include features of both debt and equity. Mezzanine instruments, such as subordinated debt and preferred equity, have intermediate priority in the capital structure of a company. In other words, they are senior to common equity but junior to debt claims. Mezzanine instruments have no voting rights and typically generate a fixed payoff that is higher compared to debt. They can also be convertible into common equity based on pre-determined terms. Mezzanine financing is used in both later-stage venture capital and leveraged

[11] NVCA Yearbook 2011: http://www.nvca.org/index.php?option=com_content&view=article&id=137&Itemid=216
[12] NVCA: http://www.nvca.org/index.php?option=com_content&view=article&id=344&Itemid=103

buyouts (Metrick and Yasuda, 2010b). In the context of buyouts, mezzanine instruments enable fine-tuning of the risk assumed by the equity investors, namely the buyout fund.

2.2 Private equity model

The following subchapter provides a detailed description of the buyout model. Section 2.2.1 presents the organization and characteristics of a private equity firm and a buyout fund. Section 2.2.2 explains the investment and value-adding process and section 2.2.3 describes the exit phase of a leveraged buyout. The compensation structure of a buyout firm is discussed in section 2.2.4.

2.2.1 Structure of a private equity firm

The key characteristics of the private equity model are described in the following list (Metrick and Yasuda, 2010b):

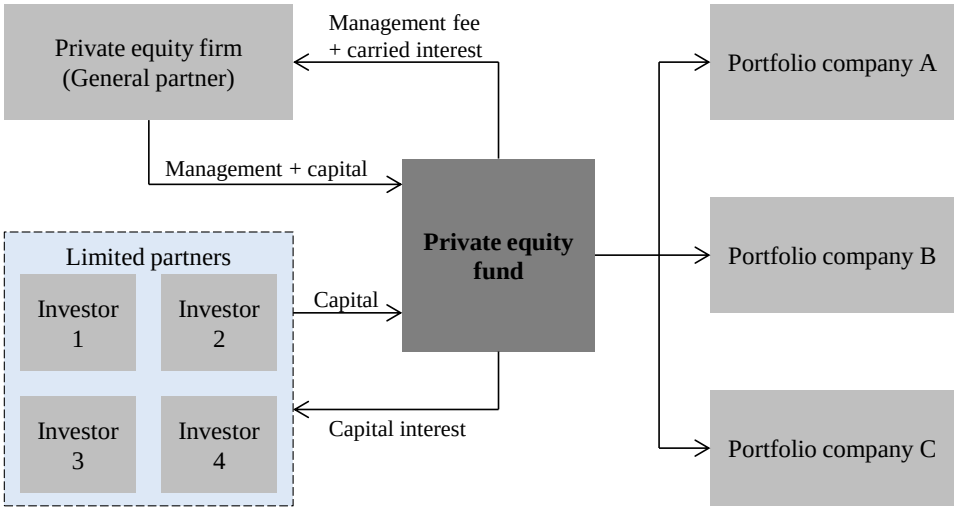
1. Private equity firms are financial intermediaries that establish investment funds which raise capital from investors and make direct investments in businesses (known as portfolio companies after the investment).
2. Portfolio companies are private companies, that is, they are not traded on a stock exchange.
3. Private equity firm takes an active role in the strategic management and monitoring of the companies in its portfolio.
4. A private equity fund's primary goal is to maximize its financial return by exiting investments through a sale or an initial public offering.

Private equity firm is an investment management company that is typically organized as a partnership or limited liability corporation (Kaplan and Strömberg, 2009). Private equity investing begins with the PE firm establishing a fund with a target amount of capital to be raised from investors that largely consist of institutions, such as pension funds or insurance companies, and wealthy individuals (Kaplan and Schoar, 2005). The fund-raising process usually takes up to one year. Successful private equity firms raise multiple follow-on funds over time with often the same investors participating in the new funds (Sahlman, 1990).

Private equity fund is a closed-end investment fund that is legally structured as a limited partnership in which the PE firm serves as a general partner (GP) that manages the fund and the investors act as limited partners (LP) that provide most of the capital. It is customary for the general partner to provide at least one percent of the total capital in the fund. The limited partners have little say in how the general partner invests the funds, as long as the covenants of the fund agreement are

followed. Common covenants include restrictions on how much capital can be invested in a single company and how much debt can be taken at the fund level. Amount of debt at the portfolio company level is unrestricted. (Kaplan and Strömberg, 2009.) Figure 1 is an illustration of the typical structure of a private equity fund.

Figure 1: Typical structure of a private equity fund



After a successful fund-raising process, the private equity fund has a finite lifetime of typically 10 years with a possible extension of up to 3 years (Phalippou and Gottschalg 2009). Depending on the fund agreement, the decision to extend a fund's lifetime is either left to the general partner alone or requires some level of consent from the limited partners. Due to the closed-end nature of the fund, withdrawal from the partnership before the termination date is prohibited and the transfer of limited partnership units is restricted. (Sahlman, 1990.)

2.2.2 Investment process and value creation

The lifetime of a buyout fund can be divided into two phases: investment phase and value creation phase. During the first phase, the general partner looks for investment opportunities. Once a suitable target is identified and the deal is negotiated, the fund issues a capital call requiring a partial payment of the capital committed by the limited partners. The year that a private equity fund stops accepting new investors and begins to make investments is called the vintage year. The investment phase of a venture capital or a buyout fund usually takes from five to six years during which an average US fund invests 90% to 95% of the committed capital (Ljungqvist and Richardson, 2003; Phalippou, 2009).

In a buyout transaction, the private equity firm usually forms a new holding company to bid for a controlling stake in an existing company. The buyout firm then negotiates debt financing, which is raised by the holding company if the acquisition goes through. The debt is backed by the target firm's assets. A basic debt structure of an LBO consists of a combination of senior debt with different tranches, subordinated debt and mezzanine debt. The debt structure might also include a component of contingent debt such as a revolving credit facility. The debt is used together with the equity capital raised by the buyout fund to finance the acquisition of the target company. (Axelson et al., 2010.) According to Kaplan and Strömberg (2009), an LBO is typically financed with 60% to 90% debt. In addition to the buyout fund, other equity investors in an LBO possibly include the management team of the target company (Kaplan and Strömberg, 2009) or other PE funds (Officer et al., 2010).

Based on a sample of 54 US buyout funds in 1981-1993, Ljungqvist and Richardson (2003) report a mean of 16.1 and a median of 13 portfolio companies per fund (corresponding figures for venture capital funds were 37.3 and 32, respectively). LBO firms require substantial borrowing capacity and, therefore, typical targets are mature businesses that operate in rather stable industries and generate a steady cash flow (Sahlman, 1990; Groh and Gottschalg, 2007). According to Groh and Gottschalg (2011), the average debt-to-equity ratio for US buyouts is 2.94 at closing and 1.28 at exit. Median leverage ratios are 2.49 and 0.64, respectively.

The second phase consists of adding value to the portfolio company. Kaplan and Strömberg (2009) identify three sources of value creation which they categorize as financial, governance, and operational engineering. Financial engineering refers to the use of leverage which can increase the value of a company in two ways. Firstly, increasing leverage reduces the cost of capital due to the tax deductibility of interest payments. Secondly, Jensen (1989) argues that high leverage reduces agency problems between the owners and the management because there is no free cash flow to be wasted. Governance engineering includes setting up a carefully designed management incentive scheme and exercising active ownership to minimize agency costs. Active ownership includes serving in the portfolio company's board and making changes to the management team. Operational engineering involves value creation through strategic changes, cost-cutting, productivity improvements and acquisitions. In addition to operating knowledge, operational engineering requires industry expertise which is why most top private equity firms are nowadays organized around industries.

2.2.3 Exit channels

Liquidation of a portfolio company, known as an exit, is an important part of the private equity process. First of all, the PE fund has a limited contractual lifetime during which it needs to return the capital invested by the limited partners. Even more importantly, a successful exit maximizes the financial return on an LBO and, therefore, is crucial for the overall performance of a PE fund (Metrick and Yasuda, 2010b; Phalippou and Gottschalg, 2009). Finally, the compensation of the general partner is also dependent on the exit timing and proceeds.

Based on a large international sample of leveraged buyouts, Kaplan and Strömberg (2009) report a median holding period of approximately six years for a portfolio company. However, they observe notable variation over time and, for example, the median holding period for deals completed after the early 1990s is less than five years. In another paper, Phalippou (2009) finds that 6 % of LBOs are liquidated already within one year from the investment, 23 % within two and 44 % within three years. For venture capital investments, Sahlman (1990) documents an average holding period of five years.

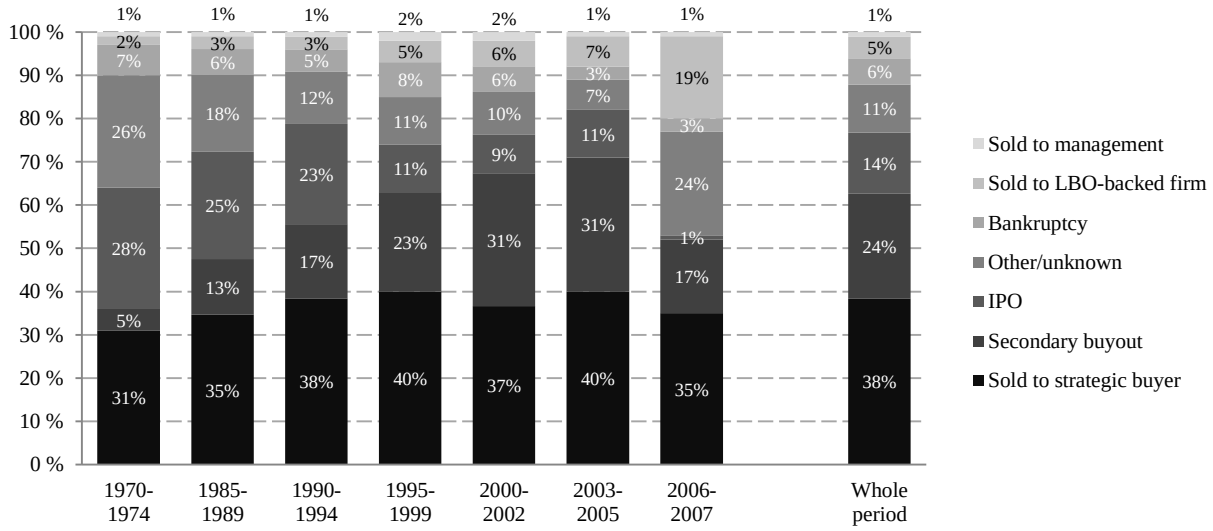
A private equity fund has five principle routes to exit from its investments: an initial public offering (IPO) in which the company is sold in the public market, a trade sale in which the entire firm is acquired by another company, a secondary buyout by a financial sponsor, a buyback in which the management team buys the PE fund's share and a write-off in which case the portfolio company is considered bankrupt. Kaplan and Strömberg (2009) report the split between alternative exit channels for a worldwide sample of 17,171 leverage buyouts from 1970 to 2007. Their results are presented in Figure 2. The most common exit route for an LBO backed by a financial sponsor is the sale of the company to a strategic buyer which accounts for 38% of all exits during the whole sample period. The bankruptcy rate of 6% seems surprisingly low given the high debt levels in LBO transactions. However, the authors note that all bankruptcies are not necessarily reported publicly and some cases may also be hidden in the "unknown" exits category. A higher incidence of bankruptcies is suggested by Andrade and Kaplan (1998) who find that 23% of large public-to-private LBOs in the 1980s defaulted on their debt payments.

Although only 14% of LBOs, on average, are exited through an initial public offering, Gompers and Lerner (2001) argue that taking a company public typically offers the most profitable exit route. In an IPO exit, the buyout sponsor typically sells only a small fraction of its shares in the offering and completes the exit in the months or years following the IPO. Although cashing out immediately would allow the PE fund to more quickly pay its investors and establish a track record, there is a

good reason for deferring a full exit. Selling insider shares or selling a large portion of the firm in the IPO sends a negative signal to the public market investors regarding the quality of the offering (Leland and Pyle, 1977). Consequently, such actions could affect the issue price or even cause the entire offering to fail. In order to signal IPO quality and align the interest of insiders and new investors, IPOs usually have a lockup period during which the insiders are prohibited from selling their shares.

Figure 2: Relative shares of LBO exit channels

The graph presents the relative shares (%) of different exit routes for 17,171 international leveraged buyout transactions during 1/1/1970 and 30/6/2007. The percentage shares are based on the number of transactions. The data is taken from Kaplan and Strömberg (2009) who collected the exit information from various sources including CapitalIQ, SDC, Worldscope and Amadeus databases.



Once the lockup period has expired, the private equity fund can liquidate its position either by selling the shares in the market and distributing the proceeds to its investors, or by distributing the shares to the limited and general partners of the fund (known as distribution in kind). Gompers and Lerner (1998) present several reasons why share distributions are used frequently by US private equity funds. First of all, the rules of the Securities and Exchange Commission (SEC) restrict sales by corporate insiders due to which it may take longer than the PE fund's remaining lifetime to complete the exit. The issue can be overcome by distributing the shares to the limited partners who usually are not considered insiders. Secondly, distributing the shares enables tax planning by the fund's partners who might prefer to postpone their sales.

Further motivation for selecting a distribution in kind derives from the possibility that selling the shares directly might have a more negative immediate price effect compared to distributing the

shares. Due to the method used in computing a PE fund's return, an immediate price drop would make the fund's performance look bad on paper. Finally, the general partner's compensation can also be affected by the distribution policy. If the fund has not returned committed capital to its limited partners, the shares are usually distributed in proportion to the partners' capital commitments (typically 1 percent for the GPs). By distributing overvalued shares prior to the return of committed capital, the general partners could collect a larger share of the profits. Even if the committed capital was already returned, the GPs still have an incentive to distribute the shares because they may be able to sell their portions at a high valuation before the limited partners receive their shares and the market notices that a distribution has occurred.

2.2.4 Compensation of the general partner

The compensation scheme of the general partner of a PE fund has a fixed and a variable component. An annual management fee forms the fixed part of the GP's compensation while the variable component consists of carried interest and portfolio company fees. Based on a sample of 144 US buyout funds, Metrick and Yasuda (2010a) find that fixed compensation accounts for roughly two-thirds of general partners' expected revenue[13]. Furthermore, Phalippou (2009) notes that the limited partners may in some instances incur extra fees and costs. For example, the fund might keep cash proceeds for up to three months before distribution and the limited partners might face penalty payments for selling their stakes or missing a capital call.

Regarding the fixed management fee, Metrick and Yasuda (2010a) describe four common methods that private equity funds use in assessing their compensation. Historically, the most common method was to define the fee as a constant percentage of committed capital. A typical 2% annual management fee would thus amount to a total of 20% of committed capital over the life of a ten-year fund, leaving only 80% as investment capital. A second approach, adopted by many funds in the recent years, is the decreasing fee schedule in which the percentage falls after the five year investment period. A third alternative is to use a constant fee rate but change the basis for this rate from committed capital to net invested capital after five years. The final approach is a combination of a decreasing percentage and a change from committed capital to net invested capital after the investment period. Based on a sample of 144 US buyout funds raised in 1993-2006, Metrick and Yasuda (2010a) report that 84% of buyout funds switch to invested capital basis, 45% lower their

[13] In the study by Metrick and Yasuda (2010a), fixed compensation also includes transaction fees as these are not based on performance. However, management fees account for the bulk of fixed compensation.

fee level, and 39% do both. The median level of lifetime fees is 12% percent of committed capital for buyout funds.

Carried interest is a performance based component of GP compensation that refers to the split of proceeds between the general partner and the limited partners (Phalippou, 2009). It is typically the most significant source of variable income for successful private equity fund managers. Metrick and Yasuda (2010a) distinguish four concepts that define the carried interest: carry level, carry basis, carry hurdle, and carry timing. Carry level is the percentage of profits that the general partner is entitled to. The industry standard for buyout funds is a 20/80 profit split between the GP and the LPs, respectively. The calculation of the profits is determined by the remaining three concepts. Carry basis refers to the standard by which profits are measured. In the sample of Metrick and Yasuda (2010a), 83% of the buyout funds use committed capital as the carry basis while the rest employ investment capital. Carry hurdle refers to a pre-determined threshold return that the GP must provide to LPs before collecting any carried interest (typically 8%)[14]. Finally, carry timing refers to the rules that govern the timing of carried interest distributions. Although these rules vary greatly between funds, carry timing usually allows for an early collection of carried interest upon profitable exits. In case of an early carry, the LPs typically have the right to recover all or some of these distributions if later fund performance is insufficient.

The second variable component of GP compensation is the portfolio company fee which is taken directly out of the portfolio companies. According to Phalippou (2009) typical portfolio company fees include transaction fees, accountant and counsel expenses as well as advisory and monitoring fees. Every time a buyout fund sells or buys a portfolio company, it charges a transaction fee similar to an M&A advisory fee (Metrick and Yasuda, 2010a). The fee is often shared between the general partner and the limited partners. In addition, buyout funds often charge a monitoring fee from their portfolio companies to compensate for time and efforts spent in working with the companies. According to Metrick and Yasuda (2010a), monitoring fees typically range from 1% to 5% of EBITDA, and are usually divided 80/20 between the LPs and the GPs, respectively.

2.3 Characteristics and development of the US buyout industry

Buyout funds first emerged in the US in the early 1980s. Over the past thirty years, the amount of dollars committed each year to US buyout funds has increased exponentially from $0.2 billion in

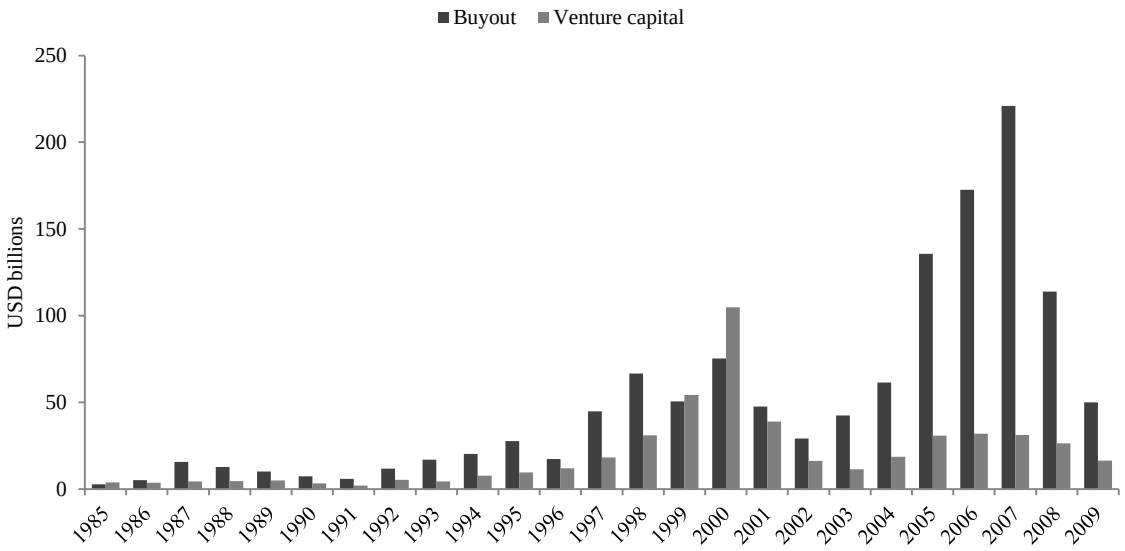
[14] The fund agreement might also include a catch-up clause. In case there is a 100% catch-up, the GP gets to collect all of profits beyond the hurdle rate and before reaching the overall carry level. Once the carry level is reached, further profits are distributed according to the carry level split.

1980 to over $200 billion in 2007. While buyout activity in the 1980s was dominated by US deals, the model quickly spread to Western Europe. In the early 2000s, Western European market already accounted for 48.9% of worldwide LBO transaction value, compared with the 43.7% share of the US market. Meanwhile, the operations of buyout firms have become global in scope as the number and size of foreign investment have increased. (Kaplan and Strömberg, 2009.)

The massive growth in the buyout industry has not been steady over the years. Indeed, the industry is characterized by strong cyclicality in terms of fundraising and deal activity. Figure 3 presents the development of private equity fundraising in the US during 1985-2009. The cyclicality of the buyout industry is closely related to the availability of debt financing. Axelson et al. (2010) find that macro-economic conditions affect both leverage and pricing of buyouts in a highly pro-cyclical manner. In other words, favorable debt market conditions lead to more LBOs, greater use of leverage and higher valuations.

Figure 3: Capital commitments to US private equity funds

The graph presents annual fundraising by US private equity industry during 1985 and 2009. The figures represent capital commitments by limited partners, and are reported separately for buyout and venture capital funds. The data is obtained from SDC Platinum's Venture Xpert database.



The cyclicality of the private equity industry also has implications for the performance of PE funds. Kaplan and Schoar (2005) show that funds launched during a boom underperform funds started in downturns. This underperformance may result from increased financial risk caused by greater use of leverage and intensified competition over good deals which pushes entry multiples higher and weakens the prospects for profitable exits. With capital inflows to private equity funds increasing

and the number of good deals in an economy being limited, there is basically too much capital chasing too few deals (Gompers and Lerner, 2000). Furthermore, Axelson et al. (2009) argue that the overabundance of capital relative to the number of good deals leads to a deterioration in buyout investment quality during a boom period.

Looking at the PE industry at the fund level, Metrick and Yasuda (2010a) find that the average size of a US buyout fund was $492 million while the median size amounted to $175 million during 1993-2005. In US venture capital, the average and median fund sizes were $126 million and $50 million, respectively. The large discrepancy between the mean and the median shows that fund size distribution is highly skewed in the private equity industry. According to Metrick and Yasuda (2010a), the top 10% of the largest buyout funds in the same sample account for approximately 55% of the total dollar amounts raised while the bottom 50% of the smallest funds account for only 7.2% of the total capital commitments.

3 LITERATURE REVIEW

The topic of my thesis is related to literature on the performance initial public offerings and, in particular, research on the implications of private equity involvement. The following chapter provides a review of relevant literature and presents some of the key findings of previous studies. As noted in the introduction of my thesis, majority of existing research on private equity-backed IPOs is focused on the role of venture capitalists instead of buyout investors. This is also reflected in the literature review of my thesis. Subchapter 3.1 discusses the role of asymmetric information in the context of initial public offerings. Subchapter 3.2 covers research on the certification role of underwriters and private equity firms. Subchapter 3.3 addresses literature on IPO underpricing and subchapter 3.4 presents research on IPO lockups. Subchapter 3.6 reviews literature on the decision to go public and the timing of IPOs. Finally, subchapter 3.7 discusses research on the long-term stock market performance of IPOs.

3.1 Asymmetric information

The theoretical background for majority of existing literature on IPOs derives from information asymmetries. In the context of capital market transactions, such as initial public offerings, information asymmetries arise when some party (or parties) in the transaction are better informed than other parties. Research on the role of private equity backing in IPOs also largely focuses on information asymmetries. The following sections discuss the agency theory and adverse selection which are central concepts related to asymmetric information.

3.1.1 Agency theory

In the finance literature, the agency theory was popularized by Jensen and Meckling (1976) who introduced a theory viewing external financing of a company as a principal-agency problem. The authors define the agency relationship as a contract under which one person, known as the agent, has been delegated authority to make decisions and act on the behalf other person(s), known as the principal(s). Assuming that both parties to the contract attempt to maximize their personal utility, it is likely that the agent will not always act in the best interest of the principal. The imbalance between the objectives of the agent and the principal causes agency costs. Agency theory has also been applied in the literature on initial public offerings, for example, in explaining IPO underpricing (e.g., Baron, 1986) and lockups (e.g., Brav and Gompers, 2003).

In the private equity model, conflicts of interest can generally arise between the general partners of the fund and the management of the portfolio company (Smith, 1998) as well as between the general partners and the limited partners of the fund (Sahlman, 1990). Furthermore, as the return on the private equity investment is highly dependent on the exit price, this gives rise to potential moral hazard problems in the exit process. Cao (2011) argues that the buyout model, in which value creation is based on restructuring of the portfolio company instead of growth opportunities, could be particularly prone to exit-related moral hazard problems. According to the author, buyout firms might be tempted to push problematic firms public before hidden problems can unfold, thereby transferring the expected bankruptcy risk and loss to public investors.

3.1.2 Adverse selection

The seminal article by Akerlof (1970) is the first study of the economics of unevenly distributed information. Taking the market for used cars as an example, the author demonstrates how markets can break down when potential buyers cannot verify the quality of the product. Due to the risk of purchasing a “lemon” (a product that turns out to be of poor quality), the buyer will demand a discount which, in turn, discourages the sellers of good products. This leads to an adverse selection problem in which the used car market becomes flooded with cars of bad quality as the owners of good cars choose not to participate in the market. In his article, Akerlof (1970) also provides examples of adverse selection related to insurance policies.

In the context of initial public offerings, potential adverse selection problem exists since managers and owners may not accurately reveal all information about a firm. Furthermore, many firms at IPO might have short operating history which means that investors cannot rely upon an extensive track

record of performance in estimating the health and value of the company. Therefore, by making overly optimistic estimates of the firm's revenues, insiders may try to inflate the expected value of the firm to increase their rewards from the IPO (Bruton et al., 2010).

As a means of alleviating the problem of adverse selection, the concept of signaling has been presented in the academic literature (e.g., Leland and Pyle, 1977). Due to the information asymmetries between IPO insiders and potential investors, the signaling theory has also become an important component of IPO research (Brau and Stanley, 2006). The theory states that the problem of asymmetric information can be mitigated by the insiders revealing a relevant piece of information to the other party in the form of a specific signal. These signals can contain either positive or negative information about the quality of the IPO, which may influence both short-term and long-term stock price performance of the newly listed company. In the field of positive signaling effects, the concepts relevant to my thesis include certification role, underpricing and lockups. The negative signaling effects presented in the IPO literature comprise selling insider shares or a large portion of the firm in the IPO and issuing units.

3.2 Certification role

Within signaling theory lies the idea of certification. The research on the topic focuses on the certification roles assumed by the underwriter of the offering, the venture capitalist backing the IPO and the accounting firm used by the issuing company. (Brau and Stanley, 2006). Certification refers to the ability of these third-party specialists to certify the value of securities issued by relatively unknown firms in capital markets that are characterized by asymmetric information between corporate insiders and public investors (Megginson and Weiss, 1991). Section 3.2.1 discusses literature on underwriter certification and section 3.2.2 reviews research on private equity certification.

3.2.1 Underwriter certification

Underwriter plays a major role in guaranteeing investors that the offering price is consistent with inside information and the prevailing market values at the time of the IPO. Reputational concerns and the underwriter's ability to charge a premium fee create an incentive to fairly price an issue (Smith and Smith, 2000). Several empirical studies conclude that using prestigious underwriters in the IPO process serves as a strong positive signal of company quality (e.g., Booth and Smith, 1986; Carter and Manaster, 1990; Carter et al., 1998). Quality refers to the level of risk associated with the company going public. In order to empirically study the certification effect, academic literature has

presented different measures that can be used as a proxy for underwriter reputation. Carter and Manaster (1990) develop a ranking based on underwriters' positions in tombstone announcements while Megginson and Weiss (1991) measure the relative market shares of underwriters. Yet another measure, the amount of investment bank's capital, has been introduced by Michaely and Shaw (1994).

Majority of studies on underwriter certification focus on examining the effect of underwriter prestige on IPO underpricing, that is, initial returns. The common conception in the studies using pre-1990s data was that underwriter certification allows companies to reduce IPO underpricing which represents a more costly way of signaling IPO quality to potential investors. For example, Carter et al. (1998) examine a sample of 2,292 IPOs in 1979-1991 and show that different proxies for underwriter reputation all lead to the same conclusion: the higher the underwriter quality, the less underpriced the IPO. However, studies employing more recent data show a reversal in this relation between underwriter prestige and initial returns in the 1990s. Loughran and Ritter (2004) present three non-mutually exclusive explanations for the phenomenon: the changing risk composition hypothesis, the realignment of incentives hypothesis, and the changing issuer objective function hypothesis. The changing risk composition suggests that part of the increase in underpricing is attributable to a general change in the composition or characteristics of firms going public. The realignment of incentives hypothesis, on the other hand, argues that managerial incentives to reduce underpricing have decreased over time due to such reasons as reduced CEO ownership and a higher fraction of IPOs with no secondary shares. The third hypothesis proposes several reasons why issuers have become more complacent about underpricing over time. These include using underpricing to compensate the underwriter for analyst coverage and the practice of corporate insiders corruptly seeking to profit from the underpricing of hot issues.

The relation between underwriter reputation and long-term IPO performance is also addressed in the academic literature. Michaely and Shaw (1991) examine two-year excess returns of US initial public offerings in 1984-1988 and show that IPOs underwritten by more reputable investment banks perform significantly better in the long-run. Consistent with this finding, Carter et al. (1998) show that, on average, the long-run market-adjusted returns are less negative for IPOs brought to market by more prestigious underwriters. A potential explanation for the superior long-term performance of IPOs underwritten by more reputable investment banks is provided by Carter and Manaster (1990) who argue that reputable investment banks pick the least risky IPOs to protect their good reputation.

3.2.2 Private equity certification

In the field of private equity certification, majority of studies focus on the certification role of venture capitalists instead of buyout investors. The topic of VC certification is also covered in two Master's theses of the Helsinki School of Economics (see Erkinheimo, 2000; Väänänen, 2002). Similar to the literature on underwriter certification, the involvement of a venture capitalist is considered as a positive signal of the quality of the firm going public. A widely recognized explanation for this effect is that venture capitalists are repeat customers to the IPO market and, therefore, becoming associated with failures would tarnish their reputation and ability to bring firms public in the future (Gompers, 1996).

The impact of venture capital involvement on IPO underpricing has been examined in numerous empirical studies. However, the results are not unanimous. In an early article, Megginson and Weiss (1991) find a significant negative relation between IPO initial returns and venture capitalist involvement (measured by a dummy variable). Their study is based on IPOs issued in the 1980s and the interpretation provided for the finding is analogous to the interpretation for the negative relation found between underwriter prestige and underpricing in the pre-1990s studies. However, as it turns out, investigation of more recent data shows a reversal in the relation in the 1990s. The reversal phenomenon is also analogous to the findings regarding underwriter certification.

In her Master's thesis on venture capitalist certification in US initial public offerings, Väänänen (2002) is among the first to observe the reversed relation between venture capitalist reputation and IPO underpricing. In a study on VC certification in German IPOs, Franzke (2004) also finds that IPOs backed by more prestigious venture capitalists are associated with more underpricing compared to offerings backed by less prestigious venture capitalists. The author uses the age of the venture capitalist as a proxy for the level of reputation. Possible explanations for the effect include the previously discussed changing risk composition and changing issuer objective function hypotheses proposed by Loughran and Ritter (2004). Lee and Wahal (2004), on the other hand, argue that a more plausible explanation is provided by the grandstanding hypothesis introduced by Gompers (1996). The grandstanding hypothesis suggests that the benefits of a successful IPO to a VC firm outweigh the cost of underpricing. Bringing a company public is an important signal of the quality of a venture capitalist and more reputable venture capitalists find it much easier to raise new funds.

The impact of venture capitalist certification on the long-run performance of a newly listed company has become a topic of growing interest in the finance literature. In a recent study on US

data, Krishnan et al. (2011) report that the venture capitalist's dollar market share of the IPO market is significantly and positively associated with long-run IPO performance measured by industry-adjusted return on assets, market-to-book ratio and listing survival. The authors conclude that more reputable venture capitalists are associated with a higher value creation for their portfolio companies in the going public process. By examining VC-backed IPOs in the UK, Epenlaub et al. (1999) and Jelic et al. (2005) also find that the long-term performance of IPOs is positively related to the level of venture capitalist reputation. In the previous article, VC firm's age and capital under management are used as proxies for reputation whereas the latter measures reputation by the number of transactions completed by the venture capitalist. However, there are also studies that find no evidence of VC reputation having an effect on the performance of initial public offerings. For instance, Rindermann (2004) observes no significant relation between post-IPO stock market performance and the level of VC reputation measured by the age and deal activity of the venture capitalist. Tykvova and Walz (2007), on the other hand, report mixed results regarding the relation between VC reputation and post-IPO abnormal returns. Depending on their methodology, the impact of VC reputation on two-year post-IPO performance seems to be either slightly positive or non-significant. The authors measure reputation by a ranking based equally on the age of the VC and the amount of funds under management.

While there are numerous articles on the certification role of venture capitalists, the number of studies assessing the reputational effect of buyout backing is very limited. By examining buyout-backed IPOs issued in the UK during 1992-2005, Levis (2011) finds no evidence of buyout firm reputation being related to post-IPO abnormal stock market performance. Unfortunately, the author does not report the exact results of his tests on the reputational effect. Cao and Lerner (2009), who study reverse leveraged buyouts issued in the US between 1981 and 2003, end up with similar findings. The authors find that IPOs backed by buyout firms that are repeat players in the IPO market perform no differently from their counterparts. Furthermore, they find that the amount of capital managed by the buyout firm, a widely used proxy for reputation, has no significant association with post-IPO abnormal returns. Accordingly, Cao and Lerner (2009) conclude that evidence regarding the reputational certification of buyout investors remains ambiguous.

3.3 Underpricing

Stoll and Curley (1970), Logue (1973), Reilly (1973), and Ibbotson (1975) were the first to document a systematic increase from the IPO offer price to the first-day closing price. Ever since, this phenomenon known as underpricing or initial return, has been a topic of great interest in the

academia. In a review of IPO literature and research, Ritter and Welch (2002) find no exceptions to the rule that the IPOs of operating companies are underpriced, on average, in all countries. The offerings of non-operating companies, such as closed-end funds, are generally not underpriced. In spite of the various models that have been proposed to explain the omnipresent anomaly, Ritter and Welch (2002) note that there is no single dominant theoretical cause for underpricing. From the viewpoint of a private equity sponsors, underpricing represents a real loss because it transfers wealth from existing shareholders (including the PE firm) to new shareholders (Gompers, 1996; Lee and Wahal, 2004).

Underpricing theories based on asymmetric information have been very popular in the academic literature. The common trait for these models is the prediction that underpricing is positively related to the degree of asymmetric information (Ritter and Welch, 2002). For instance, models based on the signaling theory view initial returns as a costly way to signal a company's quality (e.g., Welch, 1989; Grinblatt and Hwang, 1989; Allen and Faulhaber, 1989). The logic is that the greater the uncertainty surrounding a company, the greater the underpricing. While the empirical evidence regarding the signaling explanation remains mixed (e.g., Michaely and Shaw, 1994), Ritter and Welch (2002) argue that the most appealing feature of the theory is the idea that some issuers might voluntarily leave money on the table to create "a good taste in investors' mouths". According to the authors, the explanation is relatively compatible with the high levels of underpricing observed in IPOs.

In the context of information asymmetries, high initial returns have also been explained through the existence of investors whose information is superior to that of the issuing firm and that of all other investors (see Rock, 1986). According to this explanation, underpricing compensates the uninformed investors for the risk of trading against superior information and, therefore, helps overcome the winner's curse. Baron (1986) proposes a different approach in which underpricing arises from information asymmetries between the issuer and the underwriter rather than the issuer and the investors. According to this agency-based theory, the underwriter is better informed about the demand for the issue, which is why the issuer must compensate the underwriter, in the form of underpricing, for providing advice and marketing the securities. Muscarella and Vetsuypens (1989), however, find that when underwriters themselves go public, their shares are just as underpriced. This finding somewhat undermines Baron's (1986) theory although it does not refute it completely.

Although rationality-based models of asymmetric information dominate the literature on the underpricing anomaly, alternative models based on behavioral finance have also surfaced. For

example, Loughran and Ritter (2002) apply the prospect theory of Kahneman and Tversky (1979) in an attempt to shed more light on the issue. In another study, Cornelli et al. (2006) use a proxy of investor sentiment to explain IPO initial returns. They find a significant positive correlation between investor over-optimism and underpricing. Ritter and Welch (2002) argue that theories based on asymmetric information are unlikely to explain exceptionally high first-day returns or the dramatic variations in the level of IPO underpricing over the last few decades. They believe that future explanations for underpricing will need to concentrate on agency conflicts and behavioral explanations.

3.4 IPO lockup period

Studies focusing on IPO lockups typically examine the effects related to insider trading around the lockup expiration date[15]. According to Bradley et al. (2001), the typical length of a lockup period is 180 days. Research on IPO lockups has attracted a considerable amount of attention in the academic literature since the late 1990s. Furthermore, the role of private equity investors has been a topic of great interest in the field lockup studies (see, e.g., Bradley et al., 2001; Field and Hanka, 2001; Brav and Gompers, 2003).

From the signaling theory point of view, Courteau (1995) and Brau et al. (2005) model that long lockup period commitments by insiders are a positive signal of firm quality. Based on the survey answers of 336 chief financial officers (CFO) of firms that completed or attempted an IPO, Brau and Stanley (2006) find that committing to a long lockup is considered as one of the strongest positive IPO-related signals.

Although signaling theory is by far the most common theoretical framework in IPO lockup research, another viewpoint on the topic has been provided by the agency theory (Brau and Stanley, 2006). Brav and Gompers (2003) reject the signaling role of IPO lockups and argue that lockups exist to serve as a commitment device that alleviates moral hazard problems related to an IPO. In this particular setup, the moral hazard problem refers to the possibility of insiders taking advantage of the public investors by selling their shares before all (negative) information about the newly listed company is revealed to the market. Hence, the lockup period allows time for relevant information to become incorporated in the share price which prevents or reduces the insiders' ability to profit on the expense of the new owners. Brau and Stanley (2006) confirm the role of lockup as a

[15] Insider trading here does not refer to illegal transactions based on insider information. It simply refers to trading by the original shareholders of the newly listed company.

commitment mechanism that aligns the interests of insiders and new owners. Nevertheless, they argue that the main role of a lockup is to signal IPO quality.

In the literature on IPO lockups, the role and impact of private equity involvement has provided an interesting research niche for academics. Empirical studies show that lockup expirations, on average, are associated with significant negative abnormal returns and increased trading volumes, and that the effect is pronounced for IPOs with venture capital backing (Bradley et al., 2001; Field and Hanka, 2001; Brav and Gompers, 2003). In his master's thesis, Reinius (2003) studies this relationship between the lockup and venture capital financing in more detail. Using US data from the period of the stock market hype in 1998-2000, he finds that the number of venture capitalists invested in the company and the length of pre-IPO holding period are among the key determinants of the abnormal negative returns on the expiration date. According to the thesis, one possible explanation for the phenomenon derives from the operational model of venture capital: VC funds have a limited lifespan which forces them to sell or distribute the shares quickly after the lockup expiration. Consistently, Bruton et al. (2010) argue that venture capitalists have a strong motivation to fully exit the investment in order to redeploy their assets elsewhere, to distribute proceeds to the limited partners, and to establish an exit track record in order to raise further funds. A potential explanation for the lockup effect being more pronounced for VC-backed IPOs is provided by Bradley et al. (2001) who argue that VC firms have company-specific expertise which is not easily obtained by other market participants. Consequently, the exit of a venture capitalist might be considered as a more negative event compared to the exit of other original owners of the IPO.

3.6 IPO decision and timing

The following subchapter provides a review of literature regarding a firm's decision to go public and the timing of initial public offerings. Section 3.6.1 introduces central theoretical explanations and findings related to the IPO decision. Section 3.6.2 discusses theories on the timing of initial public offerings and section 3.6.3 focuses on the ability of private equity investors to time IPOs.

3.6.1 Decision to go public

Traditional corporate finance theories of optimal capital structure and pecking order provide some potential for explaining the decision to go public. According to the capital structure theory, firms conduct a public offering when external equity will minimize their cost of capital and thereby maximize the value of the company. The pecking order theory, on the other hand, would suggest IPO as the last resort of raising capital due to the high cost of equity. However, based on a survey of

CFO opinions, Brau and Stanley (2006) find only weak support for the ability of these traditional theories to explain the decision of going public.

The first formal theory to specifically explain the going public decision was introduced by Zingales (1995). The author proposes that entrepreneurs undertake an IPO to establish a market price for their firms which facilitates the sale of the company for a higher value than what they would otherwise receive. In other words, the theory predicts that initial public offerings serve as a way for the insiders to cash out. Black and Gilson (1998) reflect on this theory by arguing that IPOs are not so much exit vehicles for the entrepreneur as they are for the venture capitalists. The authors point out that entrepreneurs often regain control from the venture capitalists in the IPOs of VC-backed companies. This theory suggests that IPOs might provide an attractive harvest strategy for venture capitalists. A different explanation is provided by Brau et al. (2003) who argue that the creation of public shares is important for the fact that these shares may be used as "currency" in acquiring other companies. A survey research by Brau and Stanley (2006) provides support for both explanations. While 44% of CFOs perceive IPOs as an exit mechanism for the principals, the most important motivation for an IPO seems to be the creation of public shares that can be used in future acquisitions.

Finally, academic literature also explains IPOs as strategic moves. Chemmanur and Fulghieri (1999) develop a model in which a firm can choose to raise external financing either by placing shares privately with a risk-averse venture capitalist or by selling shares in an IPO to numerous small investors. These alternatives have their advantages and disadvantages that determine the stage of the company's life cycle at which a firm goes public. In another paper, Maksimovic and Pichler (2001) assert that firms conduct IPOs to capture competitive advantage in their industry. The intuition is that public trading, in its own right, can add value by inspiring more faith in the firm from investors, customers, creditors and suppliers.

3.6.2 Market timing of IPOs

Since the first empirical study on IPO timing by Ibbotson and Jaffe (1975), numerous academic articles have documented that IPOs tend to come in waves that are characterized by periods of hot and cold markets. This clustering of IPOs takes place not only in time but also across industries (Pagano et al., 1998). Many of the theories explaining the fluctuation in IPO volume are based on asymmetric information.

An intuitive explanation for undertaking an IPO is to raise capital in order to finance future growth. Choe et al. (1993) and Lowry (2002) argue that firms go public when they reach a certain point in the business growth cycle and need external equity capital to continue to grow. Unsurprisingly, corporate CFOs strongly agree that IPO timing is affected by the need for cash to support growth (Brau and Stanley, 2006).

Another theoretical framework for IPO timing derives from the idea of managers taking advantage of bull markets and attempting to capture attractive stock prices. Lucas and McDonald (1990) develop an asymmetric information model in which firms postpone their equity issue if they know that they are currently undervalued. If a bear market values the firm too low given the knowledge of the corporate insiders, the IPO will be delayed until the market offers more favorable pricing. Pagano et al. (1998) and Lowry (2002), on the other hand, present that industry conditions would be the key drivers of IPO activity. The role of market conditions in IPO timing is supported by Ritter and Welch (2002) who argue that the variation in the number of IPOs implies that general market conditions are the most important factor in the decision to go public. In another article, Loughran and Ritter (1995) find evidence of firms taking advantage of favorable windows of opportunity by issuing equity when, on average, they are overvalued. According to Brau and Stanley (2006), CFOs perceive both market and industry conditions as important decision factors in IPO timing.

A slightly different angle to IPO timing derives from the attractiveness of the IPO market itself. Lowry and Schwert (2002) argue that the recent first-day stock market performance of firms going public can affect the IPO decision of other firms. The argument that initial returns of recent IPOs contain information on the market's valuation and volume of future IPOs is based on the observation that more companies file IPOs following periods of high underpricing. Another explanation is proposed by Choe et al. (1993) who suggest that firms prefer to go public when other good firms are issuing IPOs. However, according to Brau and Stanley (2006), corporate CFOs do not seem to consider recent underpricing or other companies' decisions as important factors influencing the IPO timing of their companies.

In addition to the rationalistic theories presented above, explanations based on behavioral finance have also surfaced in the literature on IPO timing. For example, investor sentiment has been proposed be linked to the number of firms going public. Lowry (2002) finds that investor sentiment (measured by the discount on closed-end funds), growth opportunities, and adverse selection considerations are all determinants of aggregate IPO volume. In another article, Helwege and Liang (2004) argue that hot IPO markets are not driven primarily by changes in adverse selection costs,

managerial opportunism, or technological innovation, but more likely reflect greater investor optimism.

3.6.3 Private equity sponsors' ability to time IPOs

The research on IPO timing also investigates the ability of private equity investors to time IPOs. For instance, Lerner (1994) examines the ability of venture capitalists to take companies public when equity values are high. Using a sample of VC-backed biotechnology firms, he finds that particularly seasoned venture capitalists appear to be proficient at taking companies public near market peaks. The optimal timing of an IPO can be beneficial even if the venture capitalist didn't sell shares at the time of the offering. Barry et al., (1990) note that successful timing minimizes the dilution of the venture capitalist's ownership and Ibbotson (1975) argues that it enables deliberate underpricing to leave a "good taste" with investors.

In a more recent article, Cao (2011) argues that favorable market conditions can lead opportunistic buyout sponsors to list portfolio companies prior to realizing full operating efficiencies, which is likely to result in poor performance or even financial distress following the offering. By studying a sample of 594 reverse leverage buyouts (RLBO) issued during 1981-2006, he shows that LBO duration is negatively related to hot IPO market conditions and that buyout-backed IPOs with shorter LBO duration experience more deterioration in post-issue operating performance. The adverse effect is more pronounced for issuers with LBO duration less than a year (so called quick flips).

3.7 IPO long-term performance

The following subchapter discusses literature on the long-term stock market performance of initial public offerings. Section 3.7.1 provides an overview of the research on the general performance of IPOs and section 3.7.2 presents literature related to the performance of private equity-backed offerings.

3.7.1 Stock market performance of IPOs

Ritter (1991) was the first to document the anomaly of long-run underperformance of initial public offerings. Based on a sample of 1,526 IPOs that went public in the US during 1975-1984, he finds that, in the three years following the offering, these firms significantly underperform comparable firms matched by size and industry. Ever since these observations by Ritter (1991), the long-term

stock price performance of initial public offerings has been one of the most controversial areas of IPO research (Ritter and Welch, 2002).

Efficient markets proponents would argue that once an IPO is publicly traded, it is just like any other stock and thus the aftermarket stock price should appropriately reflect the shares' intrinsic value. Consequently, risk-adjusted post-IPO stock price performance should not be predictable and the risk-adjusted underperformance of IPOs simply results from faulty risk measurement techniques. Indeed, all studies examining long-term stock performance suffer from the fact that asset-pricing literature has failed to provide an accepted model of risk-adjusted performance (Ritter and Welch, 2002).

Brav and Gompers (1997) challenge the results of Ritter (1991) by arguing that underperformance is not an IPO-specific effect. The authors show that IPOs perform no worse than non-issuing firms with similar book-to-market ratio and size, and argue that instead of treating IPOs as one group, researchers should look more broadly at the types of firms that underperform. In another study addressing the relation between IPO-specific characteristics and long-run stock price performance, Teoh et al. (1998) find that IPO firms that window dressed their financial statements performed significantly worse in the long-run compared to firms that did not inflate earnings by managing accruals. As discussed in subchapter 3.2, underwriter certification (see, e.g., Michaely and Shaw, 1991; Carter et al., 1998) and venture capitalist certification (see, e.g., Jelic et al., 2005; Tykvova and Walz, 2007) have also been proposed to be associated with the long-term performance of IPOs.

The timing of an initial public offering has also been suggested to influence post-issue stock market performance. According to Ritter and Welch (2002), it is conventional wisdom among both academics and practitioners that the quality of firms going public deteriorates as a period of high issuing volume progresses. Consequently, the increased variation in the quality of firms going public during a hot IPO market should result in a higher number of underperforming IPOs. Consistent with this idea, Yung et al. (2008) propose that the IPO market is characterized by pro-cyclical dispersion in firm quality (measured by return variance) which heightens the problem of asymmetric information. They develop a theoretical model in which exogenous shocks to firms' investment opportunities cause time-varying adverse selection in the IPO market. The authors show that hot IPO markets are associated with greater cross-sectional variance in long-run returns and a higher incidence of delisting. Helwege and Liang (2004), on the other hand, provide contradicting evidence by showing that hot and cold IPO markets do not differ so much in the characteristics of

the firms going public. Instead, the authors attribute the IPO market cycle largely to changes in investor sentiment.

In the field of behavioral literature, Miller (1977) proposes that investors have heterogeneous expectations regarding the valuation of an initial public offering. This variance of opinions decreases over time and the valuations of the most optimistic investors converge towards the mean valuation causing the share price to fall. In a more recent study, Cornelli et al. (2006) examine whether irrational behavior among retail investors drives post-IPO prices. The authors develop a theoretical model in which Europe's pre-IPO market prices (markets that enable investors to speculate on the future stock prices of companies that are about to go public) serve as a proxy for investor sentiment. They find that over-optimism causes IPOs to trade at significantly higher first-day prices and to underperform over the subsequent 12 months as over-optimism gives away. Rajan and Servaes (2003) also investigate the impact of investor sentiment on IPO performance by modeling two different types of irrational agents, feedback traders and sentiment investors. Using market-to-book ratios as a proxy for investor sentiment, they find a positive correlation with first-day returns and a negative correlation with long-run returns.

3.7.2 Long-term performance of PE-backed IPOs

Among the studies that investigate the relation between IPO-specific characteristics and long-term stock market performance, the impact of private equity backing has been a topic of growing interest. Although several studies address the topic, the message remains ambiguous: positive, neutral, and negative influences of private equity financing can all be observed in the literature (Tykvova and Walz, 2007; Bruton et al., 2010).

Brav and Gompers (1997) were the first to investigate the role of venture capitalists on the long-run market performance of IPOs. Using US data from 1972 through 1992, they find that venture-backed IPOs outperform non-venture-backed IPOs over a five-year period when using equally-weighted returns. Possible explanations for the phenomenon proposed by the authors include reputational concerns as well as venture capitalists' ability to alleviate informational asymmetries by providing access to top-tier underwriters and higher quality analysts following.

In another study using US data, Doukas and Gonenc (2005) also provide evidence of venture-backed IPOs being associated with significant abnormal post-issue gains. By controlling for the effect of underwriter reputation, the authors show that the superior performance of these IPOs is attributable to the venture capitalist backing and not the quality of the underwriter. In other words,

they reject the explanation offered by Brav and Gompers (1997) that part of the effect of VC backing could be due to venture capitalists' having a better access to top-tier investment bank.

By studying LBOs listed in the UK and France during 1994-2004, Bergström et al. (2006) find that, on an aggregated level, buyout-backed IPOs outperform their non-buyout-backed counterparts over 6-month, 3-year and 5-year horizons. However, consistent with Ritter (1991), both PE-backed IPOs and other IPOs show evidence of negative abnormal long-run performance relative to the market. In line with the existing literature on IPO timing, Bergström et al. (2006) also observe large variations in performance across industries and years. They find that years of high IPO volumes are associated with the most severe underperformance.

Cao and Lerner (2009) investigate the three-year and five-year stock market performance of reverse leverage buyouts in the US market. They find that, in general, RLBOs perform as well as or better than other initial public offerings and the stock market as a whole, depending on the specification. In their cross-sectional analyses, RLBOs appear to consistently outperform other IPOs and the market as a whole whereas in the calendar-time approach, the performance of RLBOs does not significantly differ from the market. In an earlier study, Mian and Rosenfeld (1993) provide similar results of RLBOs slightly outperforming their stock market peers.

However, not all studies propose a positive relation between private equity backing and IPO performance. In an unpublished working paper by Audretsch and Lehmann (2002), the authors analyze the survival of companies on Germany's Neuer Markt and find that the likelihood of firm survival decreases as the ownership share of the group of venture capitalists increases. This indicates a negative effect on the part of venture capital backing. By studying the performance of reverse leveraged buyouts, Cao and Lerner (2009) provide evidence that those RLBOs that are hastily listed (so called quick flips) underperform other RLBOs and the market. Cao (2011) provides consistent results by showing that quick flips are associated with worse post-IPO operating performance and greater probability of bankruptcy compared to other RLBOs. However, RLBOs as a whole do not seem to be associated with poorer operating or stock market performance than comparable firms.

Using a combination of stock market and operating performance measures, Bruton et al. (2010) show that venture capitalists provide a negative effect on the performance of IPO firms listed in the UK and France in 1996-2002. The authors conclude that their finding is consistent with the grandstanding hypothesis introduced by Gompers (1996) which states that venture capitalists take firms public in order to raise their profile in the market and attract capital in future rounds. However,

the results of Bruton et al. (2010) also indicate that the negative impact of VC backing on IPO performance is reversed if the venture capitalist commits to post-IPO monitoring based on formal contractual terms.

Jelic et al. (2005) examine the relation between stock market performance and venture capital involvement using a sample of 167 management buyouts (MBO) listed on the London Stock Exchange during 1964-1997. The authors find no evidence of either long-term underperformance or outperformance of venture backed-offerings. In another study on European data, Rindermann (2004) finds no general association between venture capital backing and abnormal performance of initial public offerings. However, the author observes some evidence of outperformance by a subgroup of offerings that are backed by internationally operating venture capitalists. Holthausen and Larcker (1996) examine 90 reverse leveraged buyouts listed in the US during 1983-1988 and find no evidence of abnormal stock market performance. However, RLBOs appear to be associated with superior accounting performance during the four years following the offering.

In a recent European study, Levis (2011) compares the performance of buyout-backed IPOs with the performance of venture capital-backed and non-sponsored offerings listed on the London Stock Exchange during 1992-2005. The author finds that buyout-backed IPOs outperform the other two types of offerings in the three years following the issue. Moreover, the superior aftermarket performance of buyout-backed IPOs appears to be positively related to the leverage ratios of the companies and the proportion of the sponsors' shareholdings immediately after flotation. According to Levis (2011), a possible explanation for the phenomenon derives from investor sentiment. The author argues that there is a widespread market perception of aggressive pricing by buyout sponsors and a general unease regarding the high debt ratios associated with buyout-backed companies. As a consequence, investors appear to be taken by surprise by the robustness of the operating performance of these companies and the continuing involvement of the buyout sponsors after the IPO. However, the author notes that the underlying drivers and management processes that underpin the performance differences between venture capital and buyout-backed IPOs require further analysis.

4 HYPOTHESES

Academic literature suggests that initial public offerings are characterized by a problem of asymmetric information between corporate insiders and public investors (e.g., Allen and Faulhaber, 1989 on underpricing; Megginson and Weiss, 1991 on certification; Brau et al., 2005 on lockups).

According to the signaling theory, the degree of information asymmetry can be influenced by the actions of the insiders and the characteristics of the offering. The purpose of my thesis is to examine whether buyout backing is among the factors that contribute to the mitigation of IPO-related information asymmetries. The approach of my study is based on the assumption that the higher the level of information asymmetry related to an IPO, the more difficult investors find it to assess the quality and intrinsic value of the offering. As a consequence, IPOs associated with higher information asymmetries become more prone to mispricing which, in turn, leads to higher levels of post-issue abnormal returns as the information asymmetries gradually even out. Offerings that turn out to be overpriced relative to their intrinsic value become associated negative abnormal returns whereas undervalued offerings experience positive abnormal returns.

The motivation for the ability of a buyout sponsor to alleviate the problem of asymmetric information derives from both reputational concerns and the characteristics of the LBO model. Private equity firms are repeat customers to the IPO market and, therefore, becoming associated with failures would damage their reputation and undermine their ability to raise new funds and bring firms public in the future (Gompers, 1996). In other words, buyout backing can be viewed as a certification of IPO quality because the reputational capital of the buyout firm is at stake. This reputational certification also implies that, compared to otherwise similar IPOs, buyout-backed offerings will be priced closer to their intrinsic value (see Megginson and Weiss, 1991; Neus and Walz, 2005). The assumption is that the intrinsic value represents an optimal level of pricing for the buyout investor. While overpricing would lead to a negative return surprise and a loss of reputational capital, pricing the offering close to its intrinsic value maximizes the proceeds from the IPO and minimizes the transfer of wealth from the existing owners, including the buyout fund, to new shareholders (see Gompers, 1996; Lee and Wahal, 2004). Furthermore, it enables the buyout fund to complete its post-IPO exit without having to wait for the price discovery by the market. A quick exit, on the other hand, is motivated by the finite lifetime of the buyout fund and the fact that the buyout firm's marginal productivity will be higher if it redeploys its capital and efforts elsewhere (DeAngelo and DeAngelo, 1987). As a consequence, buyout-backed IPOs should be associated with less extreme post-IPO abnormal returns relative to non-buyout-backed offerings.

Further motivation for the ability of buyout backing to alleviate information asymmetries associated with initial public offerings is provided by the LBO model. The buyout model involves two components that support the role of a buyout firm in the mitigation of these IPO-related problems: 1. the pre-LBO screening process, and 2. the value-adding process. While these factors are not expected to make the intrinsic value of an IPO more transparent to new investors, they can be

considered as a positive signal of IPO quality and, therefore, contribute to the mitigation of asymmetric information. Companies backed by private equity investors have undergone a preliminary screening process in which targets of a given quality and potential are accepted for the investment (see Espenlaub et al., 1999). While it is evident that some of these investments turn out to be disappointments for the buyout fund, the fact that a portfolio company has advanced to the point of an initial public offering implies that the pre-LBO screening had been successful. In the context of an IPO, the screening process supports the effect of reputational certification by providing the new investors a positive signal about the quality and pricing proposed for the company at flotation. Consequently, buyout-backed IPOs should be associated with lower levels of post-IPO abnormal returns compared to other IPOs.

Finally, the value-adding process, a fundamental part of the LBO model, provides more support for the role of buyout backing in the mitigation of IPO-related information asymmetries. According to Barry et al. (1990) the pre-IPO monitoring by a private equity sponsor is likely to improve the quality of the company and, hence, reduce investor uncertainty regarding the IPO. Governance and operational engineering related to the value-adding process directly contribute to firm quality and value. As part of the governance engineering, the buyout sponsor typically seeks to add value by building a competent management team, setting up a carefully designed management incentive scheme and serving in the portfolio company's board. Operational engineering, on the other hand, involves implementation of strategic and operational changes that streamline and enhance the performance of the company. These value-adding measures are expected to reduce agency problems and provide certification for the IPO quality and value proposed at flotation. Accordingly, buyout-backed offerings can be priced closer to their intrinsic value which leads to less extreme post-IPO abnormal returns relative to non-buyout-backed IPOs.

Based on the above remarks, I hypothesize that buyout-backed IPOs, in general, are less prone to information asymmetries compared to non-buyout-backed IPOs. Accordingly, the testable hypothesis regarding the general impact of buyout backing on the degree of information asymmetry associated with an IPO is as follows:

H_1: Buyout-backed IPOs are associated with less extreme post-IPO abnormal returns compared to non-buyout-backed IPOs.

In order to more closely assess the impact of the value-adding process on the degree of information asymmetry, I introduce a second hypothesis in which LBO duration is used as a proxy for the stage of the process at the time of the offering. The approach follows the logic of Cumming and

MacIntosh (2001) who argue that venture capital investment duration signals the degree to which the venture capitalist has mitigated informational asymmetries and agency problems faced by the new owners in an IPO. A longer duration enables the buyout sponsor to fully implement the governance and operational improvements that are deemed relevant to the mitigation of information asymmetries. Furthermore, investors might consider short LBO duration as a sign of opportunistic behavior by the buyout investor. Consequently, longer LBO holding period should be associated with lower information asymmetry and a lower degree of valuation risk. As a result, the level of post-issue abnormal returns associated with an IPO should decrease as the duration of the pre-IPO buyout period increases.

H_2: Buyout-backed IPOs with longer LBO investment period are associated with less extreme post-IPO abnormal returns compared to buyout-backed IPOs with shorter LBO period.

My third hypothesis addresses more closely the impact of a buyout firm's reputation on the degree of information asymmetry related to an initial public offering. While reputational concerns can be considered important for the future business of any private equity firm, the magnitude of the effect has been proposed to vary depending on the level of reputation associated with a given sponsor (e.g., Espenlaub et al., 1999; Jelic et al., 2005; Tykvova and Walz, 2007). More reputable buyout sponsors are expected to be more efficient in reducing information asymmetries because investors acknowledge that they have more reputational capital at stake. In my thesis, buyout firm's age and capital under management are used as proxies for reputation.

H_3: IPOs backed by more reputable buyout firms are associated with less extreme post-IPO abnormal returns compared to IPOs backed by less reputable buyout sponsors.

5 DATA

The following chapter presents the data used in the empirical tests that are conducted in my thesis. Subchapter 5.1 explains the data gathering process and subchapter 5.2 describes the key characteristics of the sample.

5.1 Formation of the sample

I obtain the data for my research from three primary sources: SDC Platinum, the Center for Research in Security Prices (CRSP) and Compustat. SDC Platinum provides me with the event data related to the initial public offerings. This event data is supplemented with stock market data from CRSP and accounting data from Compustat. Other sources of data include the websites of Kenneth

French, Jay Ritter and the Bureau of Economic Analysis. Section 5.1.1 describes the formation of the initial sample based on the event data retrieved from the SDC database. Section 5.1.2 explains the process of extracting stock market and accounting data from CRSP and Compustat. Finally, section 5.1.3 describes the data retrieved from the three websites.

5.1.1 Event data

SDC Platinum provides the starting point for the sample generation process. I describe the process separately for the buyout-backed IPOs (referred to as the "PE-backed IPOs" sample) and non-buyout-backed IPOs (referred to as the "Other IPOs sample").

I retrieve the PE-backed IPOs sample from SDC Platinum's VentureXpert database that comprises data on private equity worldwide from 1970 to date. The database provides a platform specifically designed for retrieving detailed information on IPOs that are backed by different types of private equity sponsors. Data obtained from VentureXpert includes IPO dates, IPO prices, issuer names, Standard Industrial Classifications (SIC), underwriter names, dates of first buyout investment, buyout firm names and founding years, and amount of capital managed by the buyout sponsors. The following criteria are used in retrieving the data:

1. Database: Venture-Backed IPOs
2. Offer date: 1/1/1990 to 31/12/2008
3. Company Stock Exchange : American, NYSE, Nasdaq
4. Buyout Backed Public Company: Select All Buyout Backed Public Companies

The search returns 498 initial public offerings that were backed by a buyout sponsor. However, it turns out, that 15 companies received their first LBO investment after the IPO date which indicates a public-to-private transaction instead of a buyout-backed IPO. This inconsistency had me question the quality of the data extracted from SDC Platinum and a further investigation confirmed that the information retrieved from the database does suffer from certain reliability issues. For example, Ljungqvist and Wilhelm (2003) observe significant reporting errors and gaps in SDC Platinum's variables by comparing the data to information obtained from other sources. According to the authors, these errors also concern IPO dates and private equity backing in IPOs. Loughran and Ritter (2002) make similar observations and on his website Jay Ritter provides a list of corrections to the IPO data available from the SDC database.

Since SDC Platinum is the only event-specific database that I have access to, it provides the basis input for the empirical analyses conducted in my thesis. Although the amount of information

available on buyout-backed IPOs is very limited, I take every possible measure to verify the quality of the information extracted from the SDC database. To ensure the comprehensiveness of the PE-backed IPOs sample and to alleviate the possible problem of selection bias, I use SDC Platinum to retrieve additional samples using alternative specifications for buyout backing. These include re-running the VentureXpert search based on different fund investment stages (for example, buyout and turnaround funds) as well as retrieving a sample of all US IPOs flagged as private equity-backed from the Global New Issues database. By manually reviewing and comparing the different samples, I identify 56 additional IPOs that potentially classify as buyout-backed.

As the next step in ensuring the quality of the PE-backed IPOs sample extracted from SDC Platinum, I check the observations using Thomson One Banker and Google in order to verify the nature and timing of the private equity investment. As a result, 63 IPOs are removed and the final sample before retrieving stock market and accounting data comprises 476 buyout-backed IPOs. Since one of the main quality issues with SDC data concerns the reliability of IPO dates, I compare the dates of the sample firms to dates reported by Nasdaq, NYSE and CRSP. Based on the findings, dates on 62 IPOs are changed. Finally, based on Jay Ritter's list of SDC data errors, the names of lead underwriters are changed on two observations.

Following the generation of the PE-backed IPOs sample, I use SDC Platinum to retrieve the Other IPOs sample which provides a benchmark of IPO performance. The same data items that were retrieved for the PE-backed IPOs (excluding the buyout-specific data) are retrieved for the Other IPOs sample. In extracting the data from SDC Platinum's Global New Issues database, the following criteria are used:

1. Database: All Public & Private Common Stock
2. IPO: Select All IPOs
3. Offer date: 1/1/1990 to 31/12/2008
4. Primary Exchange Nation of Issuer's Stock : US

As the first step in editing the Other IPOs sample, I exclude the companies that are included in the PE-backed IPOs sample. Furthermore, duplicate observations that for some reason occur in the data set are removed. Consistent with previous research on IPO long-term performance (e.g., Barber and Lyon, 1997; Yung et al., 2008), I confine the sample to the common stock performance of corporations with primary listing and domicile in the US (CRSP codes 10 and 11). Therefore, for example, American Depository Receipts (ADRs), closed-end funds, real estate investment trusts (REITs) and foreign-domiciled firms are excluded from the Other IPOs sample. This leaves a total

of 5,255 observations. Finally, based on the SDC data errors documented by Jay Ritter, the names of lead underwriters are changed on seven observations and the offer price on one observation.

5.1.2 Stock market and accounting data

After retrieving the event data from SDC Platinum, I use the CRSP database to extract stock market data required in the empirical analyses in my thesis. CRSP covers historical US stock market data from 1926 to date, and is a widely used information source in financial research. From the database, I retrieve daily and monthly share prices, monthly stock returns and monthly number of shares outstanding. In addition to supplementing the event data with stock market data, I use the CRSP database to extract monthly returns, SIC codes, distribution codes and share codes for all US companies listed prior to 2006. This data set is used in the control firm method of estimating abnormal returns. The CRSP database also provides me with monthly return data on the S&P 500 index which is required for the market-adjusted model of determining abnormal returns. A detailed description of the methods is presented in subchapter 6.1.

In addition to stock market data, certain accounting items are used in the empirical analyses conducted in my thesis. The accounting data is obtained from Compustat database which provides a worldwide coverage of financial, statistical and market information from 1950 to date. I use Compustat to retrieve quarterly amounts of total debt, total assets and book equity for the initial public offerings. For the set of control firms, I extract quarter end figures of book equity, number of shares outstanding and share prices.

Matching the data obtained from different databases proves to be a challenging task due to a lack of permanent and uniform security-specific identifiers. While matching data between CRSP and Compustat is straightforward owing to the joint CRSP/Compustat Merged Database, matching the event data retrieved from SDC Platinum with CRSP and Compustat data is not. The matching process is conducted semi-manually based on CUSIP identifiers and issuer names. Due to missing or inconsistent data, the PE-backed IPOs sample is reduced from 476 to 449 observations and the Other IPOs sample is reduced from 5,255 to 3,875 observations. The exclusion of observations might result in some degree of selection and/or survivorship bias regarding the statistical tests.

5.1.3 Other data

While the main data for my thesis is obtained from SDC Platinum, CRSP and Compustat databases, there are some items that I retrieve from the websites of Kenneth French, Jay Ritter and Bureau of

Economic Analysis (BEA)[16]. Kenneth French's data library provides me with monthly Fama-French and momentum factors required for the Fama-French-Carhart four-factor model which I use in estimating post-IPO abnormal returns (see subchapter 6.1). Jay Ritter, a finance professor renowned for his research on initial public offerings, maintains an extensive collection of IPO statistics on his website. From Ritter's database, I obtain the quarterly number of IPOs issued in the US, rankings of US underwriters and the founding years of IPO firms. Bureau of Economic Analysis is an agency of the US Department of Commerce which provides statistics on the US economy. From the BEA website, I retrieve quarterly percentage changes in real private non-residential fixed investment. The data items obtained from the databases of Jay Ritter and the BEA are required as control variables in the empirical analyses.

5.2 Characteristics of the sample

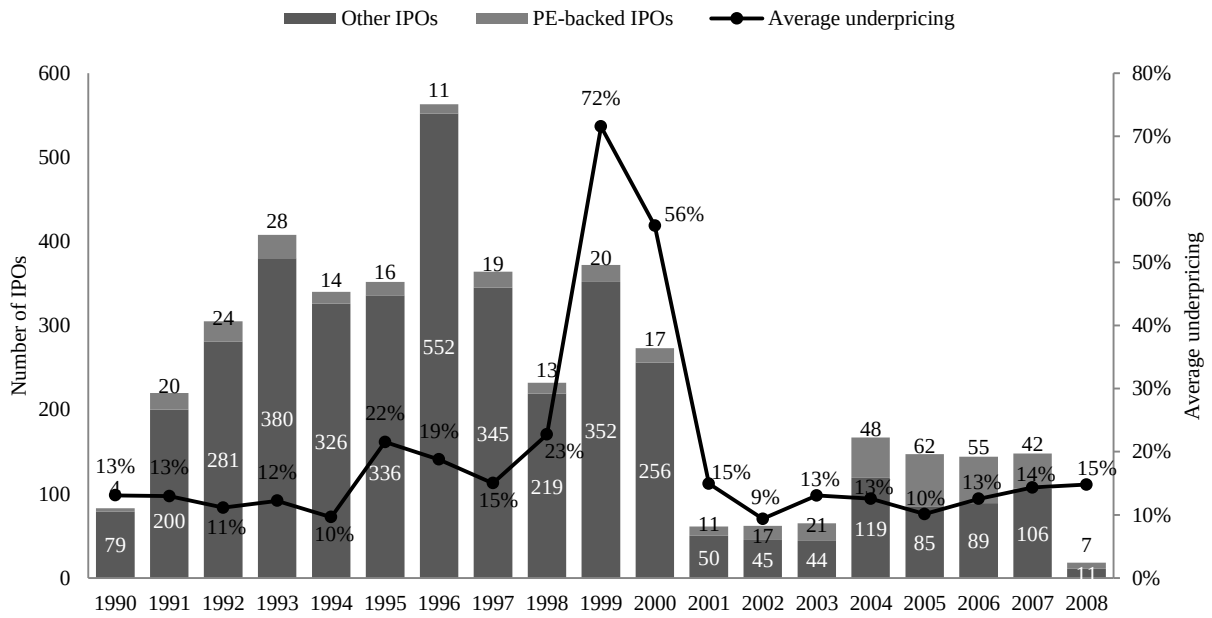
In this subchapter, I present the key characteristics of the sample used in the empirical tests conducted in my thesis. Figure 4 illustrates yearly volumes and average underpricing of the initial public offerings in the sample. The distribution of IPO activity during 1990-2001 is consistent with the distribution presented by Ritter and Welch (2002) in their extensive review of US initial public offerings issued during 1980-2001. However, the annual IPO volumes in my sample appear to be consistently 9% to 20% below the volumes reported by the authors. This reflects the extensive data requirements set by the empirical tests conducted in my thesis and, at the same time, implies that the sample suffers from a certain degree of selection and/or survivorship bias[17].

Figure 4 presents annual IPO volumes separately for the buyout-backed IPOs and the non-buyout-backed IPOs. Of the 449 buyout-backed IPOs in the sample, 280 (62%) were listed during 2000-2008 of which 214 (48%) went public during 2004-2008. A likely explanation for this notable imbalance in the timing of the buyout-backed IPOs derives from the characteristics of the buyout industry, namely growth and cyclicality. Figure 3 in subchapter 2.3 shows a significant increase in the amount of capital committed to US buyout funds in 1997-2000. Given the typical life cycle of a buyout fund, exits from the LBOs completed with these funds could explain the increase in the volume of buyout-backed IPOs in 2004-2007. On the other hand, the quality issues encountered with the SDC data imply that part of the imbalance might also be explained by flawed or missing classifications of older IPOs.

[16] Kenneth French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
Jay Ritter's website: http://bear.warrington.ufl.edu/ritter/ipodata.htm
Bureau of Economic Analysis: http://www.bea.gov/itable/index.cfm

[17] Ritter and Welch (2002) collect their data from multiple sources to which I unfortunately don't have access. These include Dealogic and unspecified sources.

Figure 4: Yearly volume and average underpricing of the IPOs in the sample



The average annual underpricing of the sample is in line with the levels of underpricing presented by Ritter and Welch (2002) for IPOs issued during 1990-2001. The degree of underpricing remains around 10% and 12% during 1990-1994 and jumps to over 15% in 1995-1998. The extreme levels of first-day returns observed in 1999-2000 are related to the internet bubble. Ritter and Welch (2002) report precisely the same levels of average underpricing for the bubble period. Panel A in Table 1 shows that, on aggregate, buyout-backed IPOs are associated with a lower level of underpricing compared to the non-buyout-backed IPOs in the sample. The average underpricing of the buyout-backed IPOs is higher only during five years. The observation is consistent with Levis (2011) who finds that buyout-backed IPOs issued in the UK are considerably less underpriced than their VC-backed and non-sponsored counterparts. If underpricing was considered to reflect the degree of IPO-related information asymmetry, the observation would indicate that buyout-backed IPOs might be less prone to asymmetric information compared to non-buyout-backed IPOs.

Other interesting observations in Panel A in Table 1 include the finding that buyout-backed IPOs, on aggregate, are larger and older than the other IPOs in the sample. However, this is not surprising given the fact that typical LBO targets are mature firms and include companies that were previously listed on a stock exchange (see chapter 2). Extensive use of debt, a fundamental characteristic of an LBO, is also clearly illustrated by the figures presented in Table 1. Another interesting observation concerns the quality rankings of the investment banks underwriting the IPOs. It seems that even if private equity firms had a better access to top-tier underwriters as suggested by Brav and Gompers

(1997), the difference in average and median underwriter rankings relative to non-buyout-backed IPOs remains marginal. Finally, book-to-market ratios are effectively the same for the buyout-backed IPOs and the non-buyout-backed offerings.

Table 1: Sample characteristics

The table presents the key characteristics of the sample used in my thesis. The sample consists of IPOs issued in the US during 1990-2008. Panel A reports the general characteristics of the IPOs and Panel B presents data related to the leveraged buyouts. In Panel A, mean and median figures are provided separately for buyout-backed IPOs and non-buyout-backed IPOs. IPO price is the listing price of the company, market capitalization is the closing market value of equity on the first trading day, underpricing is the first-day return, leverage ratio is calculated as total debt divided by total assets reported in the first quarterly report, book-to-market is calculated as the book value of equity reported in the first quarterly report divided by the market capitalization at the end of the first trading day, firm age is the difference between the IPO year and the founding year of the company, and underwriter rank is the reputation ranking of the lead underwriter on a scale of 0 to 9 (with 9 being the highest rank). Figures presented in Panel B comprise the duration of the pre-IPO buyout period (inlcuding possible secondary buyouts), the latest reported amount of capital managed by the buyout firm and the age of the buyout firm at the time of the IPO.

Panel A
IPO characteristics

	PE-backed IPOs	(N = 449)	Other IPOs	(N = 3,875)
	Mean	Median	Mean	Median
IPO price	15.8	15.0	12.3	12.0
Market capitalization (USDm)	699.2	407.6	431.0	134.9
Underpricing	11.5 %	6.5 %	23.6 %	9.8 %
Leverage ratio	0.35	0.32	0.14	0.04
Book-to-market[a]	0.39	0.33	0.38	0.30
Firm age (in years)	31	19	14	7
Underwriter rank	8.5	9.0	7.1	8.0

[a] Exlcudes 17 PE-backed IPOs and 106 Other IPOs with negative book-to-market

Panel B
Buyout-specific characteristics

	Observations	Mean	Median
LBO duration (in years)	447	3.8	3.0
Capital under management (USDm)	420	12,622.4	6,000.0
Buyout firm age (in years)	444	17.3	16.0

Panel B in Table 1 presents the LBO-specific characteristics that are addressed in my thesis. In the sample, the average and median durations of the pre-IPO buyout period are 3.8 years and 3 years, respectively. Approximately 50% of the LBOs were listed within three years from the original investment. The observation is in line with Phalippou (2009) who finds that 44% of the 2,500 buyouts in his sample were exited within three years. The average and median amounts of capital

managed by the buyout firms backing the IPOs are $12.6 billion and $6 billion, respectively. In terms of capital under management, the three largest buyout sponsors in my sample are The Carlyle Group ($97bn), Blackstone Group ($84.3bn) and TPG Group ($57.6bn). Finally, the average and median ages of the buyout backers at the time of the IPO are 17.3 years and 16 years, respectively.

6 METHODOLOGY

The following chapter presents the methodology used in testing the hypotheses. Subchapter 6.1 explains the calculation of long-term abnormal returns. The examination of the general role of buyout backing in the mitigation of IPO-related information asymmetries is conducted in two stages. The first stage consists of a simple univariate approach which is explained in subchapter 6.2. The second stage is based on a probit regression model which is described in subchapter 6.3. Finally, subchapter 6.4 presents the ordinary least squares (OLS) regression models used in testing hypotheses two and three, and the robustness of the results based on the probit model.

6.1 Long-term abnormal returns

The main challenge in examining long-term stock price performance is that the results are sensitive to the choice of methodology (Ritter and Welch, 2002). Barber and Lyon (1997) document three main sources of bias in the calculation of long-term return that can lead to misspecification of test statistics. These biases are new listing bias, rebalancing bias and skewness bias[18]. Kothari and Warner (1997) observe similar methodological issues in their assessment of various metrics used for the measurement of long-term returns. Lyon et al. (1999) identify cross-sectional dependence among sample firms and poorly specified models of asset pricing as two additional problems related to testing long-run abnormal returns. For robustness of results, I use different specifications in estimating and calculating long-term abnormal returns. Section 6.1.1 describes the calculation of post-IPO abnormal returns and section 6.1.2 presents the benchmarks used in estimating abnormal returns.

[18] *New listing bias* arises because sample firms generally have a long post-event history of returns, while firms that constitute the index (or reference portfolio) typically include new firms; *rebalancing bias* arises because the compound returns of a reference portfolio (e.g. market index) are typically calculated assuming periodic rebalancing, whereas the returns of sample firms are compounded without rebalancing*;* and *skewness bias* arises because long-run abnormal returns are positively skewed.

6.1.1 Calculation of abnormal return

In my thesis, abnormal returns are calculated using two different approaches that are widely applied in long-term event studies: buy-and-hold abnormal returns (BHAR) and cumulative abnormal returns (CAR). The approaches are described in the following.

Buy-and-hold returns

Barber and Lyon (1997) argue that long-run abnormal returns should be calculated as the long-run buy-and-hold return of a sample firm less the long-run return of an appropriate benchmark. They present two reasons why buy-and-hold returns should be favored over cumulative returns. Firstly, BHARs can be directly interpreted as the additional return over the benchmark whereas CARs do not readily translate into a measure of performance. Secondly, the authors show that CARs are a biased predictor of BHARs. Buy-and-hold abnormal return is calculated the compound return on a sample firm less the compound return on a benchmark:

$$BHAR_{iT} = \prod_{t=1}^{T}(1 + R_{it}) - \prod_{t=1}^{T}(1 + R_{bt}) \quad (1)$$

where $BHAR_{iT}$ is the T period abnormal buy-and-hold return for stock i, R_{it} is the return on stock i for sub-period t and R_{bt} is the contemporaneous return on the benchmark of normal return. For each IPO, buy-and-hold returns are calculated by compounding monthly returns. Return for the IPO month is calculated by compounding daily returns from the first trading day's closing price until the end of the IPO month.

Cumulative returns

I also calculate long-term abnormal returns as cumulative abnormal returns. For example, Fama (1998) suggests that CARs could be less biased than buy-and-hold returns as a measure of long-term performance because the latter may exaggerate a single year's poor performance. Cumulative abnormal return is calculated as follows:

$$CAR_{iT} = \sum_{t=1}^{T}(R_{it} - R_{bt}) \quad (2)$$

where CAR_{iT} is the T period cumulative abnormal return for stock i, R_{it} is the return on stock i for sub-period t and R_{bt} is the contemporaneous return on the benchmark of normal return. For each IPO, the cumulative returns are calculated based on monthly returns. Return for the IPO month is

calculated by compounding daily returns from the first trading day's closing price until the end of the IPO month.

6.1.2 Benchmarks of normal return

Three alternative benchmarks are used in estimating abnormal returns. These include the market-adjusted model, the Fama-French-Carhart four-factor model and the control firm method. The following section provides a description of each approach.

Market-adjusted model

The simplest approach to determining abnormal return on a stock at a given time is to use the contemporaneous return on a market index as the benchmark for normal return. Numerous long-term return studies employ the market-adjusted model as the baseline specification (e.g., Ritter, 1990; Brav and Gompers, 1997; Cao and Lerner, 2009). In my thesis, return on the S&P 500 index is selected as the benchmark return.

Fama-French-Carhart four-factor model

The Fama-French-Carhart four-factor model is an extension of the well-known three-factor model. The additional momentum factor captures the momentum anomaly which, according to Carhart (1997), improves the model's ability to explain stock returns. The below equation is a presentation of the four-factor model:

$$R_{it} - R_{ft} = \alpha + \beta_{i1}(R_{mt} - R_{ft}) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}MOM_t + \varepsilon_{it} \quad (3)$$

where R_{it} is the return of the IPO firm, R_{ft} is the return on one-month Treasury bill, R_{mt} is the value-weighted return on all NYSE, AMEX and NASDAQ stocks, SMB_t is the difference in the returns of value-weighted portfolios of small and large stocks, HML_t is the difference in the returns of value-weighted portfolios of high book-to-market and low book-to-market stocks, and MOM_t is the difference in returns of value-weighted portfolios of firms with high and low prior momentum. ε_{it} is the error term in the regression. The portfolios used in the calculation of the Fama-French-Carhart factors include all NYSE, AMEX and NASDAQ stocks. Monthly values for the factors are obtained from Kenneth French's website, and the construction of the factors is discussed in detail in Fama and French (1993) and Carhart (1997).

The four-factor model presented in Equation (3) yields parameters β_{i1}, β_{i2}, β_{i3} and β_{i4} for each IPO stock which are used in calculating monthly expected returns. Normally, the estimation of the model is conducted in a pre-event period after which the parameters are assumed to remain constant and are used in computing abnormal returns during the event period. However, there is no pre-event period for initial public offerings and, therefore, the parameters are estimated during the first full 60 months following the issue. This approach is consistent with Yung et al. (2008). For IPOs with less than 60 months of return data available, the estimation is conducted using as many months as possible with 24 months being the minimum. IPOs with less than 24 months of post-issue return data are excluded from the tests based on the Fama-French-Carhart model. This restriction limits the sample sizes used in the tests based on the four-factor model. The sample of PE-backed IPOs is reduced by 40 observations and the sample of Other IPOs is reduced by 431 observations. The calculation of the benchmark return based on the four-factor model is as follows:

$$R(FFC)_{it} = R_{ft} + \beta_{i1}\left(R_{mt} - R_{ft}\right) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}MOM_t \quad (4)$$

where $R(FFC)_{it}$ is the t period benchmark return for stock i, R_{ft} is the return on one-month Treasury bill for period t, β_{i1}, β_{i2}, β_{i3} and β_{i4} are the stock-specific estimates of the Fama-French-Carhart parameters, and SMB_t, HML_t and MOM_t are the Fama-French-Carhart factors for period t.

Control firm method

In their assessment of different methods used for measuring long-run abnormal returns, Barber and Lyon (1997) find that matching sample firms to control firms of similar size and book-to-market ratios yields well-specified test statistics in virtually all sampling situations because it alleviates the new listing, rebalancing, and skewness biases[19]. Consistently, Jegadeesh (2000) arrives at the conclusion that the matching firm technique is superior to factor-models. Nonetheless, the rationale behind the control firm method is similar to the Fama-French model in that common stock returns are assumed to be related to firm size and book-to-market ratios (see Fama and French, 1993). Following Yung et al. (2008), I use the primary industry of a company as a third matching criterion. To avoid matching with recently-issued firms, firms which have issued equity within three years of the sample firm's IPO are excluded from the pool of potential control firms. Equity issues are identified based on the IPO date and CRSP distribution code.

[19] N*ew listing bias* is eliminated since both the sample and control firm must be listed in the identified event month; *rebalancing bias* is eliminated because both the sample and control firm returns are calculated without rebalancing; and *skewness bias* is mitigated since the sample and control firms are equally likely to experience large positive returns.

The matching process to determine the control firm has three steps:

1. Industry matching:
   All firms with the same two-digit Standard Industrial Classification (SIC) code as the sample firm are identified.

2. Size matching:
   From the set of industry-matched firms, all firms with market value of equity between 70 percent and 130 percent of the market value of equity of the sample firm are identified. For the control firms, size is measured in June of each year as the market value of common equity (shares outstanding multiplied by June closing price). These size rankings calculated in year t are then used from July of year t through June of year t + 1. For the sample firms, size is measured as the market capitalization on the first trading day (shares outstanding multiplied by first day's closing price).

3. Book-to-market matching:
   From the set of firms identified in the preceding steps, the firm with the book-to-market ratio closest to that of the sample firm is selected as the benchmark. For the control firms, book-to-market ratio is measured as the book value of common equity reported on the firm's balance sheet in December of year t- 1 divided by the closing market value of common equity in December of year t- 1. The ratios are then used from July of year t through June of year t + 1. For the IPOs, the ratio is measured by dividing the first reported book value of common equity with the market value of common equity at the end of the first trading day.

If a control firm is delisted during the review period, it is replaced by a new control firm starting from the delisting date. The replacement firm is the next-best match based on the criteria explained above. Due to the requirements of the matching process, the PE-backed IPOs sample is reduced by 22 observations and the Other IPOs sample is reduced by 209 observations.

6.2 Univariate analysis

The first stage in examining the general impact of buyout backing on the stock market performance of an IPO is based on a simple univariate approach. The initial public offerings, both buyout-backed and non-buyout-backed, are first sorted based on their post-issue abnormal stock returns and then split into deciles of equal size. Cases of extreme abnormal returns are defined as the top 10% of IPOs with the highest abnormal returns (positive surprise) and the bottom 10% of IPOs with the

lowest abnormal returns (negative surprise). Consequently, the magnitude of post-issue abnormal return for an IPO is determined relative to the other offerings in the sample. Once the IPOs are in split into the deciles, the next step is to calculate the share of buyout-backed IPOs in the top/bottom decile and compare it to the average share of buyout-backed IPOs in the whole sample. A t-test is used to determine whether there is a statistically significant difference between the proportions. The purpose of the univariate analysis is to provide a general conception of the level of post-IPO abnormal returns associated with buyout-backed IPOs relative to non-buyout-backed IPOs.

The experiment is conducted based on 3-month, 6-month and 1-year post-IPO abnormal returns. In case the company is delisted within the period, abnormal return is calculated until the delisting date. The measurement period must be kept relatively short to capture the degree of information asymmetry related to the IPO as accurately as possible. Extending the study horizon would subject the statistical tests to increasing noise as the number of possible determinants of stock price performance is likely to grow exponentially over time. However, observing returns over a sufficiently long horizon allows for information asymmetries to even out and the share price to adjust to its intrinsic value as new information gradually enters into the market. Expirations of the post-IPO quiet period and the lockup period as well as the release of the first earnings report are among the key events during which new information about the firm is revealed to the market. The post-IPO quiet period refers to a period of time during which the Securities and Exchange Commission (SEC) regulations generally prohibit firms and their underwriters from publishing opinions regarding the valuation of the stock and from making forward-looking statements concerning earnings, revenues, and similar items. The logic behind the period that typically lasts 25 days following the offering is that all material information should be contained in the IPO prospectus (Bradley et al., 2003). Based on the above discussion, the measurement period of interest is limited to a maximum of one year from the IPO date.

6.3 Probit analysis

In the second stage of testing hypothesis one, the general ability of a buyout sponsor to alleviate information asymmetries related to initial public offerings is investigated using a binary choice probit model. The purpose is to confirm the results received in the univariate test by controlling for a set of issue-specific characteristics. In the probit model, maximum likelihood estimation is used to assess the determinants of the probability of an IPO being in the top/bottom 10% decile of abnormal performance. In other words, the model is used to identify the factors that contribute to the likelihood of a post-IPO abnormal return surprise. The analysis is based on variables that have been

proposed in the academic literature to explain post-IPO stock price performance (see, e.g., Brav and Gompers, 1997; Tykvova and Walz, 2007; Cao and Lerner, 2009). Probit estimation with multiple explanatory variables hypothesizes that the probability of a given occurrence is determined by the standardized normal distribution:

$$p = F(Z_i) \tag{5}$$

where Z_i is based on the following linear function:

$$Z_i = \alpha + \beta_1 PEbacked_i + \beta_2 FirmAge + \beta_3 URank_i + \beta_4 HighTech_i + \beta_5 Underpricing_i + \beta_6 Bubble_i + \beta_7 Leverage_i + \beta_8 FirmSize_i + \beta_9 BtM_i + \beta_{10} Heat_i + \varepsilon_i \tag{6}$$

where Z_i is a binary variable that equals one for an IPO in the top/bottom 10% decile and is zero otherwise, $PEbacked_i$ is a dummy variable that is equal to one for a buyout-backed IPO and zero otherwise, $FirmAge_i$ is the difference between the IPO date and the firm founding date in years, $URank_i$ is the reputation ranking of the IPO underwriter, $HighTech_i$ is a dummy variable that equals one for high-tech firms and is zero otherwise, $Underpricing_i$ is the initial return on the IPO, $Bubble_i$ is a dummy variable that equals one for IPOs issued in 1999-2000 and is zero otherwise, $Leverage_i$ is the ratio of total debt to total assets reported in the first quarterly report, $FirmSize_i$ is the natural logarithm of one plus the market capitalization of the firm at the end of the first trading day, BtM_i is the book-to-market ratio of the IPO firm based on the book value of equity reported in the first quarterly report and the market capitalization at the end of the first trading day, $Heat_i$ is the measure of market heat for the issuing quarter, and ε_{it} is the error term. The remainder of this subchapter provides a more detailed description of each of the explanatory variables.

Private equity backing

The variable of interest, $PEbacked_i$, captures the general effect of buyout backing on the stock market performance of an IPO. In the studies that use regression analysis to examine the effect of VC involvement on IPO performance, venture capitalist participation is typically denoted by a dummy variable (e.g., Megginson and Weiss, 1991; Brav and Gompers, 1997; Rindermann, 2004; Yung et al., 2008). Consistently, I use a dummy variable that is equal to one if the IPO is backed by a buyout sponsor and zero otherwise. The hypothesis that buyout-backed IPOs are associated with less extreme abnormal stock price performance compared to other IPOs predicts that the variable has a negative impact on the likelihood of an abnormal return surprise.

Company age

Demers and Joos, (2007) argue that there is greater uncertainty and a greater risk of failure associated with younger firms that do not have a record of past performance. Consistently, Brau and Stanley (2006) find that company CFOs view strong historical earnings as the most important factor in signaling IPO quality to potential investors. Their finding is consistent with Teoh et al. (1998) who demonstrate that reported earnings in the IPO prospectus have a significant impact on investor enthusiasm toward the offer. Furthermore, Lowry et al. (2010) show that IPOs of young firms are associated with higher underpricing and higher deviation of initial returns, which result from greater information asymmetries and valuation difficulties. In another article, Yung et al. (2008) find that older firms are less likely to delist within the five years following the IPO. Consistent with prior studies, I define the age of an IPO firm as the number of years between the IPO date and the firm's incorporation date (e.g., Weber and Willenborg, 2003; Yung et al., 2008). Based on the above remarks, the variable $FirmAge_i$ is expected to be negatively associated with the likelihood of a post-IPO abnormal return surprise.

Underwriter rank

Michaely and Shaw (1991) and Carter et al. (1998) provide evidence that underwriter quality is related to the long-run stock market performance of IPOs. To control for the relation of underwriter prestige and IPO performance, the $URank_i$ variable is included in the regression. The variable receives values on a scale of 0 to 9 with high-prestige underwriters having a ranking of 8 or higher.

The underwriter rankings used in my thesis are based on the rankings of Carter and Manaster (1990) and Carter et al. (1998) that have been complemented and corrected by Loughran and Ritter (2004). The reputational rankings are based on the pecking order among investment banks which is reflected in the "tombstone announcements". A tombstone announcement is the part of an announcement of a pending public security offering in which the investment banks in the underwriting syndicate are listed. The reputation of an underwriter is reflected by its position in the listing. The rankings are obtained from Jay Ritter's website.

In case of multiple lead underwriters, the rank of the bookrunner or the highest ranking joint-bookrunner is used in the regression analysis. This approach is consistent with Loughran and Ritter (2004). Based on the previous literature, IPOs underwritten by more reputable investment banks are expected to be associated with a lower likelihood of a negative return surprise. The expected effect of underwriter reputation on the likelihood of a positive abnormal return surprise, on the other hand,

is more difficult to judge. Previous findings of underwriter ranking being positively related to superior stock market performance of IPOs do not necessarily imply that offerings underwritten by more reputable investment banks should be among the top 10% of IPOs with the highest abnormal returns.

High-tech dummy

Lowry et al. (2010) argue that technology firms are characterized by high information asymmetry. Consequently, estimation of the value of a high-tech firm tends to be more difficult because it depends on growth options. The authors find that, compared to other IPOs, technology companies are associated with more underpricing and higher dispersion of initial returns. By studying changes in the level of IPO underpricing during 1980-2003, Loughran and Ritter (2004) find that the general increase in initial returns is partly attributable to the increase in the fraction of technology and internet IPOs.

$HighTech_i$ dummy controls for the higher uncertainty related to technology and biotechnology firms. The variable receives a value of one for high-tech firms and zero otherwise. Consistent with Loughran and Ritter (2004), the classification between high-tech and non-high-tech firms is based on the four-digit primary industry SIC codes. High-tech firms are expected to be associated with a higher likelihood of experiencing extreme post-IPO abnormal returns. The following industries are classified as high-tech industries:

- Biotechnology (2830, 2833, 2834, 2835, 2836, 8731)
- Computer hardware (3571, 3572, 3575, 3577, 3578)
- Communications equipment (3661, 3663, 3669)
- Electronics (3671, 3672, 3674, 3675, 3677, 3678, 3679)
- Navigation equipment (3812)
- Measuring and controlling devices (3823, 3825, 3826, 3827, 3829)
- Medical instruments (3841, 3845)
- Telephone equipment (4812, 4813)
- Communications services (4899)
- Software (7371, 7372, 7373, 7374, 7375, 7378, 7379)

Underpricing

Academic literature suggests that high underpricing is an indication of information asymmetry (e.g., Welch, 1989; Grinblatt and Hwang; 1989 and Allen and Faulhaber, 1989) and/or investor over-optimism surrounding the IPO (e.g., Miller, 1977; Cornelli et al. 2006; Purnanandam and Swaminathan, 2004). Ritter (1991) presents evidence that IPOs with high first-day returns are followed by abnormally low returns in the long-run. In a more recent study, Loughran and Ritter (2004) observe similar reversals for IPOs issued during the Internet bubble. However, the authors find no general negative relation between IPO underpricing and the subsequent stock market performance of a company. $Underpricing_i$ is expected to be positively associated with the likelihood of an IPO experiencing extreme post-IPO abnormal returns.

Bubble dummy

Loughran and Ritter (2004) argue that the internet bubble in 1999-2000 influenced the whole IPO market and not just internet and technology stocks. The authors point out that, for example, mature non-tech or non-biotech stocks also experienced higher first-day returns during the period. Consistently, Figure 4 in subchapter 5.2 shows a substantial increase in average underpricing in 1999-2000 for the IPO sample used in my thesis. In another paper, Ljungqvist and Wilhelm (2003) argue that the change in pricing behavior during the dot-com bubble followed mainly from incentives created by firm characteristics that were unique for the period. According to the authors, these include marked changes in pre-IPO ownership structures and insider selling behavior.

Identifying the unique characteristics that were driving IPO pricing and subsequent stock price performance during the internet boom is beyond the scope of my thesis. Therefore, the impact of these factors is taken into account by including a bubble dummy in the probit model. The $Bubble_i$ variable is equal to one for IPOs issued during 1999-2000 and zero otherwise.

Leverage

In the academic literature, high leverage is typically associated with firms of low growth opportunities and low information asymmetry (e.g., Rajan and Zinlgales, 1995; Dittmar and Thakor, 2007). Leverage is measured as the ratio of total debt to total assets reported in the first quarterly report following the initial public offering. High $Leverage_i$ is expected to be associated with a lower likelihood of a post-IPO abnormal return surprise.

Company size

Small companies are generally considered riskier than large companies. Analogously, small IPOs are potentially subject to more severe information asymmetries than large IPOs (e.g., Beatty and Ritter, 1986; Lowry et al., 2010). Company size also has implications for the type of investors that participate in the IPO. Institutional investors typically invest in companies of sufficient size which implies that small IPOs are potentially subject to greater investor sentiment (Bergström et al., 2006). Following Tykvova and Walz (2007) and Brav and Gompers (1997), company size is measured as the natural logarithm of one plus market capitalization at the end of the first trading day. Smaller companies are expected to be associated with a higher likelihood of experiencing extreme levels of post-IPO abnormal returns.

Book-to-market ratio

Book-to-market ratio can be interpreted as a risk factor (Fama and French, 1992) or as a proxy for investor sentiment (Rajan and Servaes, 2003). Accordingly, a low book-to-market ratio is an indication of either high idiosyncratic risk or investor over-optimism. In other words, book-to-market ratio reflects growth expectations associated with a specific firm. Stocks of firms with low book-to-market ratio are known as growth stocks while stocks of firms with high book-to-market are generally referred to as value stocks.

Both the risk factor and the investor sentiment interpretations suggest a negative relation between BtM_i and the uncertainty related to the value and the post-issue performance of an IPO. The variable is calculated as the book value of equity reported in the first quarterly report following the offering divided by the market value of equity at the end of the first trading day.

Market heat degree

The $Heat_i$ variable accounts for the effect of IPO market heat on post-issue stock price performance. It is a continuous variable that is measured as the moving average of a specific heat indicator divided by its historic average. The market heat variable receives positive values which are above (below) one for hot (cold) IPO market. I use two alternative heat indicators which are based on IPO activity and fixed investment growth. Based on the previous literature, IPOs issued during a hot market are expected to be associated with a higher probability of a negative abnormal return surprise (see Ritter and Welch, 2002; Yung et al., 2008).

The first measure of market heat is based on the total number of IPOs during a calendar quarter. This method of measuring IPO market heat is consistent with Yung et al. (2008). The purpose of using a four-quarter moving average is to control for the seasonality in IPOs which is illustrated by the observation that approximately 34% more IPOs were issued in the fourth quarter relative to the first quarter in the US during 1980-2008. The heat measure based on IPO activity is calculated as follows:

$$Heat1_t = \frac{\frac{1}{4}\sum_{i=t-3}^{t} NumIPO_t}{\frac{1}{t}\sum_{i=j}^{t} NumIPO_t} \quad (7)$$

where $Heat1_t$ is the measure of IPO market heat for the quarter t based on IPO activity, the numerator is the four-quarter moving average of the number of IPOs for the quarter t, and the denominator is the historic average of the number of IPOs calculated from the first quarter of 1960 until the quarter t.

The second approach to measuring IPO market heat is based on private firms' demand for capital. Pastor and Veronesi (2005) find that real fixed investment growth is positively related to recent market returns and negatively related to future market returns. Accordingly, the authors conclude that aggregate investment growth is related to changes in market conditions, similar to IPO volume. The link between IPO activity and investments is also supported by Lowry (2003) who finds that private firms' demand for capital is a key empirical determinant of IPO volume. Consequently, market heat is measured based on the percentage change in real private non-residential fixed investment. The heat measure based on private firms' demand for capital is calculated as follows:

$$Heat2_t = \frac{1 + \sum_{i=t-3}^{t} RealInve_t}{1 + \frac{1}{t}\sum_{i=j}^{t} RealInve_t} \quad (8)$$

where $Heat2_t$ is the measure of IPO market heat for the quarter t based on private firms' demand for capital, the numerator is the four-quarter moving average of the percentage change in real private non-residential fixed investment for the quarter t, and the denominator is the historic average of the indicator calculated from the first quarter of 1960 until the quarter t.

6.4 OLS regression

This subchapter describes the ordinary least squares regression models used in my thesis. Section 6.4.1 presents the regression model used in the empirical testing of hypotheses two and three.

Section 6.4.2 explains the regression model used in testing the robustness of the results provided by the probit model.

6.4.1 Testing the effect of LBO process and reputational differences

In the examination of hypotheses two and three, the analysis is confined to the buyout-backed initial public offerings. The testing is conducted using a regression model where the absolute value of post-IPO abnormal return is determined as a linear function of LBO holding period duration (hypothesis two), buyout firm reputation (hypothesis three) and a set of firm-specific control variables. The control variables are selected based on the regression models used in related studies (e.g., Brav and Gompers, 1997; Cao and Lerner, 2009). Having absolute values of post-IPO abnormal return as the dependent variable enables the model to capture the degree of abnormal return dispersion associated with the sample of buyout-backed IPOs. In the academic literature, absolute values of stock return are a widely used measure of volatility (e.g., Miller and Reilly, 1987; Longin and Solnik, 2001; Chordia et al., 2002). Positive (negative) correlation is an indication of high (low) abnormal returns which, in turn, implies high (low) information asymmetries. The following regression model is estimated:

$$|AR_{it}| = \alpha + \beta_1 LBOduration_i + \beta_2 ReputationProxy_i + \beta_3 URank_i + \beta_4 Leverage_i + \beta_5 FirmSize_i + \beta_6 BtM_i + \varepsilon_i \quad (9)$$

where $|AR_{it}|$ is the absolute value of stock return for firm i during period t, $LBOduration_i$ is the duration of the LBO holding period in years, $ReputationProxy_i$ is the proxy for buyout firm's reputation (based on age and capital under management), $URank_i$ is the reputation ranking of the IPO underwriter, $Leverage_i$ is the ratio of total debt to total assets reported in the first quarterly report, $FirmSize_i$ is the natural logarithm of one plus the market capitalization of the firm at the end of the first trading day, BtM_i is the book-to-market ratio of the newly listed firm based on the book value of equity reported in the first quarterly report and the market capitalization at the end of the first trading day, and ε_{it} is the error term.

In the finance literature, several methods have been used in estimating the level of reputation associated with a private equity investor. For instance, Jelic et al. (2005) base their reputation ranking on the number of MBO transactions completed by a private equity investor in their sample. In the empirical tests, the authors assign a high reputation dummy variable for the three PE firms with the most deals. In a similar manner, Rindermann (2005) uses the number of IPOs in which a

venture capitalist has been involved as a proxy for reputation. In another study, Lin and Smith (1998) measure venture capitalist reputation by age, number of deals and an index based on the two indicators. According to Gompers (1996), age becomes a proxy for VC reputation because young venture capitalists have not yet established a track record in the market. Yet another approach is adopted by Tykvova and Walz (2007) who construct a proxy of VC reputation based equally on the age of the VC and the amount of capital under management. In a similar manner, Espenlaub et al. (1999) and Cao and Lerner (2009) use a PE firm's age and capital under management to estimate the impact of PE reputation on post-IPO stock market performance. In my thesis, buyout firm's age and capital under management are selected as proxies for reputation[20]. Deal activity, although not tested in my thesis, is likely to have a high positive correlation with both the age and the amount of capital under management and, therefore, would probably lead to similar results.

6.4.2 Robustness test

In addition to testing hypotheses two and three, OLS regression is used as a robustness test for the results of the probit model. In the robustness check, absolute values of post-IPO abnormal returns are regressed on the same independent variables that are employed in the probit analysis. While the probit model approach is subject to discretion in determining the cut-off points of an abnormal return surprise, the OLS regression directly captures the degree of abnormal return dispersion associated with the sample of IPOs. Positive (negative) correlation is an indication of high (low) abnormal returns which, in turn, implies high (low) information asymmetries. The following regression model is estimated:

$$|AR_{it}| = \alpha + \beta_1 PEbacked_i + \beta_2 FirmAge + \beta_3 URank_i + \beta_4 HighTech_i + \beta_5 Underpricing_i + \beta_6 Bubble_i + \beta_7 Leverage_i + \beta_8 FirmSize_i + \beta_9 BtM_i + \beta_{10} Heat_i + \varepsilon_i \quad (10)$$

where $|AR_{it}|$ is the absolute value of stock return for firm i during period t, $PEbacked_i$ is a dummy variable that is equal to one for a buyout-backed IPO and zero otherwise, $FirmAge_i$ is the difference between the IPO date and the firm founding date in years, $URank_i$ is the reputation ranking of the IPO underwriter, $HighTech_i$ is a dummy variable that equals one for high-tech firms and is zero otherwise, $Underpricing_i$ is the initial return on the IPO, $Bubble_i$ is a dummy variable that equals one for IPOs issued in 1999-2000 and is zero otherwise, $Leverage_i$ is the ratio of total

[20] SDC Platinum has no historical data on the amount of capital under management, and, therefore the proxy is based on the latest reported amount of capital managed by the buyout firm. Using historical figures would provide a more accurate proxy of reputation at the time of the IPO.

debt to total assets reported in the first quarterly report, $FirmSize_i$ is the natural logarithm of one plus the market capitalization of the firm at the end of the first trading day, BtM_i is the book-to-market ratio of the IPO firm based on the book value of equity reported in the first quarterly report and the market capitalization at the end of the first trading day, $Heat_i$ is the measure of market heat for the issuing quarter, and ε_{it} is the error term.

7 EMPIRICAL RESULTS

The following chapter presents and discusses the empirical results of my thesis. Subchapter 7.1 presents and analyzes the findings of the univariate analysis. Results of the probit analysis are provided and discussed in subchapter 7.2. Finally, subchapter 7.3 describes the findings regarding the effect of the LBO process and reputational differences.

7.1 Results of the univariate analysis

In the univariate analysis the initial public offerings are divided into deciles based on the level of post-IPO abnormal returns. According to the hypothesis, there should be relatively less buyout-backed IPOs in the top and bottom deciles which represent offerings associated with extreme levels of post-issue abnormal returns. Consistent with the hypothesis, Figure 5 shows that the share of buyout-backed IPOs in the top 10% and bottom 10% deciles is consistently below the average share of buyout-backed IPOs in the whole sample. Although there is some variation in the shapes of the distributions and the proportions of buyout-backed IPOs per decile, the pattern remains robust regardless of the measurement period or the approach used in estimating abnormal returns.

Comparison of the results received using the three alternative benchmarks of abnormal return, shows that the distribution based on the market-adjusted model is slightly more tilted towards the top decile. This is particularly the case for the 6-month and 1-year horizons, where 62% and 66% of the 449 buyout-backed IPOs are in the top five deciles, respectively. Depending on the specification, post-issue abnormal returns turn positive in decile five or six. The tilted shape of the distribution implies that the market-adjusted model yields relatively higher abnormal returns for the buyout-backed IPOs compared to the control firm method and the four-factor model. Mean and median abnormal returns reported in Table 2 confirm that there is notable variation in the level of post-IPO abnormal returns between the different approaches. For the buyout-backed IPOs, the aggregate level of abnormal return is consistently higher in the estimates based on the market-adjusted model. For the non-buyout-backed IPOs, on the other hand, the aggregate level of abnormal return varies largely depending on the benchmark and the measurement period.

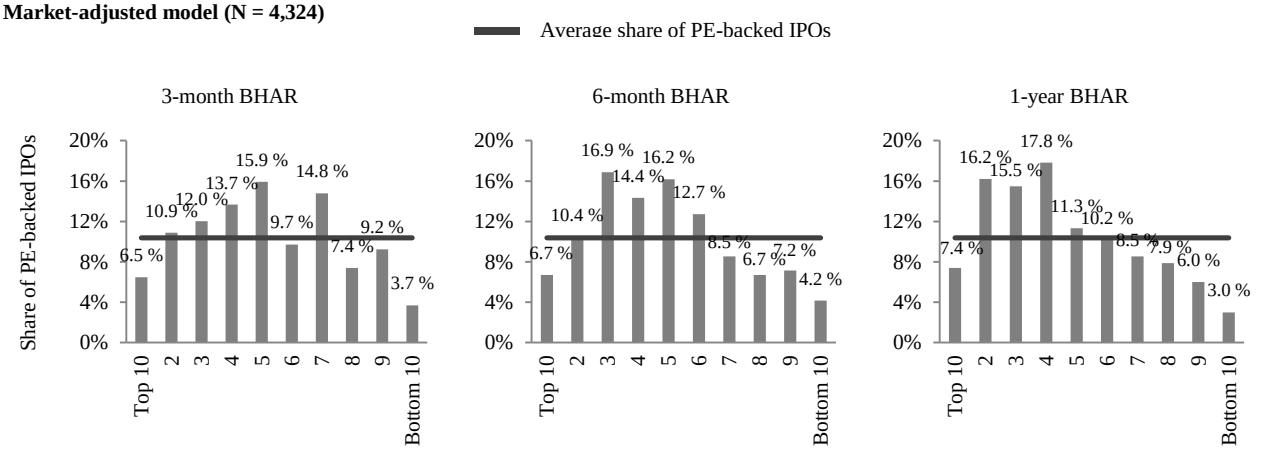
Figure 5: Relative distribution of abnormal returns of buyout-backed IPOs

The graphs below present the proportion of buyout-backed IPOs in the abnormal return deciles. The Top 10 (Bottom 10) decile comprises the 10% of IPOs that are associated with the highest positive (highest negative) abnormal returns. The relative distribution is provided for 3-month, 6-month and 1-year periods using buy-and-hold (Panel A) and cumulative returns (Panel B). Abnormal returns are calculated based on three approaches: market-adjusted model, control firm method and Fama-French-Carhart four-factor model. The sample consists of IPOs issued in the US during 1990-2008.

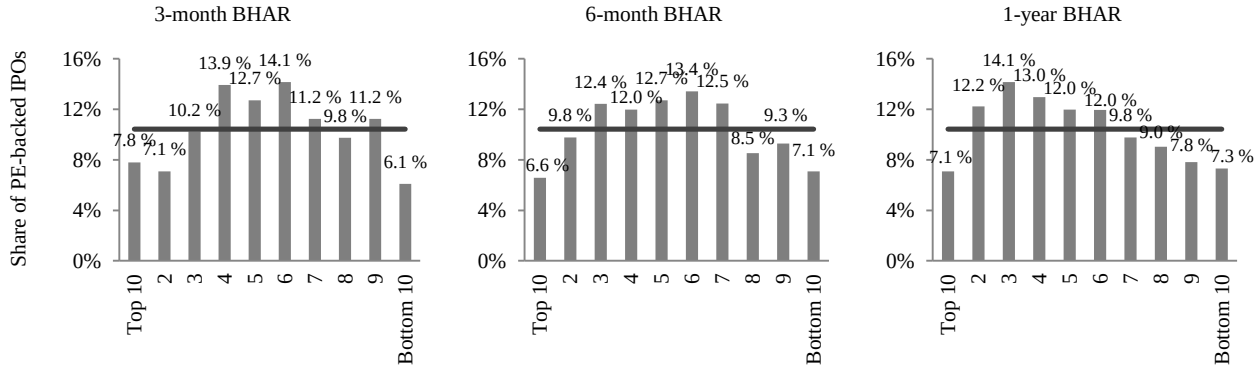
Panel A

Buy-and-hold abnormal return deciles

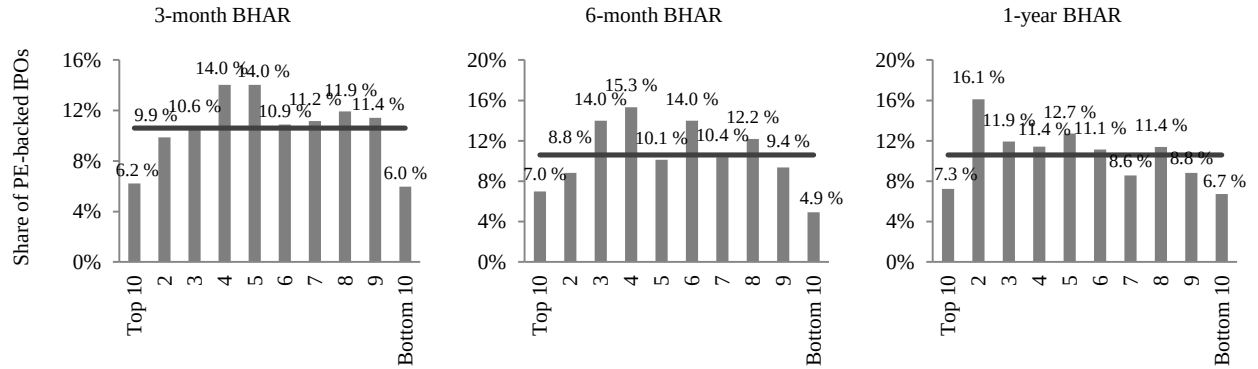
Market-adjusted model (N = 4,324)



Control firm method (N = 4,093)



Fama-French-Carhart (N = 3,853)



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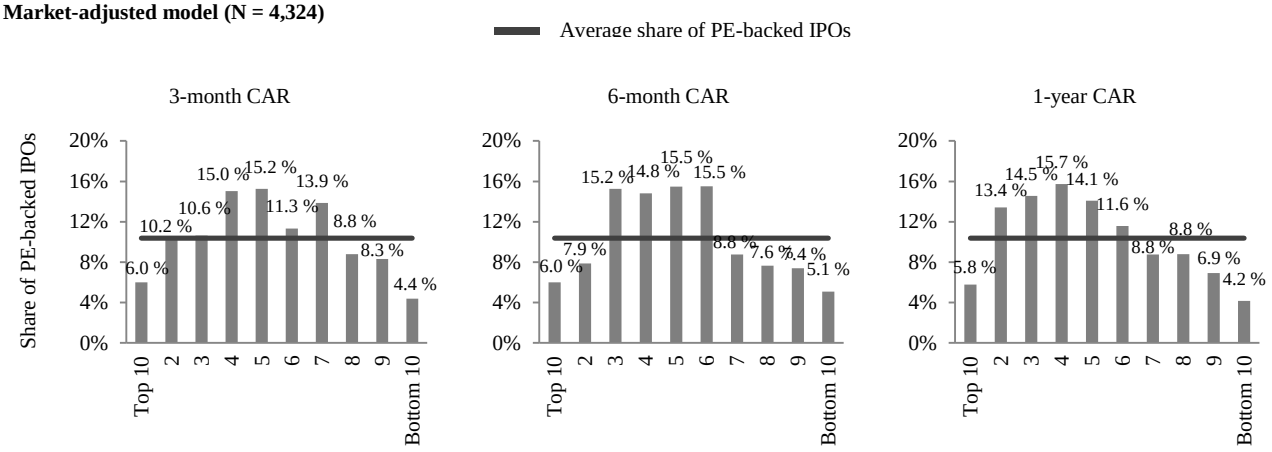
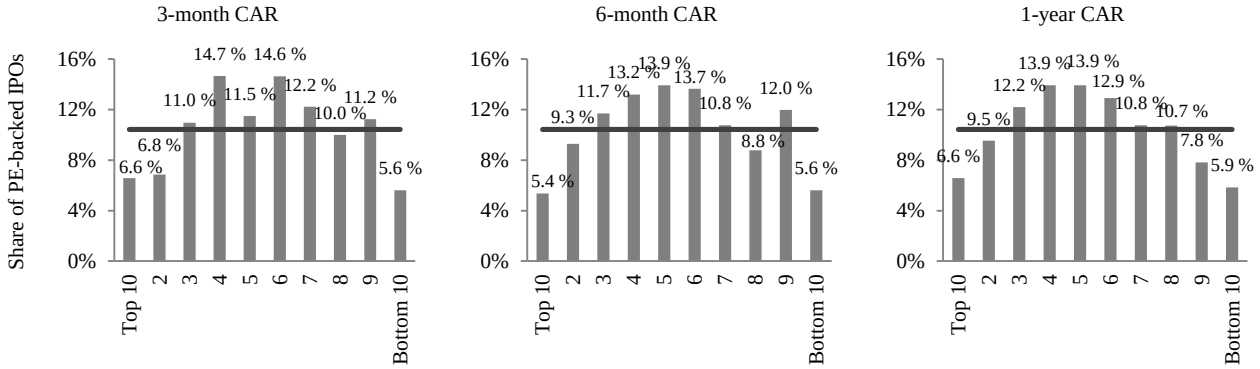
Panel B
Cumulative abnormal return deciles

Market-adjusted model (N = 4,324)



Control firm method (N = 4,093)



Fama-French-Carhart (N = 3,853)

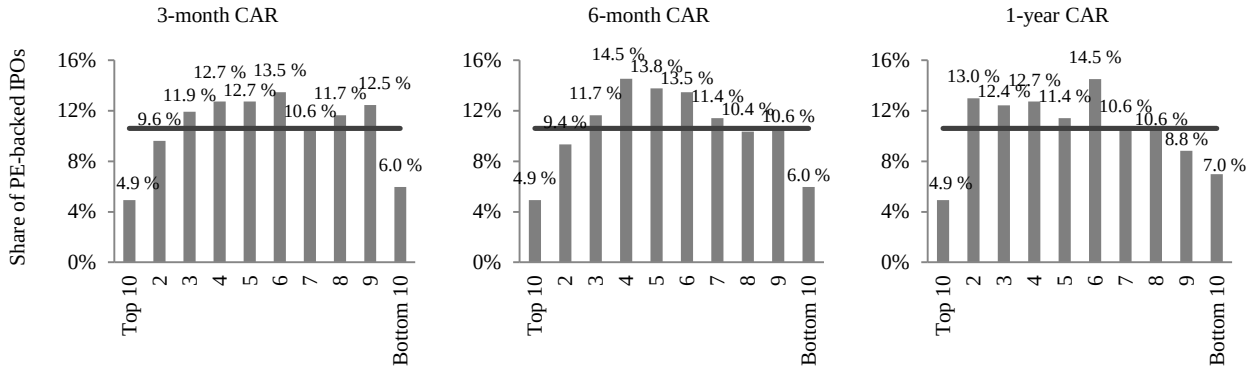


Table 2 clearly shows that the level of post-IPO abnormal returns is highly dependent on the choice of methodology. The aggregate levels of abnormal return vary markedly depending on the benchmark used in estimating abnormal returns and the approach used in calculating the returns. Therefore, instead of attempting to make inferences about the actual level of abnormal returns associated with initial public offerings, I focus on assessing the relative level of abnormal returns between the offerings. Furthermore, the mean and median figures in Table 2 are only broad

indicators of the level of abnormal returns associated with the IPOs in the sample. In order to provide a more detailed picture of the performance differences between buyout-backed IPOs and non-buyout-backed IPOs, I split the offerings into two subsamples which I divide into deciles based on the post-issue abnormal returns. The aggregate abnormal returns per subsample in Figure 6 show that, in the 6-month measurement period, buyout-backed IPOs are associated with lower mean and median buy-and-hold abnormal returns in effectively every decile. The difference between the subsamples appears to be particularly pronounced in the top and bottom deciles. The pattern remains consistent in the 3-month and 1-year horizons, and when abnormal returns are calculated as cumulative returns (results are not reported). The observation is in line with the hypothesis of professional buyout investors being able to reduce information asymmetries related to initial public offerings.

Table 2: Mean and median abnormal returns of the IPOs

The table presents the mean and median buy-and-hold abnormal returns (Panel A) and cumulative abnormal returns (Panel B) for the buyout-backed IPOs and the non-buyout-backed IPOs. Abnormal returns are calculated based on three approaches: market-adjusted model, control firm method and Fama-French-Carhart four-factor model. Results are presented for 3-month, 6-month and 1-year periods following the IPO. The sample consists of IPOs issued in the US during 1990-2008.

Panel A
Buy-and-hold abnormal returns

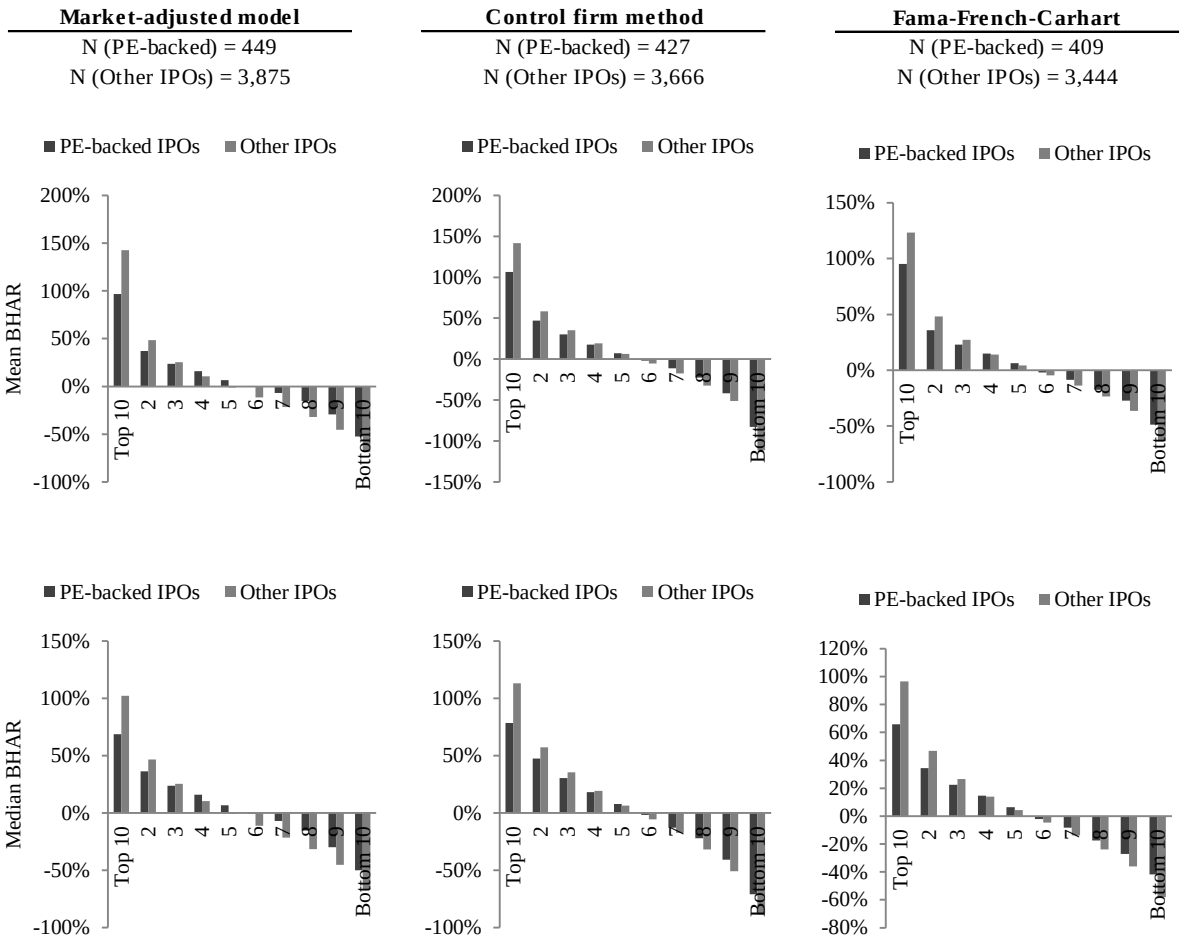
			3 months		6 months		1 year	
		Observations	Mean	Median	Mean	Median	Mean	Median
PE-backed IPOs	Market-adjusted	449	5.0 %	2.5 %	9.0 %	2.5 %	12.0 %	5.9 %
	Control firm	427	3.6 %	1.9 %	6.4 %	2.3 %	5.9 %	3.8 %
	Fama-French-Carhart	409	3.9 %	1.3 %	8.4 %	1.6 %	8.5 %	1.9 %
Other IPOs	Market-adjusted	3,875	4.2 %	-1.2 %	4.9 %	-6.3 %	-2.4 %	-17.8 %
	Control firm	3,666	3.8 %	2.1 %	4.6 %	0.4 %	-3.2 %	-5.3 %
	Fama-French-Carhart	3,444	5.9 %	1.0 %	7.7 %	-0.3 %	5.3 %	-5.6 %

Panel B
Cumulative abnormal returns

			3 months		6 months		1 year	
		Observations	Mean	Median	Mean	Median	Mean	Median
PE-backed IPOs	Market-adjusted	449	4.3 %	3.6 %	7.0 %	5.6 %	8.9 %	11.8 %
	Control firm	427	2.6 %	1.7 %	4.0 %	3.6 %	2.2 %	5.9 %
	Fama-French-Carhart	409	3.3 %	2.0 %	5.9 %	5.7 %	6.9 %	7.3 %
Other IPOs	Market-adjusted	3,875	3.3 %	0.5 %	3.6 %	0.3 %	-2.4 %	-1.9 %
	Control firm	3,666	3.3 %	2.4 %	3.5 %	2.9 %	-3.3 %	-1.1 %
	Fama-French-Carhart	3,444	5.3 %	2.5 %	7.2 %	4.3 %	6.6 %	5.3 %

Figure 6: Mean and median 6-month buy-and-hold abnormal returns by decile

The graphs below present the mean and median abnormal returns by decile for the subsamples of buyout-backed IPOs and non-buyout-backed IPOs. The IPOs are divided into deciles based on the 6-month post-IPO buy-and-hold abnormal returns. The Top 10 decile includes the 10% of IPOs with the highest positive abnormal returns and the Bottom 10 decile includes the 10% of IPOs with the highest negative abnormal returns. Three approaches are used in estimating abnormal returns: market-adjusted model, control firm method and Fama-French-Carhart. The sample consists of IPOs issued in the US during 1990-2008.



In order to further assess the pattern suggested by the graphs in Figure 5, the statistical significance of the difference in the proportion of buyout-backed IPOs in the top/bottom decile is examined relative to the average share of buyout-backed IPOs in the whole sample. Table 3 presents the results of a t-test on the significance of the difference. The results indicate that the share of buyout-backed IPOs in the top and bottom deciles is significantly smaller compared to the sample average. The market-adjusted model, the control firm method and the Fama-French-Carhart four-factor model provide consistent results. Tests based on buy-and-hold abnormal returns show slight variation in the level of statistical significance while results based on cumulative abnormal returns are consistently significant at the 1% level.

Table 3: Results of t-test on the share of buyout-backed IPOs in top and bottom return deciles

The table presents the results of the t-test on the proportion of buyout-backed IPOs in the top 10% and bottom 10% abnormal return deciles. The statistical significance of the difference in the share of buyout-backed IPOs in the top/bottom decile relative to average share of buyout-backed IPOs in the whole sample is indicated by an asterisk. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively. Abnormal returns are calculated based on three approaches: market-adjusted model, control firm method and Fama-French-Carhart model. Results using buy-and-hold returns are presented in Panel A and results using cumulative returns are presented in Panel B. The sample consists of IPOs issued in the US during 1990-2008.

Panel A
Buy-and-hold abnormal returns

			Share of buyout-backed IPOs			
		Observations	3 months	6 months	1 year	Sample mean
Top 10%	Market-adjusted	4,324	6.5%***	6.7%***	7.4%**	10.4 %
	Control firm	4,093	7.8%*	6.6%***	7.1%***	10.4 %
	Fama-French-Carhart	3,853	6.2%***	7%***	7.3%**	10.6 %
Bottom 10%	Market-adjusted	4,324	3.7%***	4.2%***	3.0%***	10.4 %
	Control firm	4,093	6.1%***	7.1%***	7.3%**	10.4 %
	Fama-French-Carhart	3,853	6.0%***	4.9%***	6.7%***	10.6 %

Panel B
Cumulative abnormal returns

			Share of buyout-backed IPOs			
		Observations	3 months	6 months	1 year	Sample mean
Top 10%	Market-adjusted	4,324	6.0%***	6.0%***	5.8%***	10.4 %
	Control firm	4,093	6.6%***	5.4%***	6.6%***	10.4 %
	Fama-French-Carhart	3,853	4.9%***	4.9%***	4.9%***	10.6 %
Bottom 10%	Market-adjusted	4,324	4.4%***	5.1%***	4.2%***	10.4 %
	Control firm	4,093	5.6%***	5.6%***	5.9%***	10.4 %
	Fama-French-Carhart	3,853	6.0%***	6.0%***	7.0%***	10.6 %

To summarize, the results obtained in the univariate analysis provide support for the hypothesis that buyout backed IPOs are associated with less extreme post-IPO abnormal returns compared to non-buyout-backed IPOs. T-test indicates that, relative to the average share of buyout-backed IPOs in the whole sample, the proportion of buyout-backed offerings is significantly smaller among the 10% of IPOs with the highest positive abnormal returns and the 10% of IPOs with the highest negative abnormal returns. However, it should be noted that the results are only indicative as the univariate approach does not control for the effect of issue-specific factors aside from buyout backing.

7.2 Results of the probit analysis

The following subchapter presents the results of the probit analysis. Section 7.2.1 discusses the results regarding the impact of buyout backing and section 7.2.2 provides a brief assessment of the control variables used in the probit model.

7.2.1 General impact of buyout backing

In the probit analysis, the probability of an IPO being in the top/bottom decile of abnormal stock market performance is determined by a function of multiple issue-specific characteristics (see subchapter 6.3). Hence, the probit model extends the univariate approach by controlling for a set of factors that can affect the likelihood of a post-IPO abnormal return surprise. As explained in subchapter 6.1, I use two different measurement methods and three alternative benchmarks in calculating abnormal returns to ensure the robustness of the results. This leads to a total of 36 estimations of the probit model. Therefore, to facilitate the readability of the analysis presented in this subchapter, results based on the market-adjusted model and the Fama-French-Carhart four-factor model are placed in the appendix (see Appendix 2 and 3). Table 4 presents the results of the probit model based on the control firm method which, according to Barber and Lyon (1997) and Jegadeesh (2000), is the preferred method for estimating long-term abnormal returns. In the analysis, I discuss and compare the results of the three approaches.

Results of the probit model imply that buyout backing in general is not a determinant of the likelihood of a post-IPO abnormal return surprise. The finding applies to both positive and negative return surprises. The hypothesis predicted a significant negative relation between buyout backing and the probability of an IPO being in the top/bottom decile of abnormal stock market performance. In the probit model, the coefficient of the variable (*PE dummy*) used for capturing the impact of buyout backing remains non-significant in all 36 estimations (with the exception of the Fama-French-Carhart model 6-month BHAR). In addition, the sign of the variable varies largely between estimations, thus further suggesting that the observations in the univariate analysis are explained by factors other than buyout sponsor involvement. Changing the cut-off points that determine an abnormal return surprise in the probit model from 10% to 15% does not alter the results regarding the impact of buyout backing (results are not reported). Furthermore, the finding is confirmed by the OLS regression model which is used as a robustness check for the probit approach. Table 5 presents the results of the OLS model based on the control firm method. Comparable results based on the market-adjusted model and the four-factor model are provided in the appendix (see Appendix 1). In the OLS estimations, the relation between buyout backing and the absolute value of abnormal returns remains non-significant. Moreover, the sign of the coefficient is positive in all estimations which is contrary to the prediction of the hypothesis (with the exception of the market-adjusted model 1-year CAR).

Table 4: Determinants of post-IPO extreme abnormal returns (control firm method)

The table presents the results of the probit model regarding the determinants of extreme post-IPO abnormal stock performance. Extreme abnormal performance is defined relative to other IPOs in the sample by splitting the IPOs into deciles based on buy-and-hold abnormal returns (Panel A) and cumulative abnormal returns (Panel B). Abnormal returns are estimated using the control firm method. Top 10% decile (Bottom 10% decile) represent IPOs with extreme positive (negative) abnormal return surprises. The dependent variable is equal to one for IPOs in the top/bottom 10% decile and zero for IPOs in the remaining nine deciles. The results are reported for 3-month, 6-month and 1-year periods. The explanatory variables are PE dummy (dummy variable indicating whether or not the issue is backed by a buyout sponsor), firm age (age of the firm at the time of IPO in years), underwriter rank (underwriter's reputation ranking), high-tech dummy (dummy variable indicating IPO by a high-tech company), underpricing (first day return), bubble dummy (dummy variable indicating an issue during the internet bubble in 1999-2000), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization), book-to-market (first reported book value of equity divided by the market capitalization at the end of first trading day) and market heat (four-quarter moving average of the number of IPOs divided by its historic average). The sample consists of IPOs issued in the US during 1990-2008. Z-statistics are reported in parenthesis below each variable. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Number of observations: PE-backed IPOs 427 & Other IPOs 3,666

	Buy-and-hold abnormal returns						Cumulative abnormal returns					
	Top 10 decile			Bottom 10 decile			Top 10 decile			Bottom 10 decile		
Variable	3m	6m	1y	3m	6m	1y	3m	6m	1y	3m	6m	1y
Intercept	0.21	0.51	0.09	0.1	0.46	1.6**	-0.05	0.08	-0.33	-0.47	0.26	1.09*
	(0.33)	(0.82)	(0.15)	(0.17)	(0.76)	(2.57)	(-0.08)	(0.13)	(-0.53)	(-0.75)	(0.43)	(1.72)
PE dummy	0.18	-0.02	-0.09	0.13	0.12	0.1	0.1	-0.09	-0.001	0.13	0.04	0.05
	(1.62)	(-0.21)	(-0.84)	(1.11)	(1.08)	(0.91)	(0.88)	(-0.79)	(0.00)	(1.07)	(0.30)	(0.42)
Firm age	-0.001	-0.001	-0.001	-0.003	-0.004*	-0.003*	-0.003	-0.003	-0.001	-0.002	-0.002	-0.01***
	(-0.44)	(-0.86)	(-0.65)	(-1.44)	(-1.95)	(-1.94)	(-1.48)	(-1.56)	(-0.61)	(-1.14)	(-1.34)	(-2.77)
Underwriter rank	0.04**	0.05***	0.04**	-0.05***	-0.05***	-0.01	0.03	0.04**	0.02	-0.08***	-0.07***	-0.05***
	(2.22)	(2.77)	(2.22)	(-3.05)	(-3.05)	(-0.54)	(1.60)	(1.98)	(1.05)	(-4.59)	(-3.91)	(-2.98)
High-tech dummy	0.29***	0.26***	0.19***	0.07	0.11*	0.15**	0.27***	0.28***	0.26***	0.11*	0.12*	0.15**
	(4.73)	(4.18)	(3.12)	(1.20)	(1.84)	(2.47)	(4.31)	(4.44)	(4.26)	(1.84)	(1.94)	(2.43)
Underpricing	-0.001	-0.03	0.002	0.2***	0.15**	0.28***	-0.004	-0.07	-0.04	0.14**	0.1*	0.25***
	(-0.02)	(-0.46)	(0.03)	(3.41)	(2.49)	(4.69)	(-0.06)	(-1.03)	(-0.64)	(2.37)	(1.71)	(4.23)
Bubble dummy	0.59***	0.4***	-0.06	0.61***	0.65***	0.64***	0.63***	0.59***	0.32***	0.68***	0.71***	0.78***
	(7.62)	(5.04)	(-0.70)	(7.69)	(8.22)	(8.09)	(8.16)	(7.66)	(3.95)	(8.54)	(9.04)	(9.87)
Leverage	-0.46***	-0.25	-0.09	-0.36**	-0.03	0.15	-0.52***	-0.17	-0.34**	-0.4**	-0.22	0.2
	(-2.60)	(-1.49)	(-0.56)	(-2.11)	(-0.18)	(0.97)	(-2.91)	(-1.01)	(-2.02)	(-2.29)	(-1.30)	(1.21)
Firm size	-0.1***	-0.11***	-0.09**	-0.06*	-0.08**	-0.16***	-0.08**	-0.09**	-0.06*	-0.03	-0.06*	-0.11***
	(-2.87)	(-3.13)	(-2.45)	(-1.73)	(-2.17)	(-4.27)	(-2.24)	(-2.46)	(-1.77)	(-0.73)	(-1.68)	(-2.99)
Book-to-market	-0.29**	-0.45***	-0.3***	-0.18*	-0.17	-0.02	-0.29**	-0.41***	-0.51***	-0.24**	-0.24**	-0.21*
	(-2.55)	(-3.50)	(-2.71)	(-1.75)	(-1.64)	(-0.19)	(-2.51)	(-3.15)	(-3.75)	(-2.11)	(-2.16)	(-1.89)
Market heat	0.05	0.003	0.03	0.06	-0.02	-0.09*	0.03	0.03	0.11**	0.11**	-0.01	-0.08
	(0.98)	(0.05)	(0.59)	(1.12)	(-0.47)	(-1.69)	(0.49)	(0.64)	(2.23)	(2.08)	(-0.26)	(-1.45)
Prob > χ^2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pseudo R^2	0.06	0.04	0.02	0.06	0.06	0.06	0.07	0.06	0.04	0.08	0.07	0.09

As noted in the introduction of my thesis, there appears to be only one study on the relation between private equity backing and post-IPO long-term abnormal returns that adopts an approach somewhat similar to mine. In the article, Tykvova and Walz (2007) find evidence that the participation of a venture capitalist significantly decreases the idiosyncratic volatility of an IPO in the two-year post-issue period. The authors attribute the finding to venture capitalists' ability to overcome information asymmetries. Similar to my thesis, Tykvova and Walz (2007) use a dummy variable to capture the general effect of VC backing. Although my results appear to contradict the finding presented in the article, there are some important differences between the two studies that could explain the differences in the results. Firstly, the authors examine venture capital-backed IPOs while my focus is on buyout-backed IPOs. Potential implications of this are discussed in subchapter 7.3. Secondly, the article examines IPOs issued in Germany whereas my thesis investigates IPOs issued in the US. The German Neuer Markt is much younger than the US IPO market and, therefore, it is potentially more subject to market inefficiencies (also noted by the authors). And finally, the methodology used in the article is somewhat different from the methodology used in my thesis. The most important methodological difference is that the authors focus on examining the abnormal return volatility of individual stocks whereas my focus is on the magnitude of abnormal returns. As previously noted, stock-specific volatility is potentially a noisy measure of information asymmetry due to liquidity differences between IPO shares. Furthermore, the authors estimate abnormal returns only based on the capital asset pricing model (CAPM).

Regarding other related studies, a comparison of results is possible only to a certain extent due to the novel approach used in my thesis. First of all, the probit model only examines the determinants of extremely positive or negative abnormal returns. Therefore, my findings are not directly comparable with studies that use OLS regression or a similar method to investigate the general relation between PE backing and long-term abnormal returns of an IPO. Secondly, as previous studies typically adopt a one-sided approach to investigating the impact of PE backing on post-IPO stock price performance, it is not possible to make direct comparisons based on the results of the robustness test either. Nonetheless, since both the probit analysis and the robustness check indicate no explicit relation between buyout backing and post-IPO abnormal returns, my results could be considered analogous to studies that find no significant negative or positive relation between PE backing and post-IPO abnormal returns. These include Holthausen and Larcker (1996) on US reverse leveraged buyouts, Rindermann (2004) on UK and German VC-backed IPOs, Jelic et al. (2005) on UK venture capital-backed IPOs and Cao (2011) on US reverse leveraged buyouts.

Table 5: Robustness test (control firm method)

The table presents the results of the OLS regression which is used as a robustness check for the results of the probit model (hypothesis 1). The dependent variable is the absolute value of abnormal return. Abnormal returns are estimated based on the control firm method. Results are reported for 3-month, 6-month and 1-year periods using buy-and-hold returns and cumulative returns. The independent variables are PE dummy (dummy variable indicating whether or not the issue is backed by a buyout sponsor), firm age (age of the firm at the time of IPO in years), underwriter rank (underwriter's reputation ranking), high-tech dummy (dummy variable indicating IPO by a high-tech company), underpricing (first day return), bubble dummy (dummy variable indicating an issue during the internet bubble in 1999-2000), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization), book-to-market (first reported book value of equity divided by the market capitalization at the end of first trading day) and market heat (four-quarter moving average of the number of IPOs divided by its historic average). The sample consists of IPOs issued in the US during 1990-2008. T-statistics are reported in parenthesis below each variable. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Number of observations: PE-backed IPOs 427 & Other IPOs 3,666

	Buy-and-hold abnormal returns			Cumulative abnormal returns		
Variable	3m	6m	1y	3m	6m	1y
Intercept	0.84***	1.3***	1.91***	0.64***	1.06***	1.51***
	(6.96)	(7.16)	(7.58)	(6.70)	(7.94)	(8.06)
PE dummy	0.02	0.03	0.005	0.02	0.03	0.001
	(1.12)	(0.88)	(0.11)	(1.02)	(1.27)	(0.04)
Firm age	-0.004	-0.001*	-0.0004	-0.001*	-0.001**	-0.001
	(-1.47)	(-1.71)	(-0.68)	(-1.91)	(-2.29)	(-1.47)
Underwriter rank	-0.001	0.003	0.006	-0.005*	-0.01	-0.01**
	(-0.23)	(0.54)	(0.76)	(-1.68)	(-1.46)	(-2.52)
High-tech dummy	0.07***	0.11***	0.15***	0.06***	0.08***	0.1***
	(5.40)	(5.90)	(5.62)	(5.73)	(5.65)	(5.12)
Underpricing	0.02	0.05**	0.16***	0.02	0.03	0.1***
	(1.47)	(2.31)	(5.07)	(1.53)	(1.63)	(4.37)
Bubble dummy	0.3***	0.37***	0.28***	0.27***	0.35***	0.41***
	(16.18)	(13.28)	(7.14)	(18.38)	(17.31)	(14.32)
Leverage	-0.09***	-0.04	0.02	-0.1***	-0.09**	-0.04
	(-2.90)	(-0.82)	(0.25)	(-3.70)	(-2.51)	(-0.82)
Firm size	-0.03***	-0.05***	-0.07***	-0.02***	-0.03***	-0.04***
	(-4.13)	(-4.38)	(-4.78)	(-3.10)	(-4.04)	(-3.78)
Book-to-market	-0.04**	-0.07***	-0.08**	-0.05***	-0.07***	-0.14***
	(-2.56)	(-2.77)	(-2.26)	(-3.43)	(-3.50)	(-5.02)
Market heat	-0.001	-0.03*	-0.04*	0.004	-0.01	-0.01
	(-0.12)	(-1.84)	(-1.87)	(0.54)	(-0.55)	(-0.71)
Prob > F	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.11	0.08	0.05	0.14	0.12	0.11

Based on the probit approach and the robustness test, it appears that the results of the univariate analysis are, at least partly, explained by firm-specific factors that are characteristic of a leveraged buyout. Table 6 shows that buyout backing (*PE dummy*) has a positive correlation with the *leverage* variable, the *firm size* variable and the *firm age* variable. In other words, buyout-backed IPOs in the sample tend to be large and mature firms with relatively high leverage. These three variables, on the other hand, appear to be inversely related to the likelihood of an abnormal return surprise. The statistical significance of the effect varies depending on the specifications used in the probit model. Consistently, the results of the OLS regression show that the variables are negatively related to the absolute level of post-IPO abnormal returns. By dropping the variables from the probit model, the

coefficient of the *PE dummy* becomes significantly negative in some of the estimations. The effect becomes more pronounced if the *high-tech dummy* is also excluded. This is not unexpected as the majority of the buyout-backed IPOs in the sample are non-high-tech firms. These findings are in line with the fact that buyout sponsors typically target mature firms in stable industries, and that leveraged buyouts, by definition, are characterized by high levels of debt (Sahlman, 1990; Groh and Gottschalg, 2007).

Another explanation for the finding of buyout backing not having a general effect on the degree of IPO-related information asymmetries derives from the interplay between the factors that determine the ability of a buyout investor to alleviate information asymmetries. As previously discussed, reputational concerns, the LBO-screening process and the value-adding process are candidates in this category. However, if these factors are not in line with each other, the certification signal becomes mixed and information asymmetries persist. For example, investors might not buy into the reputational certification in case of a quick flip that was acquired only months before the IPO date. As an implication, buyout backing would have no general role in the mitigation of IPO-related information asymmetries because the ability of a buyout investor to alleviate the problem would be determined case-by-case. Empirical testing of hypotheses two and three in subchapter 7.3 provides an assessment of two factors that can be seen to contribute to the ability of a buyout investor to overcome information asymmetries, namely LBO duration and buyout investor's reputation.

A non-mutually exclusive explanation derives from the uncertainty related to the post-IPO plans of the buyout owner. Although investors know for a fact that the buyout sponsor will eventually sell or distribute its stake in the company, the post-IPO role of the buyout firm and the exact timing of the exit might be less clear at the time of the offering. While the buyout sponsor's active commitment to the post-IPO governance and development of the company could make the transition of ownership smoother and be beneficial for the performance of the company, any uncertainty related to the matter provides a new source of asymmetric information. In other words, buyout-backed IPOs could be subject to specific information asymmetries that offset any possible certification effects related to buyout backing. The explanation is supported by the finding of Bradley et al., (2001) that VC-backed IPOs are associated with significantly higher negative abnormal returns at lockup period expiration compared to other IPOs. To overcome the uncertainty related to the post-lockup intentions of the insiders, the authors propose a mandatory disclosure of selling plans by the original owners before the offering.

Table 6: Correlations between explanatory variables

The matrix presents correlations between the explanatory variables employed in the regression models. The variables are PE dummy (dummy variable indicating whether or not the issue is backed by a buyout sponsor), firm age (age of the firm at the time of IPO in years), underwriter rank (underwriter's reputation ranking), , high-tech dummy (dummy variable indicating IPO by a high-tech company), underpricing (first day return), bubble dummy (dummy variable indicating an issue during the internet bubble in 1999-2000), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization), book-to-market (market capitalization at the end of first trading day divided by first reported book value of equity), IPO activity (four-quarter moving average of the number of IPOs divided by its historic average) and real investment (four-quarter moving average of the change in real private non-residential fixed investment divided by its historic average).

	Firm age	Underwriter rank	High-tech dummy	PE dummy	Bubble dummy	Underpricing	Leverage	Book-to-market	Firm size	IPO activity
Underwriter rank	0.17									
High-tech dummy	-0.24	0.09								
PE dummy	0.23	0.19	-0.13							
Bubble dummy	-0.1	0.17	0.21	-0.09						
Underpricing	-0.13	0.1	0.2	-0.08	0.39					
Leverage	0.24	0.07	-0.31	0.29	-0.12	-0.17				
Book-to-market	0.23	0.03	-0.24	0.03	-0.14	-0.21	0.09			
Firm size	0.16	0.69	0.13	0.23	0.35	0.38	0.06	-0.15		
IPO activity	-0.11	-0.23	-0.03	-0.28	-0.14	-0.04	-0.03	-0.03	-0.33	
Real investment	-0.11	-0.09	0.06	-0.11	0.16	0.09	-0.05	-0.06	-0.02	0.49

To summarize the analysis, hypothesis one is rejected and it is concluded that, in general, IPOs backed by professional buyout sponsors are equally subject to information asymmetries as any other initial public offerings. The finding remains robust to three different benchmarks of abnormal return, namely the market-adjusted model, the control firm method and the Fama-French-Carhart four-factor model. Furthermore, the method of calculating abnormal returns and the measurement period used in the estimation has no effect on the results. In addition, the robustness test based on OLS regression confirms the results of the probit model.

7.2.2 Assessment of the control variables

Due to the novel methodological approach used in my study, I provide a brief assessment of the effects related to the control variables used in the probit model. *Firm age* is the first control variable reported in the probit output in Table 4. Older firms have established a record of past performance which should reduce information asymmetries and facilitate the valuation of the IPO (Demers and Joos, 2007; Lowry et al., 2010). Therefore, the age of a firm was expected to be negatively associated to with the probability of an abnormal return surprise. Regarding the likelihood of an IPO being associated with a positive abnormal return surprise, the effect of *firm age* is consistently negative which is in line with expectations (only exception is the market-adjusted model 1-year BHAR). However, the explanatory power of the variable is statistically significant only in the 6-

month BHAR and CAR estimations based on the Fama-French-Carhart model. On the other hand, the impact of *firm age* on the likelihood of an IPO being in the bottom decile appears to be stronger: older firms seem to be associated with a lower probability of a negative return surprises. While results based on the market-adjusted model are consistently significant at the 1% to 10% level, the control firm and four-factor model suggest a lagged effect. In these approaches, the coefficient of *firm age* becomes significant only in the 6-month and 1-year horizons. Results of the robustness test confirm that *firm age* is negatively related to the absolute level of post-IPO abnormal returns. The coefficient of the variable is statistically significant in 15 out of 18 estimations of the OLS model.

The measure of underwriter reputation appears to be positively related to the likelihood of a positive return surprise and negatively related to the likelihood of a negative return surprise. Similar to the *firm age* variable, the effect is consistently significant in the simple market-adjusted approach while results based on the control firm method and the Fama-French-Carhart model show more variation in the level of statistical significance. Although the sign of the variable is consistent with my expectations and the existing literature (e.g., Michaely and Shaw, 1991; Carter et al., 1998), it is not self-evident whether there should be a significant positive relation between *underwriter rank* and positive abnormal return surprises. Previous findings of superior performance being associated with IPOs underwritten by more reputable investment banks do not necessarily imply that these IPOs would be associated with extremely high levels of positive abnormal return. The finding that underwriter reputation is more significantly related to IPO performance than buyout backing appears to contradict the results of Doukas and Gonenc (2005) who argue that underwriter reputation matters only in the absence of a venture capitalist.

The *high-tech dummy* captures the likelihood that IPOs of firms classified as high-tech are associated with extreme abnormal returns. Regarding positive return surprises, the variable is positive and significant at the 1% level in all estimations. The results are consistent with the argument that technology firms are characterized by high information asymmetry and potential valuation difficulties (Lowry et al., 2010). However, results on the probability of a high-tech IPO being associated with a negative return surprise are more ambiguous. While the sign of the coefficient is generally positive, with some exceptions in the estimations based on the market-adjusted model, the effect appears to be statistically significant only in the control firm method. If high-tech firms were associated with high information asymmetries and difficulties to accurately value the growth options of the company, one would expect high-tech IPOs also to have a greater likelihood of producing negative return surprises to investors. A potential explanation for the finding could be that investors are more conservative in the valuation of high-tech IPOs because

they acknowledge the information asymmetries and uncertainties associated with these companies. As a result, negative abnormal return surprises attributable to the *high-tech dummy* would become smaller relative to abnormal return surprises experienced by non-high-tech IPOs. Furthermore, conservative IPO valuations would also lead to more pronounced positive abnormal returns. The results of the robustness test support the explanation as the coefficient of *high-tech dummy* is consistently positive and significant at the 1% level. The strong relation implies that high-tech firms are associated with both high positive and high negative abnormal returns (depending on the specification, 47% to 61% of the high-tech IPOs in the sample are associated with negative returns).

According to the academic literature, large initial return is an indication of information asymmetry (e.g., Welch; 1989, Grinblatt and Hwang, 1989; Allen and Faulhaber, 1989) and/or investor over-optimism surrounding the IPO (e.g., Miller, 1977; Cornelli et al. 2006; Purnanandam and Swaminathan, 2004). Consequently, *underpricing* was expected to increase the probability of an IPO being associated with an abnormal return surprise. Results of the probit model indicate that high initial returns do not have a significant effect on the likelihood of a positive return surprise. On the other hand, there appears to be a significant positive relation between *underpricing* and the probability of a negative return surprise. This observation is consistent with the reversal effect of high first-day returns being followed by abnormally low returns in the long-run (Ritter, 1991). Furthermore, the finding is in line with the explanation that due to investor over-optimism, IPO shares can be overpriced relative to their long-run intrinsic value and still exhibit positive initial returns (e.g., Purnanandam and Swaminathan, 2004; Derrien, 2005; Ljungqvist et al., 2006).

The *bubble dummy* variable in the model aims to capture the unique characteristics associated with IPOs issued during the dot-com bubble in 1999-2000 (see Ljungqvist and Wilhelm, 2003). Remarkably, the variable appears to significantly increase the probability of an IPO being related with either a positive or a negative abnormal return surprise. The only exceptions are the top decile 1-year BHAR estimates for the coefficient which are non-significant regardless of the approach used in estimating abnormal returns. Likewise, the robustness test indicates a positive correlation between the *bubble dummy* and the absolute level of abnormal returns. In the OLS model, the effect is statistically significant at the 1% level in all estimations except the four-factor model 1-year BHAR which shows significance at the 5% level. The results indicate a high dispersion in the quality of IPOs issued during the internet bubble. However, it is outside the scope of my thesis to further analyze the impact of the dot-com bubble on the stock market performance of IPOs.

Researchers argue that high leverage is a characteristic of firms with low growth opportunities and low information asymmetries (e.g., Rajan and Zingales, 1995; Dittmar and Thakor, 2007). Consistently, the results of the probit model indicate that highly leveraged IPOs are associated with a lower probability of being in the top decile. The negative effect of the *leverage* variable on the likelihood of a positive return surprise is significant in 12 out of 18 estimations (mostly at the 1% and 5% significance level). On the other hand, results regarding the effect of *leverage* on the likelihood of a negative return surprise are less evident. While the estimates based on the market-adjusted model are consistently negative and significant in the 3-month and 6-month horizons, in the estimations based on the control firm method and the four-factor model, the coefficients turn positive in the 1-year measurement period. Providing an exhaustive explanation for the reversal is difficult because the *leverage* variable captures not only the effect of capital structure but also the effects of multiple firm-specific characteristics that are reflected by the capital structure. For instance, the correlations in Table 6 show that high leverage is a characteristic of large and mature non-high-tech firms. It seems only intuitive that large mature firms in stable industries can afford to take on more debt. Results of the OLS regression indicate that highly leveraged firms are generally associated with lower levels of post-issue abnormal returns. The coefficient of the variable is consistently negative and becomes statistically significant in 11 out of 18 estimations.

Small IPOs are considered riskier and potentially subject to more severe information asymmetries and/or greater investor sentiment compared to large IPOs (e.g., Beatty and Ritter, 1986; Brav and Gompers, 1997; Bergström et al., 2006; Lowry et al., 2010). Consequently, f*irm size* was expected to be negatively associated with the likelihood of an abnormal return surprise. In the top decile, the negative relation appears to hold well with 15 out of 18 estimations being statistically significant. However, the results regarding a negative return surprise are somewhat mixed. While the effect is consistently negative in the estimations based on the control firm method and the four-factor model, the estimations based on the market-adjusted model indicate a positive effect. Given the simplistic approach of the market–adjusted model, the results based on the previous two approaches are likely to provide a more reliable picture of the effect. Furthermore, the results of the control firm method and the four-factor model are in line with the previous finding of small firm size being significantly related to the long-term underperformance of IPOs (Brav and Gompers, 1997). The robustness check also indicates that older firms are associated with lower levels of abnormal returns. In the OLS model, the negative effect of *firm size* is statistically significant in 16 out of 18 estimations.

The *book-to-market* variable captures the risk and/or investor sentiment related to growth firms. Consistent with the expectations, a high *book-to-market* ratio reduces the probability of an IPO

being associated with an abnormal return surprise. The effect is statistically significant in 32 out of 36 estimations. The finding is in line with the conception of growth stocks being riskier and potentially subject to greater investor sentiment compared to value stocks.

The final control variable, *market heat*, accounts for the possible impact of IPO market heat on the stock market performance of an initial public offering. Previous literature argues that hot IPO markets are associated with higher information asymmetries and larger variation in the quality of firms going public (Ritter and Welch, 2002; Yung et al., 2008). Consequently, issuance during a hot IPO market was expected to increase the probability of a negative return surprise. In my study, I use the number of IPOs and the change in fixed investments as two alternative measures for market heat (see subchapter 6.3). The variables are highly correlated as seen in Table 6 and, accordingly, lead to similar results. Therefore, results are reported only for the heat measure based on IPO activity. The coefficient of the *market heat* variable is consistent with the expectations only in the simple market-adjusted model while results based on the control firm method and the four-factor model are mixed and generally non-significant. A potential explanation for the difference is that the results based on the simple market-adjusted model are driven by firm-specific characteristics that are captured by the control firm method and the Fama-French-Carhart model in the estimation of abnormal returns.

As a general remark, it should be noted that regression models used in long-term event studies are typically subject to some degree of multicollinearity caused by correlations between the independent variables. However, given the large size of the sample used in my study and the modest levels of correlation reported in Table 6, it seems unlikely that my results would suffer from serious multicollinearity. Furthermore, the effects of the control variables are consistent with findings presented in previous studies, which also indicates that multicollinearity should not be a problem.

7.3 Analysis on the effect of LBO process and reputational differences

Even though buyout-backed IPOs generally appear to be no different from other IPOs in terms of information asymmetries, it is important to examine the factors that determine the ability of a buyout sponsor to alleviate information asymmetry in order to better understand the role of buyout backing in the mitigation of IPO-related information asymmetries. For instance, while Jelic et al. (2005) and Rindermann (2004) observe no general relation between VC backing and post-IPO long-run returns, they find evidence of superior stock price performance by a subgroup of IPOs backed by reputable and international venture capitalists, respectively. Section 7.3.1 provides a descriptive analysis of how LBO duration and buyout firm reputation are related to post-issue abnormal returns of buyout-backed IPOs. Section 7.3.2 presents the results of the OLS regression model.

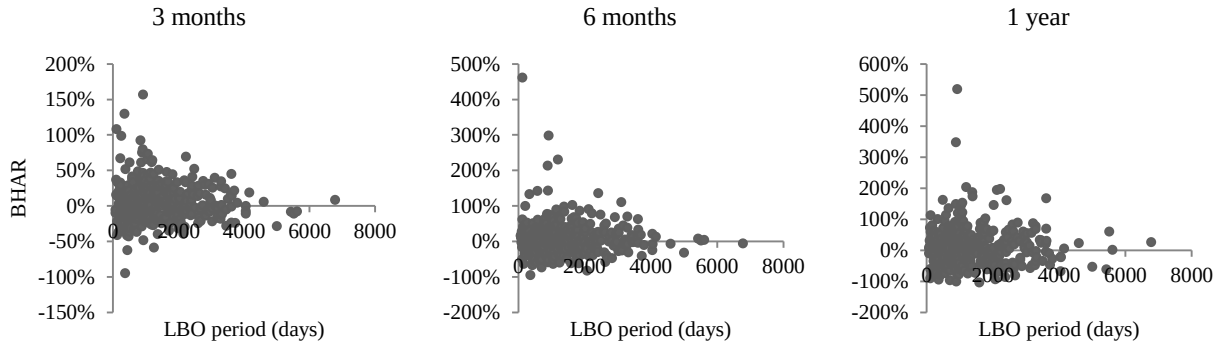
7.3.1 Descriptive analysis

Hypothesis two examines the impact of the value-adding LBO process on the degree of IPO-related information asymmetry. In assessing the effect, LBO duration is used as a proxy for the stage of the process which, in turn, reflects the degree to which the buyout sponsor has mitigated informational asymmetries and agency problems faced by the new owners in an IPO. The hypothesis predicts that buyout-backed IPOs with longer LBO investment period are associated with less extreme post-IPO abnormal returns. Figure 7 presents the relation between LBO duration and buy-and-hold abnormal returns. Consistent with the hypothesis, the shapes of the graphs seem to indicate a negative relation between the LBO duration and the level of abnormal return associated with an IPO. Using cumulative abnormal returns provides scatter plots with similar shapes (see Appendix 4).

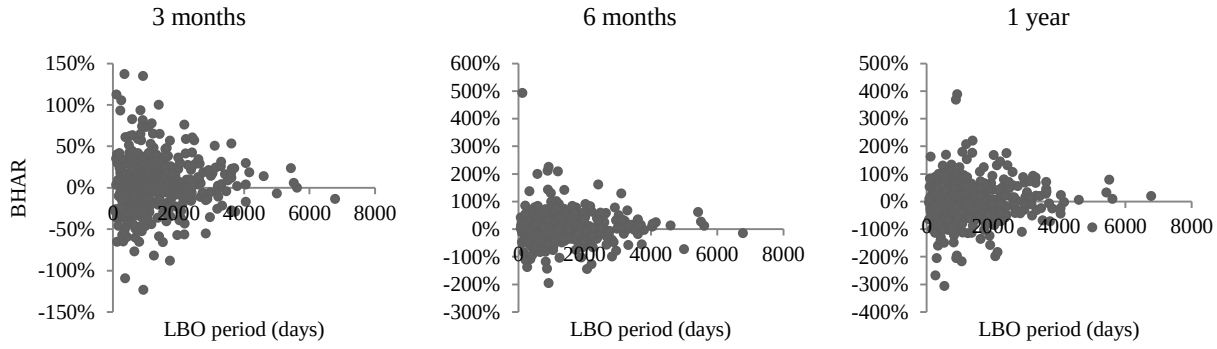
Figure 7: Relation between abnormal returns and LBO duration

The graphs below illustrate the relation between post-IPO abnormal returns and the duration of the LBO investment period. In case of a secondary buyout, the duration of the previous LBO is included in the LBO duration. Abnormal returns are calculated as buy-and-hold abnormal returns (BHAR) for 3-month, 6-month and 1-year periods using three approaches: marked-adjusted model, control firm method and Fama-French-Carhart four-factor model. The sample consists of buyout-backed IPOs issued in the US during 1990-2008.

Market-adjusted model (N = 447)



Control firm method (N = 425)



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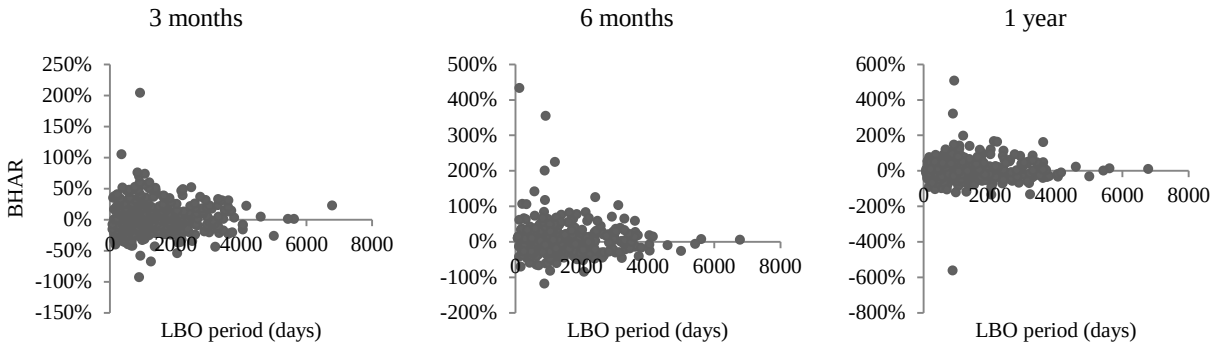
Fama-French-Carhart (N = 408)



Hypothesis three addresses the impact of buyout firm reputation on the degree of IPO-related information asymmetry. More reputable buyout sponsors are expected to be more efficient in reducing information asymmetries because investors acknowledge that they have more reputational capital at stake. Figure 8 presents the relation between post-IPO abnormal returns and two different proxies of reputation, namely the amount of capital managed by the buyout investor and the age of the buyout firm at the time of the IPO. In Panel A, the shapes of the scatter plots illustrating the relation between post-IPO abnormal returns and the amount of capital under management are somewhat similar to the observations regarding LBO duration. In other words, there seems to be a wider dispersion of abnormal returns among IPOs backed by buyout firms with less capital under management. Using cumulative abnormal returns produces scatter plots with similar shapes (see Appendix 5). The finding provides indicative support for the reputational certification role of buyout investors.

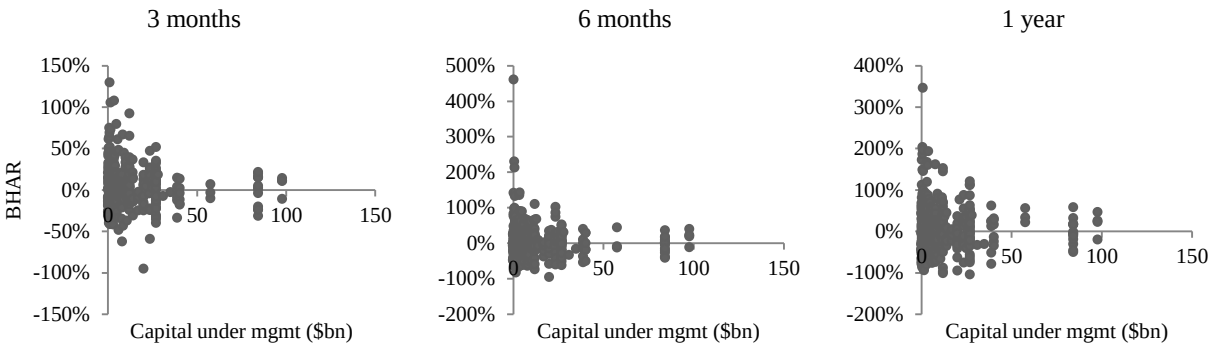
Panel B in Figure 8 illustrates the relation between post-IPO abnormal returns and the age of the buyout firm at the time of the IPO. Compared to the observations regarding LBO duration and capital under management, the shapes of the age graphs provide a less clear picture of the possible relation with abnormal returns. In fact, the distribution of post-IPO abnormal returns based on the buyout firm's age appears to be arbitrary. Using cumulative abnormal returns provides scatter plots with similar shapes (see Appendix 5). Gompers (1996), who was among the first researchers to use venture capitalist's age as a proxy for reputation, notes that age is an imperfect measure of the reputation of a VC firm because experienced partners sometimes leave to start new venture capital firms. In other words, the reputation of a private equity firm is largely based on the reputation and experience of its partners. Accordingly, it might be that the amount of capital under management provides a better proxy of reputation as it reflects the level of reputation established by a buyout firm over time.

Figure 8: Relation between abnormal returns and buyout firm's reputation

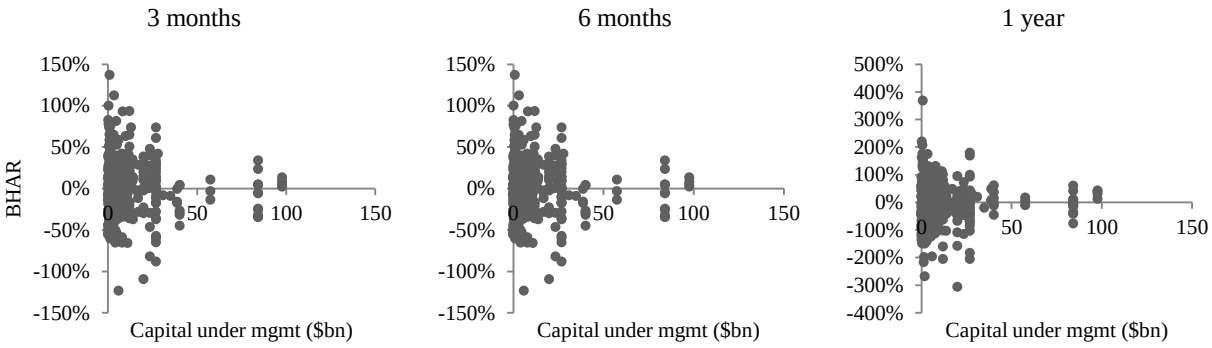
The graphs below illustrate the relation between post-IPO abnormal returns and two proxies used for buyout firm reputation. The relation is presented for buyout firm's capital under management in Panel A and buyout firm's age at the time of IPO in Panel B. Abnormal returns are calculated as buy-and-hold abnormal returns (BHAR) for 3-month, 6-month and 1-year periods using three approaches: marked-adjusted model, control firm method and Fama-French-Carhart four-factor model. The sample consists of buyout-backed IPOs issued in the US during 1990-2008.

Panel A
Relation between capital under management and BHAR

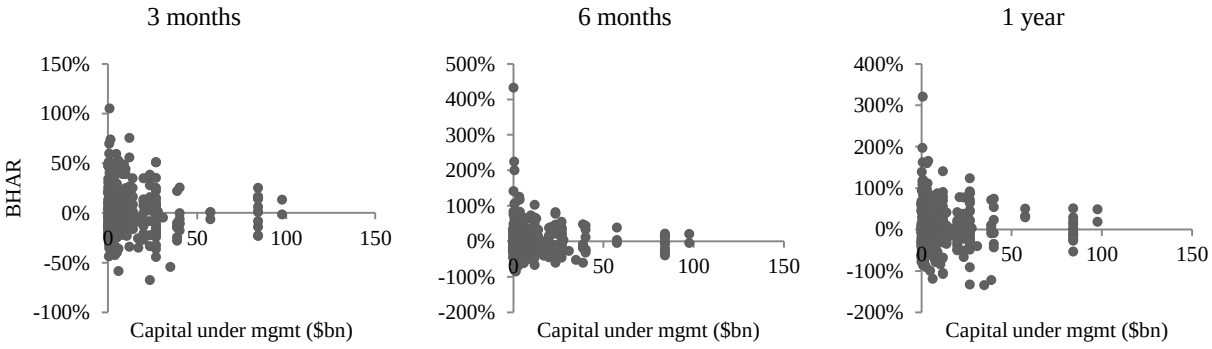
Market-adjusted model (N = 420)



Control firm method (N = 399)



Fama-French-Carhart (N = 383)



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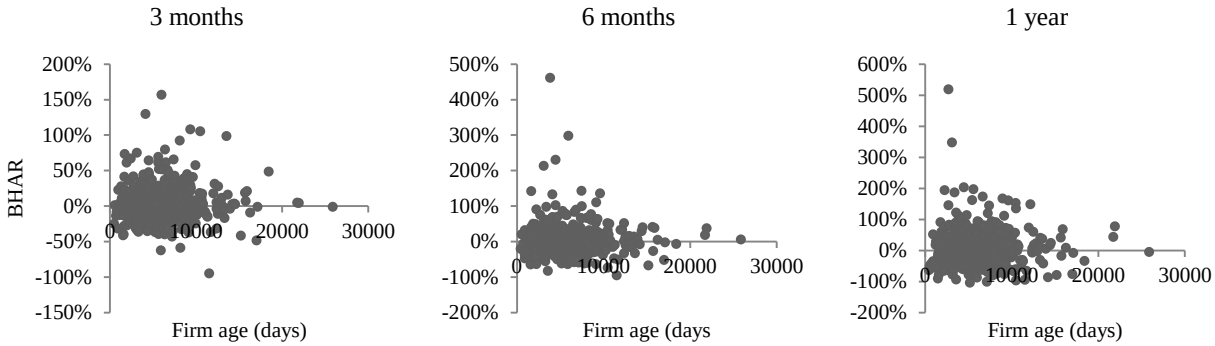
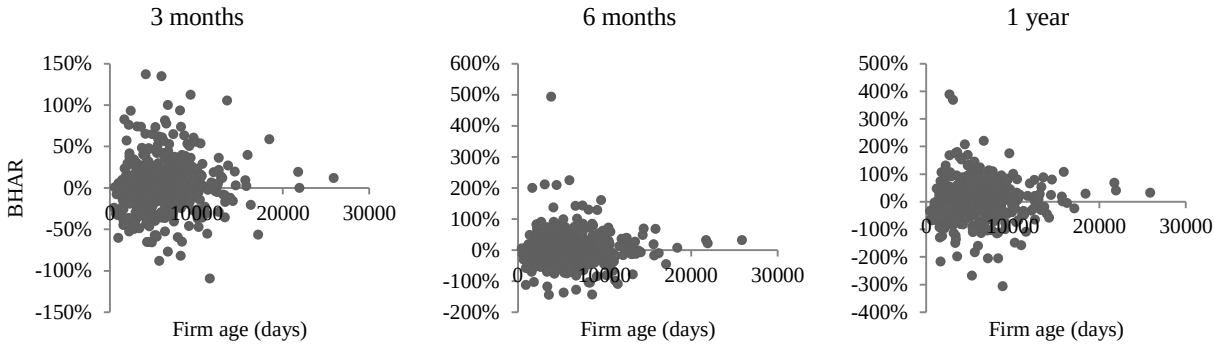
Panel B
Relation between buyout firm age and BHAR

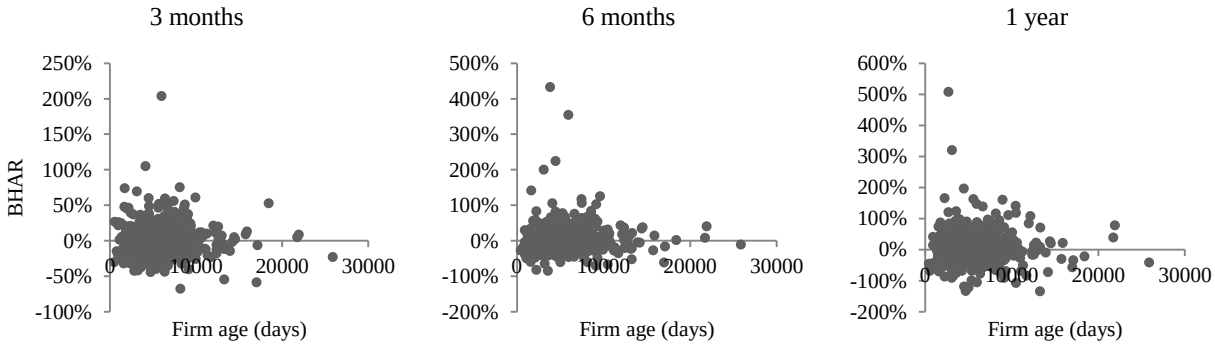
Market-adjusted model (N = 444)



Control firm method (N = 422)



Fama-French-Carhart (N = 405)



7.3.2 Results of the OLS regression

The next step in testing the effects of LBO duration and reputation employs regression analysis to control for the effect of other firm-specific characteristics. The regression model used in the analysis is described in subchapter 6.4. Similar to subchapter 7.2, results of the estimations based on the market-adjusted model and the Fama-French-Carhart model are provided in the appendix (see Appendix 6). Table 7 presents the results of the OLS regression model in which abnormal returns are calculated using the control firm method. In the analysis presented in this section, I discuss and compare the results of the three approaches. In general, the empirical results provide support for the effect of LBO duration while the hypothesis regarding the effect of reputation is rejected.

The results presented in Table 7 are consistent with the hypothesis that LBO duration is negatively associated with the level of post-IPO abnormal returns. The coefficient of *LBO duration* is negative in all estimations regardless of the benchmark or measurement period used in estimating post-IPO abnormal returns. Moreover, the results are not affected by the method used for calculating the abnormal returns. The effect is statistically significant in 24 out of 36 estimations and appears to be most pronounced in the 3-month post-IPO horizon. The results are unlikely to be driven by only positive or negative abnormal returns as the split between positive and negative returns is almost even in the sample (the share of buyout-backed IPOs associated with negative abnormal returns varies between 44% and 48% depending on the specifications). The finding provides support for the argument that LBO investment duration signals the degree to which the buyout sponsor has mitigated informational asymmetries and agency problems faced by the new owners in an IPO (see Cumming and MacIntosh, 2001).

Direct comparison of the results to previous findings is complicated by the fact that previous studies adopt a one-sided approach to examining the relation between LBO duration and post-IPO abnormal returns. Nonetheless, my results are in line with Cao (2011) who finds that reverse leveraged buyouts with shorter LBO duration experience greater deterioration of operating performance and a higher probability of bankruptcy compared to RLBOs with a longer LBO duration. In another study examining US reverse leveraged buyouts, Cao and Lerner (2009) find that quick flips, that is buyout-backed IPOs with LBO duration less than one year, perform worse compared to RLBOs with a longer LBO duration. The performance differences, however, are not statistically significant. In a study on venture capitalist certification, Megginson and Weiss (1991) show that IPO underpricing is less pronounced when VC investment duration is longer, suggesting that the investment duration is negatively related to the level of information asymmetry.

As previously discussed, the argument that the length of the LBO duration is associated with the degree of IPO-related information asymmetry is based on the idea that the duration of the buyout investment period reflects the stage of the value-adding process which, in turn, determines the signaling effect related to the process. In other words, a short LBO duration implies that the governance and operational improvements might not have been completed at the time of the IPO. Consequently, buyout-backed IPOs with short LBO duration become associated with greater uncertainty and information asymmetry regarding the intrinsic value of the company. The argument is in line with Barry et al. (1990) and Chemmanur and Loutskina (2007) who assert that the time devoted to pre-IPO monitoring by a venture capitalist investor is likely to improve the quality of the company relative to other IPOs. In explaining the expected sign of the abnormal return surprise related to a buyout-backed IPO with short LBO duration, the motivation for the decision to take the portfolio company public becomes highly important. For instance, high positive abnormal returns could be associated with IPOs that are motivated by a need for additional capital to fund growth rather than an attempt to cash out quickly. In this scenario, the portfolio company would be facing significant growth opportunities and the buyout sponsor would be unwilling or unable to provide the additional funding itself. High negative abnormal returns, on the other hand, could be an indication of window dressing practices or an attempt to take advantage of favorable listing conditions[21]. Such opportunistic behavior could be prompted by the finite lifetime of a buyout fund and the compensation structure of the general partner which incentivizes buyout firms to extract maximum profits from their investments within a certain horizon (see Cao, 2011). Table 6 in subchapter 7.2, however, shows a negative correlation between buyout backing and the measures of IPO market heat, which implies that buyout sponsors do not take advantage of market conditions that other issuers seem to find attractive.

The regression results in Table 7 indicate no significant relation between the level of post-IPO abnormal returns and the two variables used as proxies for buyout firm reputation. For the *capital under management*, the sign of the coefficient is consistent with the hypothesis but the effect becomes statistically, albeit weakly, significant only in the estimation based on 6-month CAR. At the same time, the results based on the market-adjusted model and the four-factor model are mixed and consistently non-significant. As indicated by the descriptive analysis, buyout firm's age is not related to the level of post-IPO abnormal returns. The coefficient of *PE firm age* is mixed and non-significant in all of the estimations. Based on the results of the regression model, hypothesis three is rejected.

[21] Window dressing refers to the practice of making financial statements look better by managing accruals.

Table 7: Effect of LBO duration and buyout firm's reputation (control firm method)

The table presents the results of the OLS regression regarding the impact of LBO duration and buyout firm's reputation on the dispersion of post-IPO abnormal returns. Abnormal returns are measured using the control firm method. Results are reported for 3-month, 6-month and 1-year periods using buy-and-hold returns (Panel A) and cumulative returns (Panel B). The dependent variable is the absolute value of abnormal return. The independent variables are LBO duration (duration of the LBO holding period in years), capital under management (natural logarithm of one plus the latest reported amount of capital managed by the buyout firm), PE firm age (age of the buyout firm at the time of the IPO in years), underwriter rank (underwriter's reputation rank), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization) and book-to-market (first reported book value of equity divided by the closing market capitalization of IPO date). The sample consists of IPOs issued in the US during 1990-2008. T-statistics are reported in parenthesis below each variable. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Panel A

Buy-and-hold abnormal return

	3 months		6 months		1 year	
Intercept	0.64**	0.66**	1.53***	1.59***	2.68***	2.6***
	(2.25)	(2.45)	(2.79)	(3.07)	(3.46)	(3.57)
LBO duration	-0.01***	-0.02***	-0.01	-0.01	-0.02	-0.02*
	(-2.66)	(-3.10)	(-1.26)	(-1.27)	(-1.54)	(-1.66)
Reputation proxies						
Capital under management	-0.002		-0.03		-0.01	
(N = 399)	(-0.25)		(-1.56)		(-0.21)	
PE firm age		0.001		0.0003		-0.001
(N = 422)		(0.61)		(-0.14)		(-0.33)
Control variables						
Underwriter rank	0.02	0.02	0.01	-0.002	-0.006	0.001
	(1.62)	(1.62)	(0.31)	(-0.07)	(-0.02)	(0.03)
Leverage	-0.02	-0.02	-0.02	-0.03	-0.08	-0.08
	(-0.27)	(-0.29)	(-0.19)	(-0.26)	(-0.47)	(-0.50)
Firm size	-0.03	-0.03*	-0.04	-0.05*	-0.09**	-0.09**
	(-1.53)	(-1.84)	(-1.38)	(-1.93)	(-2.12)	(-2.35)
Book-to-market	-0.05	-0.05	-0.12*	-0.12*	-0.2**	-0.2**
	(-1.38)	(-1.50)	(-1.77)	(-1.87)	(-2.13)	(-2.12)
Prob > F	0.06	0.02	0.09	0.20	0.06	0.05
R^2	0.03	0.04	0.03	0.02	0.03	0.03

Panel B

Cumulative abnormal return

	3 months		6 months		1 year	
Intercept	0.63**	0.64***	1.28***	1.35***	2.41***	2.36***
	(2.58)	(2.77)	(3.36)	(3.71)	(4.56)	(4.74)
LBO duration	-0.01***	-0.02***	-0.01	-0.01	-0.02**	-0.02**
	(-3.11)	(-3.60)	(-1.32)	(-1.36)	(-2.09)	(-2.32)
Reputation proxies						
Capital under management	-0.004		-0.02*		-0.01	
(N = 399)	(-0.53)		(-1.72)		(-0.48)	
PE firm age		0.001		-0.0003		0.003
(N = 422)		(0.99)		(-0.02)		(1.53)
Control variables						
Underwriter rank	0.02*	0.02*	-0.01	-0.02	-0.0005	-0.01
	(1.92)	(1.77)	(-0.44)	(-0.87)	(-0.02)	(-0.20)
Leverage	-0.02	-0.01	-0.02	-0.03	0.06	0.04
	(-0.31)	(-0.29)	(-0.29)	(-0.41)	(0.51)	(0.42)
Firm size	-0.02*	-0.03**	-0.03	-0.04*	-0.09***	-0.09***
	(-1.71)	(-2.06)	(-1.31)	(-1.94)	(-2.81)	(-3.22)
Book-to-market	-0.04	-0.05	-0.08	-0.08*	-0.12*	-0.12**
	(-1.39)	(-1.54)	(-1.63)	(-1.78)	(-1.89)	(-1.98)
Prob > F	0.01	<0.01	0.04	0.09	0.01	<0.01
R^2	0.04	0.05	0.03	0.03	0.04	0.05

Regarding previous studies on the effect of buyout firm's reputation on IPO performance, my results are in line with Levis (2011) and Cao and Lerner (2009) who find no evidence of buyout firm reputation having a significant effect on post-IPO abnormal stock market performance. In the previous article, the author examines a sample of buyout-backed IPOs issued in the UK during 1992-2005. Unfortunately, due to the non-significant results, Levis (2011) does not report his exact findings regarding the reputational effect. Cao and Lerner (2009), on the other hand, focus on reverse leveraged buyouts issued in the US between 1981 and 2003. They find that offerings backed by buyout firms that are repeat players in the IPO market perform no differently compared to IPOs backed by first time participants. The authors also use the amount of capital under management to examine the relation between IPO performance and buyout firm's reputation. Although RLBOs backed by buyout groups with more capital under management exhibit slightly better long-run performance, the difference is not statistically significant. Cao and Lerner (2009) conclude that the evidence as to whether more reputable buyout groups guarantee better IPO performance in the long-run remains ambiguous.

While the number of studies on the reputational effect of buyout backing is very limited, there are numerous articles that address the impact of venture capitalist reputation. Consistent with the previously discussed studies on buyout backing, Rindermann (2004) finds no significant relation between post-IPO stock market performance and the age of the venture capitalist backing the issue. In another European study, Tykvova and Walz (2007) observe no explicit relation between the level of VC reputation and post-IPO abnormal returns. The authors measure reputation by a ranking based equally on the age of the VC and the amount of funds under management. However, Tykvova and Walz (2007) present weak evidence of VC reputation being associated with lower post-IPO abnormal return volatility. The effect becomes statistically significant only for a subset of independent venture capitalists. On the other hand, there are also studies that find a positive relation between VC reputation and IPO performance. By examining VC-backed IPOs in the UK, Epenlaub et al. (1999) and Jelic et al. (2005) find that the long-term performance of IPOs is positively related to the reputation of the venture capital backers. The previous article uses VC firm's age and capital under management as proxies for reputation while the latter measures VC reputation based on the number of transactions completed by the venture capitalist. Krishnan et al. (2011) study US VC-backed IPOs and find a significant positive association between VC reputation, measured by the past market share of VC-backed IPOs, and measures of long-run firm performance.

As previously noted, one should be careful when comparing the results of this study with the findings presented in the existing literature. In addition to the novel approach adopted in my thesis,

there are at least two data related differences that complicate the comparability of the results regarding the reputational effect. First of all, majority of previous studies appear to focus on the European markets instead of the US market. Bruton et al. (2010) note that country-specific differences in institutional settings and legal systems can have significant implications for the empirical results and applicability of theories. Secondly, and more importantly, most previous studies on the association between PE firm's reputation and post-IPO abnormal returns focus on venture capital-backed IPOs instead of buyout-backed IPOs. Although Barry et al. (1990) argue that venture capitalists are in many ways similar to buyout specialists, there are important differences in the business models that also could explain the differences in the results. While venture capitalists invest in young growth firms, LBO targets are typically mature companies that might have already been listed on a stock exchange. Consequently, the value creation in venture capital is largely based on growth opportunities whereas in LBOs value is created through financial, governance and operational engineering (see subchapter 2.2). This fundamental difference could lead to differences in investors' perceptions and attitudes regarding the certification role of two types of financial sponsors. In other words, investors might be more suspicious towards IPOs that have undergone the LBO makeover which, in turn, would undermine the effect of buyout firm's reputation on the degree of information asymmetry associated with an IPO. The frequently surfacing debate in the business media regarding the quality of buyout-backed IPOs and the previously discussed argument of buyout-backed IPOs being subject to potential moral hazard (Cao, 2011) provide support for this view (see subchapters 1.1 and 3.1).

Another possible explanation for the results that provide no support for reputational certification could be that while good reputation assists buyout firms in fundraising, it has no effect on the level of information asymmetry related to an IPO. For instance, the rationale for using capital under management as a proxy for a buyout firm's reputation follows directly from the argument that more reputable private equity firms find it easier to raise new funds compared to their less reputable counterparts (see Gompers, 1996). Although this may well be the case, there is no guarantee that reputation has any impact in the IPO market. The ambiguous evidence presented in the previous literature provides no definitive conclusions regarding the relation between private equity firm's reputation and post-IPO returns. Moreover, as reputation is intangible and abstract, the main challenge in examining the reputational effect is obviously finding a good proxy for it. Imperfect measures of reputation lead to imperfect and ambiguous results.

Aside from the challenges related to measuring reputation, another possible interpretation for my results follows from Arthurs et al. (2008) argument that private equity sponsors have a dual role as

both principals and agents, which leads to conflicting objectives. Venture capital and buyout firms have short-term pressures to obtain results for the limited partners with timely and profitable exits from investments while they simultaneously face long-term pressures for reputation building in the IPO market. If IPO market investors share this view and acknowledge the potential conflicts of interest, they will not take the reputation of a buyout investor as a certification of IPO quality. As a consequence, the level of reputation would not affect the degree of information asymmetry related to an IPO. Consistent with this interpretation, Chemmanur and Loutskina (2007) argue that, for a venture capitalist, obtaining a higher IPO price and thereby improving reputation with venture fund investors and entrepreneurs dominate considerations of building and maintaining reputation with IPO market investors.

To summarize, I find evidence that buyout-backed IPOs with longer LBO duration are associated with less extreme abnormal returns relative to IPOs with shorter LBO period. This finding provides support for the argument that the value-adding LBO process has an impact on the degree of information asymmetry related to an IPO. On the other hand, the empirical tests show no evidence of buyout firm reputation being associated with the degree of information asymmetry related to an IPO. However, due to the difficulty of finding a good measure for reputation, I do not completely rule out the possibility of reputational certification.

8 CONCLUSION

My thesis addresses the role of buyout backing in the mitigation of information asymmetries associated with initial public offerings. The research is motivated by the growing importance of the buyout industry in the capital and M&A markets, the public debate about the performance of buyout-backed IPOs, and the ambiguous results presented in the previous literature. By investigating the post-IPO stock market performance of 449 buyout-backed IPOs issued in the US in 1990-2008, I assess the ability of professional buyout investors to alleviate the information asymmetries associated with initial public offerings.

In my thesis, I use a novel approach to examine the relation between buyout backing and IPO-related information asymmetries. Consistent with Chemmanur and Loutskina (2007), I argue that IPO underpricing is not the most appropriate measure to evaluate the impact of buyout backing on the degree of information asymmetry. Accordingly, I investigate the role of buyout involvement by studying post-IPO abnormal returns over 3-month, 6-month and 1-year measurement periods. In my approach, the degree of information asymmetry associated with an IPO is reflected by the level of

post-IPO abnormal returns, both positive and negative, relative to the other offerings in the sample. The approach follows the logic of the theoretical model developed by Neus and Walz (2005) in which venture capitalists are able to exit at prices that reflect the intrinsic value of the company. Consequently, the authors predict that VC-backed IPOs are associated with less post-IPO firm-specific volatility of returns relative to non-VC-backed IPOs because there will be less adjustment towards the intrinsic market price. To ensure the robustness of the results, I use three different methods in estimating abnormal returns, namely the market-adjusted model, the control firm method and the Fama-French-Carhart four-factor model. In addition, I calculate abnormal returns as both buy-and-hold (BHAR) and cumulative returns (CAR).

In the empirical testing conducted in this thesis, I first focus on studying the general impact of buyout backing on the degree of information asymmetry associated with an IPO. The examination of the effect is performed in two stages. The first stage consists of a univariate analysis in which the level of abnormal returns associated with buyout-backed IPOs is compared with the level of abnormal returns associated with non-buyout-backed offerings. The second stage is based on a probit regression model that extends the univariate analysis by controlling for the effect of multiple issue-specific factors. In addition, I use OLS regression as an alternative method to ensure the robustness of the results. Based on the previous literature, I expect that the ability of a buyout investor to alleviate information asymmetries is based on positive signaling effects related to the reputation of the buyout sponsor (e.g., Megginson and Weiss, 1991; Gompers, 1996) and the characteristics of the LBO model (see Barry et al. 1990; Espenlaub et al., 1999). Accordingly, I use OLS regression to assess the effect of buyout firm's reputation and the value-adding LBO process on the degree of IPO-related information asymmetries. Reputation is measured by the amount of capital under management and the age of the buyout firm. The duration of the LBO investment period is used as a proxy for the stage of the value-adding process at the time of the offering.

8.1 Main findings

The main findings of my thesis are summarized in Table 8. I find no evidence of buyout investors, in general, being able to alleviate the problem of asymmetric information related to initial public offerings. Regarding the effect of the LBO process, I find that buyout-backed IPOs with longer LBO duration are associated with less extreme post-IPO abnormal returns. The results provide support for the argument that the value-adding LBO process has an impact on the degree of information asymmetry related to an IPO. Reputational differences among the buyout firms, on the other hand, appear to play no role in the mitigation of information asymmetries.

In testing the general impact of buyout backing, the univariate analysis implies that buyout-backed IPOs are associated with less extreme post-IPO abnormal returns compared to the other offerings in the sample. Results of a t-test indicate that, relative to the average share of buyout-backed IPOs in the whole sample, the proportion of buyout-backed offerings is significantly smaller among the 10% of IPOs with the highest positive abnormal returns (positive surprise) and the 10% of IPOs with the highest negative abnormal returns (negative surprise). The univariate analysis is extended by the probit model in which maximum likelihood estimation is used to assess the determinants of the likelihood of an IPO being in the top 10% and bottom 10% deciles of abnormal stock market performance. Contrary to the indicative evidence, the results of the probit model show that buyout backing has no general effect on the probability of an IPO being associated with an abnormal return surprise. It appears that the observations in the univariate approach are, at least in part, explained by firm-specific factors that are characteristic of a leveraged buyout, namely firm size and age, operating industry, and leverage. In other words, buyout targets are typically relatively large and mature firms that operate in stable industries (see Sahlman, 1990; Groh and Gottschalg, 2007). These typical characteristics of an LBO, in turn, are negatively associated with the likelihood of an IPO experiencing extreme levels of post-issue abnormal returns. The results of the probit model are confirmed by the robustness check based on OLS regression.

The finding can be considered analogous to studies that find no significant negative or positive relation between private equity involvement and post-IPO abnormal returns (e.g. Holthausen and Larcker, 1996; Rindermann, 2004; Jelic et al., 2005; Cao, 2011). However, to my best knowledge, there is only one article by Tykvova and Walz (2007) that adopts an approach similar to the one used in my thesis. In the study, the authors find evidence that the participation of a venture capitalist decreases the abnormal return volatility of an IPO in the two-year post-issue period. The finding is attributed to venture capitalists' ability to overcome information asymmetries. Even though my results appear to contradict the results presented by Tykvova and Walz (2007), there are some important factors that should be taken into account when comparing the two studies. In addition to different methodological choices, the key difference is that the authors focus on venture capital-backed IPOs in the German market whereas I investigate buyout-backed IPOs in the more established US market. Consequently, it is possible that the contradicting results are explained by differences between the German market and the US market as well as differences between the venture capital and buyout models. As discussed in subchapter 7.3, investors might be more suspicious towards IPOs that have undergone the LBO makeover as opposed to VC-backed IPOs in which the value of the private equity investment is based on growth opportunities rather than

restructuring of the company. The frequently surfacing debate in the business media regarding the quality of buyout-backed IPOs provides support for this view.

Table 8: Summary of key findings

Hypothesis	Empirical evidence	Conclusion
H_1 Buyout-backed IPOs are associated with less extreme post-IPO abnormal returns compared to non-buyout-backed IPOs.	**No support.** Probit analysis indicates that buyout backing has no general impact on the likelihood of a post-IPO abnormal return surprise. The result remains robust to three different approaches used in estimating abnormal returns: market-adjusted model, control firm method and Fama-French-Carhart model. A robustness test based OLS regression confirms the finding.	**Hypothesis is rejected.** It is concluded that, in general, IPOs backed by buyout sponsors are equally subject to information asymmetries as any other IPOs.
H_2 Buyout-backed IPOs with longer LBO investment period are associated with less extreme post-IPO abnormal returns compared to buyout-backed IPOs with shorter LBO period.	**Support.** Results of the OLS regression model indicate that LBO duration is negatively associated with the level of post-IPO abnormal returns. The finding is robust to three different approaches used in estimating abnormal returns: market-adjusted model, control firm method and Fama-French-Carhart model. In the regression analysis, the coefficient is consistently negative and statistically significant in 24 out of 36 estimations.	**Further research required.** The results support the argument that LBO investment duration signals the degree to which the buyout sponsor has mitigated informational asymmetries and agency problems related to an IPO. A closer examination of the LBO process and the motives behind the IPO decision is required.
H_3 IPOs backed by more reputable buyout firms are associated with less extreme post-IPO abnormal returns compared to IPOs backed by less reputable buyout sponsors.	**No support.** Results of the OLS regression model indicate no relation between buyout sponsor reputation and the level post-IPO abnormal returns. The finding remains robust to three alternative approaches used for estimating abnormal returns (market-adjusted model, control firm method and Fama-French-Carhart model) and two different reputation proxies (age and capital under management).	**Hypothesis is rejected.** The level of reputation associated with a buyout investor has no effect on the degree of IPO-related information asymmetry. However, as reputation cannot be explicitly measured, the finding does not completely exclude the possibility of reputational certification.

I find evidence that the length of value-adding LBO process is related to the degree of information asymmetry associated with an IPO. The results of the OLS regression model indicate that buyout-backed IPOs with longer LBO duration experience lower levels of post-IPO abnormal returns compared to offerings with shorter LBO duration. The finding is in line with the argument that private equity investment duration signals the degree to which the financial sponsor has mitigated informational asymmetries and agency problems faced by the new owners in an IPO (see Cumming and MacIntosh, 2001). A longer LBO duration implies that the value-adding governance and operational changes have been successfully implemented before the IPO whereas a shorter investment period might be considered as a sign of opportunistic behavior by the buyout investor. The finding is consistent with Cao and Lerner (2009) and Cao (2011) who find that quick flips are associated with worse post-IPO performance compared to reverse leveraged buyouts with longer LBO duration.

Finally, the empirical tests conducted in my thesis show no evidence of the level of buyout firm's reputation being associated with the degree of information asymmetry related to an IPO. The finding is in line with the few previous studies on the reputational effect of buyout backing. Levis (2011), who examines buyout-backed IPOs issued in the UK during 1992-2005, finds no significant relation between post-IPO abnormal stock market performance and the level of reputation associated with the buyout investor backing the offering. Cao and Lerner (2009) make similar observations in the US market and conclude that evidence regarding the reputational effect of buyout backing remains ambiguous.

The results presented in my thesis have two important implications. Firstly, if there was a role for buyout backing in the mitigation of IPO-related information asymmetries, it would be determined by the interplay of different buyout-specific factors. For instance, the amount of reputational capital alone might not be sufficient to overcome investors' suspicions related to a quick flip. Secondly, the concerns raised by the critics and the media about the quality of buyout-backed IPOs seem largely exaggerated. My results indicate that buyout backing, in general, does not affect the likelihood of an IPO experiencing extreme levels of abnormal returns during the first year following the offering.

8.2 Future research suggestions

Future research addressing the topic of buyout-backed initial public offerings should focus on three areas: 1. closer examination of the different factors that contribute to the role of a buyout investor in the mitigation of IPO-related information asymmetries, 2. development of new approaches to estimate the impact of buyout backing, and 3. assessment of differences between buyout backing and venture capital backing.

As discussed in subchapter 7.2, a possible explanation for the finding that buyout backing has no generalizable effect on the degree of IPO-related information asymmetry derives from the interplay between the different factors that determine the role of buyout backing in the mitigation of information asymmetries. In my thesis, I present evidence of the length of the value-adding LBO process being related to the degree of information asymmetry associated with an IPO. To provide a deeper understanding of the matter, future research should focus on examining the factors that determine the nature and magnitude of the post-issue abnormal returns associated with buyout-backed IPOs with short LBO duration. These factors include the operational and governance-related changes implemented during the LBO period as well as the underlying motives for the decision to take the portfolio company public. In addition, the post-IPO plans and commitment of the buyout firm should also be taken into account when assessing the interplay between the factors that

determine the degree of information asymmetry associated with a buyout-backed IPO. For instance, it would be important to know if the buyout firm had disclosed its exit plans before the offering. The challenge in studying the above factors is the limited availability of pre-IPO data on leveraged buyouts.

Future research should also focus on developing new approaches to examining the role of private equity backing. Based on the literature review, it appears that the main contribution of most of the new studies on the topic is based on either the use of a novel set of data or a different set of control variables. This statement of course exaggerates the matter, but the point is that clinging on to the traditional research approaches is unlikely to provide valuable new insights into the topic. For instance, supplementing the analysis of stock market and accounting data with interviews of the general partners of buyout funds and institutional investors that frequently participate in IPOs could result in interesting findings. Interviews of IPO investors could, for example, shed more light on the ambiguous results regarding the reputational certification of buyout investors.

Finally, future research should examine whether the fundamental differences between the buyout model and the venture capital model influence the perceived role of a given financial sponsor in the context of an IPO. As previously discussed, investors might be more suspicious towards IPOs that have undergone the LBO makeover in which value creation is based on financial, governance and operational engineering rather than growth opportunities. Cao (2011) argues that the buyout model could be prone to a moral hazard problem where buyout sponsors push problematic firms public with certain "insider knowledge." It is also possible that problems of moral hazard and opportunistic behavior will become more pronounced in future exits due to the increasing competition in the buyout industry. The record amounts of capital committed to buyout funds during 2006-2007 imply a greater competition for transactions which, in turn, pushes entry prices higher and weakens the prospects for profitable exits.

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APPENDIX

Appendix 1: Results of robustness test (market-adjusted model & Fama-French-Carhart model)

The table presents the results of the OLS regression which is used as a robustness check for the results of the probit model (hypothesis 1). The dependent variable is the absolute value of abnormal return. Abnormal returns are estimated based on market-adjusted model (Panel A) and Fama-French-Carhart model (Panel B) Results are reported for 3-month, 6-month and 1-year periods using buy-and-hold returns and cumulative returns. The independent variables are PE dummy (dummy variable indicating whether or not the issue is backed by a buyout sponsor), firm age (age of the firm at the time of IPO in years), underwriter rank (underwriter's reputation ranking), high-tech dummy (dummy variable indicating IPO by a high-tech company), underpricing (first day return), bubble dummy (dummy variable indicating an issue during the internet bubble in 1999-2000), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization), book-to-market (first reported book value of equity divided by the market capitalization at the end of first trading day) and market heat (four-quarter moving average of the number of IPOs divided by its historic average). The sample consists of IPOs issued in the US during 1990-2008. T-statistics are reported in parenthesis below each variable. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Panel A

Market-adjusted model

Number of observations: PE-backed IPOs 432 & Other IPOs 3,769

	Buy-and-hold abnormal returns			Cumulative abnormal returns		
Variable	3m	6m	1y	3m	6m	1y
Intercept	0.38***	0.88***	0.9***	0.29***	0.74***	0.78***
	(3.99)	(5.49)	(4.37)	(3.68)	(6.60)	(5.21)
PE dummy	0.01	0.02	0.004	0.01	0.003	-0.01
	(0.81)	(0.56)	(0.11)	(0.65)	(0.16)	(-0.52)
Firm age	-0.001**	-0.001**	-0.001*	-0.001***	-0.001***	-0.001***
	(-2.53)	(-2.17)	(-1.81)	(-2.77)	(-2.85)	(-3.09)
Underwriter rank	0.004	0.01	-0.01	0.001	-0.0003	-0.01***
	(1.40)	(1.13)	(-0.80)	(0.49)	(-0.07)	(-2.84)
High-tech dummy	0.05***	0.08***	0.1***	0.05***	0.06***	0.07***
	(5.27)	(4.86)	(4.57)	(6.05)	(4.65)	(4.39)
Underpricing	0.04***	0.07***	0.12***	0.04***	0.04***	0.09***
	(3.06)	(3.67)	(4.73)	(3.82)	(3.00)	(4.96)
Bubble dummy	0.25***	0.38***	0.18***	0.24***	0.36***	0.39***
	(16.68)	(15.24)	(5.69)	(19.43)	(20.31)	(16.92)
Leverage	-0.11***	-0.1**	-0.06	-0.1***	-0.11***	-0.05
	(-4.17)	(-2.35)	(-1.00)	(-4.76)	(-3.67)	(-1.14)
Firm size	-0.01*	-0.03***	-0.02*	-0.01	-0.02***	-0.01
	(-1.83)	(-3.14)	(-1.67)	(-1.08)	(-3.10)	(-1.20)
Book-to-market	-0.05***	-0.08***	-0.08***	-0.05***	-0.08***	-0.09***
	(-3.60)	(-3.62)	(-2.74)	(-4.36)	(-4.93)	(-4.28)
Market heat	0.02*	-0.01	0.02	0.02***	-0.001	0.01
	(1.90)	(-0.50)	(1.02)	(2.92)	(-0.05)	(0.52)
Prob > F	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.13	0.11	0.04	0.18	0.16	0.14

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Panel B

Fama-French-Carhart model

Number of observations: PE-backed IPOs 392 & Other IPOs 3,354

	Buy-and-hold abnormal returns			Cumulative abnormal returns		
Variable	3m	6m	1y	3m	6m	1y
Intercept	0.45***	0.84***	1.11***	0.36***	0.66***	0.85***
	(4.74)	(5.67)	(4.98)	(4.44)	(6.20)	(5.87)
PE dummy	0.01	0.03	0.02	0.01	0.01	0.01
	(0.52)	(0.95)	(0.40)	(0.44)	(0.45)	(0.23)
Firm age	-0.001***	-0.001**	-0.001*	-0.001***	-0.001***	-0.001**
	(-2.66)	(-2.35)	(-1.72)	(-2.64)	(-2.96)	(-2.49)
Underwriter rank	0.01*	0.01*	0.004	0.001	0.0002	-0.01
	(1.92)	(1.81)	(0.63)	(0.43)	(0.07)	(-1.15)
High-tech dummy	0.05***	0.09***	0.12***	0.06***	0.08***	0.1***
	(5.26)	(5.39)	(4.73)	(6.33)	(6.44)	(6.04)
Underpricing	0.02	0.04**	0.09***	0.03**	0.01	0.05**
	(1.38)	(2.30)	(3.09)	(2.47)	(0.79)	(2.50)
Bubble dummy	0.21***	0.22***	0.09**	0.21***	0.25***	0.28***
	(13.58)	(9.10)	(2.56)	(15.46)	(14.06)	(11.61)
Leverage	-0.08***	-0.08**	-0.01	-0.07***	-0.09***	-0.04
	(-3.06)	(-2.08)	(-0.18)	(-3.37)	(-3.23)	(-0.92)
Firm size	-0.01**	-0.03***	-0.03***	-0.01*	-0.02***	-0.02**
	(-2.55)	(-3.36)	(-2.62)	(-1.77)	(-2.80)	(-2.24)
Book-to-market	-0.06***	-0.09***	-0.09***	-0.05***	-0.08***	-0.1***
	(-4.26)	(-4.10)	(-2.84)	(-4.76)	(-5.07)	(-4.82)
Market heat	0.01	-0.01	-0.02	0.01*	-0.001	-0.0001
	(1.12)	(-0.79)	(-1.02)	(1.96)	(-0.08)	(-0.01)
Prob > F	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.11	0.07	0.03	0.14	0.12	0.1

Appendix 2: Determinants of post-IPO extreme abnormal returns (market-adjusted model)

The table presents the results of the probit model regarding the determinants of extreme post-IPO abnormal stock performance. Extreme abnormal performance is defined relative to other IPOs in the sample by splitting the IPOs into deciles based on buy-and-hold abnormal returns (Panel A) and cumulative abnormal returns (Panel B). Abnormal returns are estimated using the market-adjusted model. Top 10% decile (Bottom 10% decile) represent IPOs with extreme positive (negative) abnormal return surprises. The dependent variable is equal to one for IPOs in the top/bottom 10% decile and zero for IPOs in the remaining nine deciles. The results are reported for 3-month, 6-month and 1-year periods. The explanatory variables are PE dummy (dummy variable indicating whether or not the issue is backed by a buyout sponsor), firm age (age of the firm at the time of IPO in years), underwriter rank (underwriter's reputation ranking), high-tech dummy (dummy variable indicating IPO by a high-tech company), underpricing (first day return), bubble dummy (dummy variable indicating an issue during the internet bubble in 1999-2000), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization), book-to-market (first reported book value of equity divided by the market capitalization at the end of first trading day) and market heat (four-quarter moving average of the number of IPOs divided by its historic average). The sample consists of IPOs issued in the US during 1990-2008. Z-statistics are reported in parenthesis below each variable. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Number of observations: PE-backed IPOs 432 & Other IPOs 3,769

	Buy-and-hold abnormal returns						Cumulative abnormal returns					
	Top 10 decile			Bottom 10 decile			Top 10 decile			Bottom 10 decile		
Variable	3m	6m	1y	3m	6m	1y	3m	6m	1y	3m	6m	1y
Intercept	-0.45	0.74	-0.47	-2.83***	-2.31***	-1.79***	0.16	0.64	-0.11	-2.5***	-1.65***	-1.9***
	(-0.75)	(1.23)	(-0.82)	(-4.67)	(-3.59)	(-2.86)	(0.25)	(1.03)	(-0.18)	(-4.18)	(-2.71)	(-3.20)
PE dummy	0.1	0.01	-0.15	-0.06	0.03	-0.12	0.12	0.04	-0.12	-0.01	0.05	-0.14
	(0.88)	(0.08)	(-1.41)	(-0.47)	(0.27)	(-0.83)	(1.04)	(0.39)	(-1.02)	(-0.09)	(0.44)	(-1.10)
Firm age	-0.001	-0.002	0.001	-0.01***	-0.004*	-0.01***	-0.002	-0.003	-0.001	-0.002*	-0.002**	-0.01***
	(-0.58)	(-0.96)	(0.83)	(-3.03)	(-1.85)	(-3.22)	(-1.13)	(-1.44)	(-0.76)	(-1.96)	(-2.57)	(-2.78)
Underwriter rank	0.05***	0.06***	0.03*	-0.08***	-0.1***	-0.08***	0.07***	0.06***	0.04**	-0.08***	-0.08***	-0.08***
	(2.76)	(3.10)	(1.86)	(-4.57)	(-5.36)	(-4.41)	(3.45)	(3.06)	(2.01)	(-4.72)	(-4.89)	(-4.79)
High-tech dummy	0.34***	0.31***	0.22***	0.09	0.02	-0.003	0.36***	0.36***	0.35***	0.11*	-0.04	-0.02
	(5.58)	(5.07)	(3.73)	(1.47)	(0.34)	(-0.05)	(5.78)	(5.87)	(5.65)	(1.90)	(-0.58)	(-0.35)
Underpricing	0.08	0.06	0.02	0.05	0.05	0.33***	0.13**	0.07	0.03	0.02	0.01	0.16***
	(1.31)	(1.00)	(0.34)	(0.87)	(0.82)	(5.65)	(2.12)	(1.09)	(0.46)	(0.29)	(0.21)	(2.82)
Bubble dummy	0.59***	0.54***	0.08	0.63***	0.77***	0.51***	0.74***	0.76***	0.52***	0.65***	0.66***	0.61***
	(7.65)	(7.00)	(0.96)	(8.04)	(9.64)	(5.97)	(9.75)	(10.04)	(6.82)	(8.24)	(8.44)	(7.78)
Leverage	-0.66***	-0.19	-0.22	-0.69***	-0.44**	-0.25	-0.67***	-0.29*	-0.38**	-0.49***	-0.42**	-0.04
	(-3.63)	(-1.16)	(-1.43)	(-3.75)	(-2.46)	(-1.45)	(-3.59)	(-1.67)	(-2.23)	(-2.81)	(-2.48)	(-0.27)
Firm size	-0.07**	-0.13***	-0.05	0.09**	0.07**	0.02	-0.11***	-0.13***	-0.07**	0.07**	0.04	0.05
	(-2.12)	(-3.66)	(-1.56)	(2.59)	(2.00)	(0.45)	(-3.03)	(-3.52)	(-2.06)	(2.08)	(1.25)	(1.31)
Book-to-market	-0.23**	-0.31***	-0.1	-0.14	-0.85***	-0.17*	-0.3**	-0.36***	-0.25**	-0.14*	-0.48***	-0.17*
	(-2.00)	(-2.73)	(-1.22)	(-1.57)	(-4.88)	(-1.94)	(-2.42)	(-2.90)	(-2.28)	(-1.65)	(-3.46)	(-1.95)
Market heat	0.05	-0.06	-0.08	0.25***	0.3***	0.46***	0.03	-0.04	-0.12**	0.25***	0.18***	0.2***
	(1.03)	(-1.27)	(-1.61)	(4.76)	(5.41)	(7.96)	(0.52)	(-0.85)	(-2.40)	(4.65)	(3.42)	(3.83)
Prob > χ^2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pseudo R^2	0.08	0.06	0.02	0.09	0.12	0.11	0.11	0.10	0.07	0.08	0.08	0.08

Appendix 3: Determinants of post-IPO extreme abnormal returns (Fama-French-Carhart)

The table presents the results of the probit model regarding the determinants of extreme post-IPO abnormal stock performance. Extreme abnormal performance is defined relative to other IPOs in the sample by splitting the IPOs into deciles based on buy-and-hold abnormal returns (Panel A) and cumulative abnormal returns (Panel B). Abnormal returns are estimated using the Fama-French-Carhart four-factor model. Top 10% decile (Bottom 10% decile) represent IPOs with extreme positive (negative) abnormal return surprises. The dependent variable is equal to one for IPOs in the top/bottom 10% decile and zero for IPOs in the remaining nine deciles. The results are reported for 3-month, 6-month and 1-year periods. The explanatory variables are PE dummy (dummy variable indicating whether or not the issue is backed by a buyout sponsor), firm age (age of the firm at the time of IPO in years), underwriter rank (underwriter's reputation ranking), high-tech dummy (dummy variable indicating IPO by a high-tech company), underpricing (first day return), bubble dummy (dummy variable indicating an issue during the internet bubble in 1999-2000), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization), book-to-market (first reported book value of equity divided by the market capitalization at the end of first trading day) and market heat (four-quarter moving average of the number of IPOs divided by its historic average). The sample consists of IPOs issued in the US during 1990-2008. Z-statistics are reported in parenthesis below each variable. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

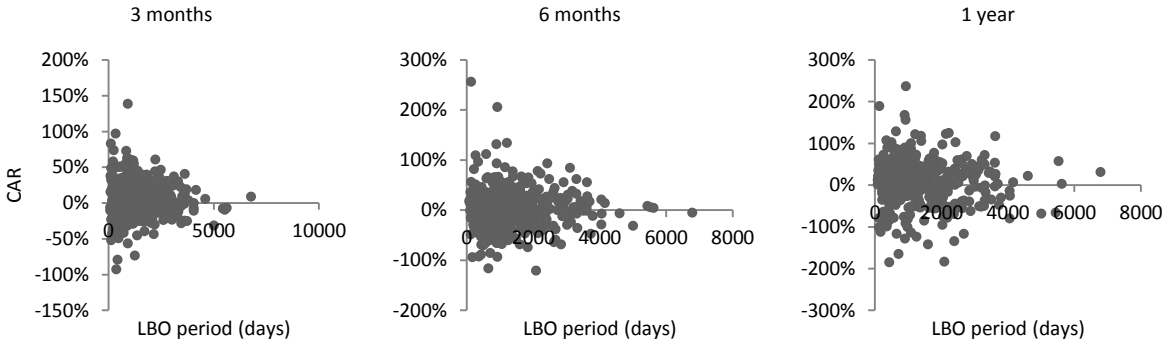
Number of observations: PE-backed IPOs 392 & Other IPOs 3,354

	Buy-and-hold abnormal returns						Cumulative abnormal returns					
	Top 10 decile			Bottom 10 decile			Top 10 decile			Bottom 10 decile		
Variable	3m	6m	1y	3m	6m	1y	3m	6m	1y	3m	6m	1y
Intercept	-0.48	0.45	-0.46	0.01	-0.26	1.25**	-0.63	0.52	0.37	-0.59	-0.1	0.15
	(-0.75)	(0.69)	(-0.75)	(0.01)	(-0.40)	(1.97)	(-0.94)	(0.76)	(0.55)	(-0.93)	(-0.16)	(0.24)
PE dummy	0.05	0.09	-0.11	-0.07	-0.22*	-0.09	-0.06	-0.005	-0.11	-0.06	-0.11	-0.11
	(0.41)	(0.76)	(-1.00)	(-0.59)	(-1.73)	(-0.77)	(-0.46)	(-0.04)	(-0.84)	(-0.48)	(-0.95)	(-0.95)
Firm age	-0.002	-0.004*	-0.0003	-0.001	-0.004**	-0.004**	-0.003	-0.01***	-0.003	-0.002	-0.0002	-0.004**
	(-0.92)	(-1.91)	(-0.17)	(-0.70)	(-2.14)	(-2.31)	(-1.33)	(-2.86)	(-1.30)	(-1.05)	(-0.11)	(-2.40)
Underwriter rank	0.04**	0.04**	0.02	-0.03	-0.02	0.03	0.03*	0.02	0.01	-0.04**	-0.05**	-0.01
	(2.24)	(2.25)	(1.16)	(-1.54)	(-1.33)	(1.38)	(1.79)	(1.22)	(0.45)	(-2.18)	(-2.52)	(-0.51)
High-tech dummy	0.38***	0.31***	0.25***	0.07	0.09	0.02	0.38***	0.32***	0.35***	0.08	0.09	0.01
	(5.81)	(4.76)	(3.85)	(1.05)	(1.31)	(0.38)	(5.76)	(4.83)	(5.38)	(1.20)	(1.45)	(0.23)
Underpricing	-0.01	-0.08	-0.07	0.11	0.23***	0.21***	-0.04	-0.1	-0.05	0.14**	0.18***	0.22***
	(-0.10)	(-0.99)	(-0.91)	(1.59)	(3.65)	(3.25)	(-0.53)	(-1.34)	(-0.62)	(2.11)	(2.76)	(3.44)
Bubble dummy	0.62***	0.44***	0.11	0.35***	0.34***	0.26***	0.77***	0.63***	0.52***	0.34***	0.39***	0.38***
	(7.40)	(5.08)	(1.26)	(3.94)	(3.87)	(2.90)	(9.24)	(7.37)	(6.06)	(3.87)	(4.55)	(4.35)
Leverage	-0.49***	-0.35**	-0.25	-0.27	-0.04	0.08	-0.45**	-0.58***	-0.35*	-0.17	-0.19	0.34**
	(-2.61)	(-1.97)	(-1.52)	(-1.56)	(-0.26)	(0.48)	(-2.34)	(-2.97)	(-1.90)	(-0.99)	(-1.11)	(2.17)
Firm size	-0.07*	-0.11***	-0.05	-0.05	-0.04	-0.14***	-0.06	-0.1**	-0.09**	-0.02	-0.04	-0.07*
	(-1.94)	(-2.87)	(-1.41)	(-1.41)	(-1.01)	(-3.64)	(-1.58)	(-2.48)	(-2.26)	(-0.54)	(-1.03)	(-1.79)
Book-to-market	-0.21*	-0.42***	-0.24**	-0.52***	-0.48***	-0.43***	-0.28**	-0.55***	-0.58***	-0.56***	-0.52***	-0.46***
	(-1.82)	(-3.20)	(-2.23)	(-3.90)	(-3.56)	(-3.62)	(-2.23)	(-3.64)	(-3.82)	(-4.05)	(-3.82)	(-3.69)
Market heat	0.08	0.03	0.01	0.002	-0.05	-0.04	0.07	-0.02	-0.01	0.05	-0.06	-0.05
	(1.40)	(0.58)	(0.13)	(0.04)	(-0.87)	(-0.83)	(1.30)	(-0.29)	(-0.11)	(1.04)	(-1.18)	(-1.01)
Prob > χ^2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pseudo R^2	0.08	0.05	0.02	0.04	0.05	0.03	0.10	0.09	0.07	0.04	0.05	0.04

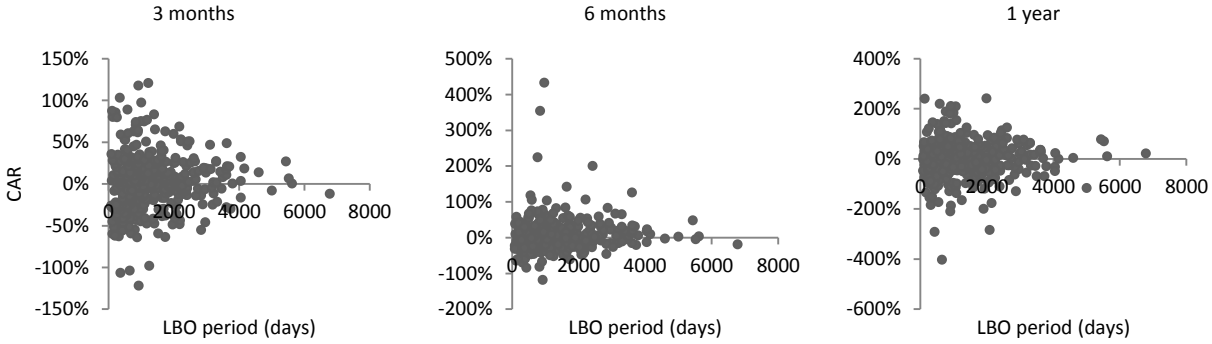
Appendix 4: Relation between abnormal returns and LBO duration

The graphs below illustrate the relation between post-IPO abnormal returns and the duration of the LBO investment period. In case of a secondary buyout, the duration of the previous LBO is included in the LBO duration. Abnormal returns are calculated as cumulative abnormal returns (CAR) for 3-month, 6-month and 1-year periods using three approaches: marked-adjusted model, control firm method and Fama-French-Carhart four-factor model. The sample consists of buyout-backed IPOs issued in the US during 1990-2008.

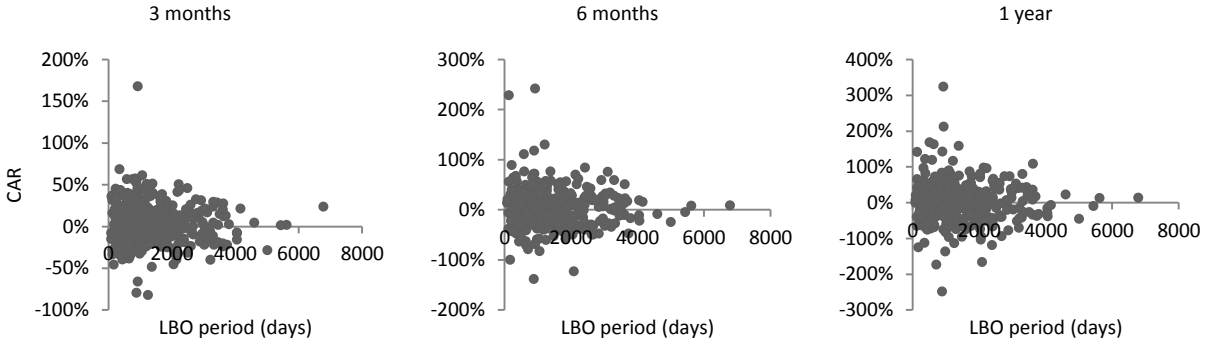
Market-adjusted model (N = 447)



Control firm method (N = 425)



Fama-French-Carhart (N = 408)



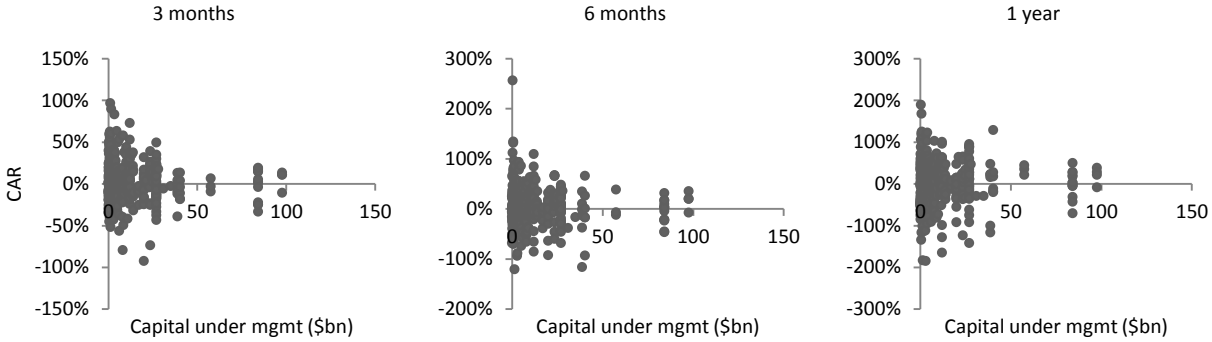
Appendix 5: Relation between abnormal returns and buyout firm reputation proxies

The graphs below illustrate the relation between post-IPO abnormal returns and two proxies used for buyout firm reputation. The relation is presented for buyout firm's capital under management in Panel A and buyout firm's age at the time of IPO in Panel B. Abnormal returns are calculated as cumulative abnormal returns (CAR) for 3-month, 6-month and 1-year periods using three approaches: marked-adjusted model, control firm method and Fama-French-Carhart four-factor model. The sample consists of buyout-backed IPOs issued in the US during 1990-2008.

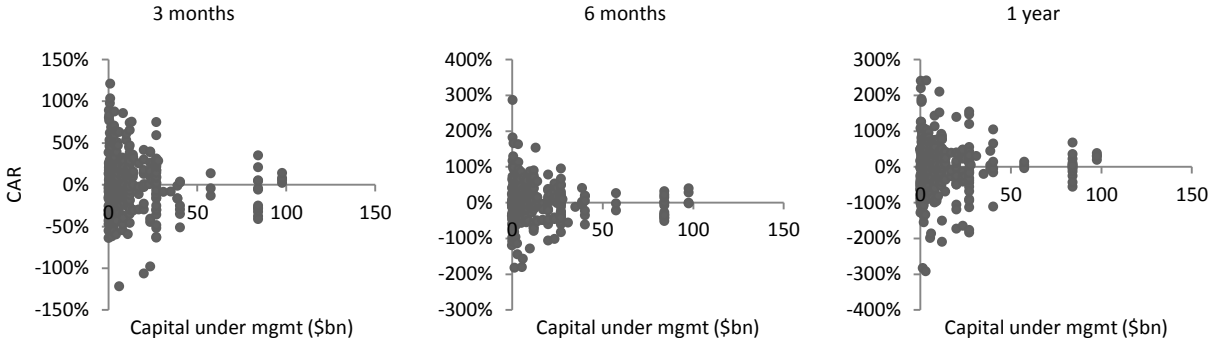
Panel A

Relation between capital under management and CAR

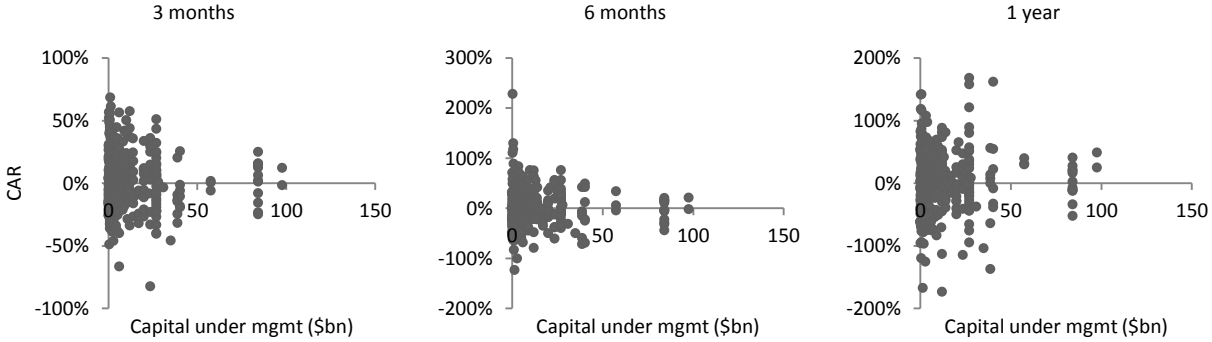
Market-adjusted model (N = 420)



Control firm method (N = 399)



Fama-French-Carhart (N = 383)



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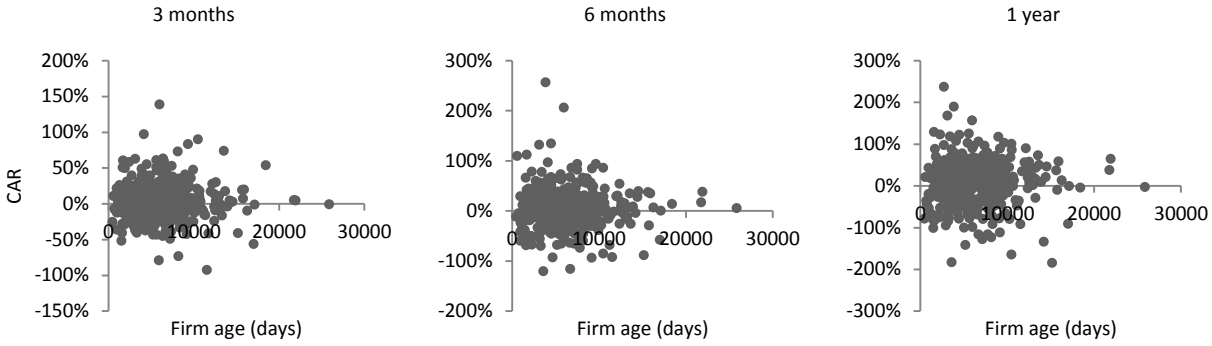
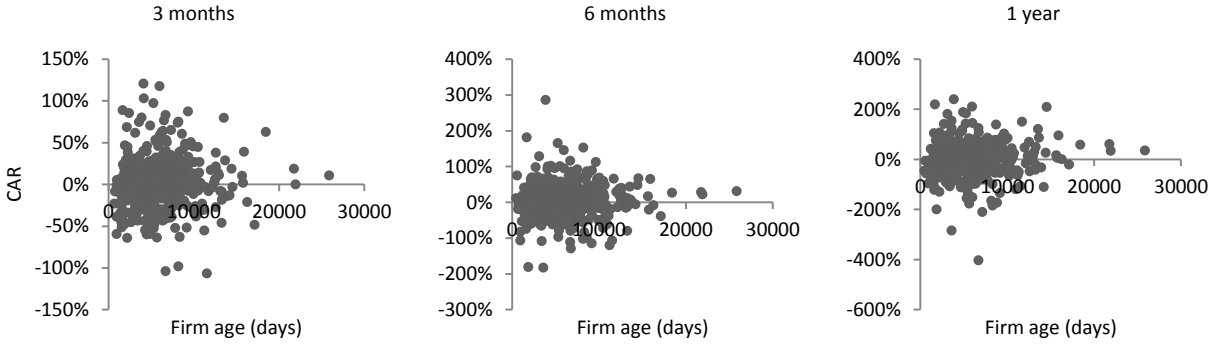
Panel B
Relation between buyout firm age and CAR

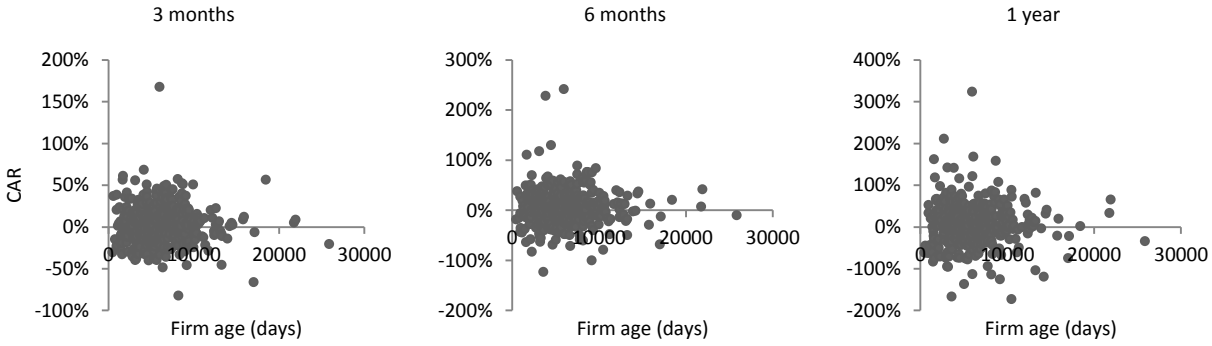
Market-adjusted model (N = 444)



Control firm method (N = 422)



Fama-French-Carhart (N = 405)



Appendix 6: Effect of LBO duration and buyout firm's reputation (market-adjusted model & Fama-French-Carhart)

The table presents the results of the OLS regression regarding the impact of LBO duration and buyout firm's reputation on the dispersion of post-IPO abnormal returns. Abnormal returns are measured using the market-adjusted model (Panel A and Panel B) and the Fama-French-Carhart model (Panel C and Panel D). Results are reported for 3-month, 6-month and 1-year periods using buy-and-hold and cumulative returns. The dependent variable is the absolute value of abnormal return. The independent variables are LBO duration (duration of the LBO holding period in years), capital under management (natural logarithm of one plus the latest reported amount of capital managed by the buyout firm), PE firm age (age of the buyout firm at the time of the IPO in years), underwriter rank (underwriter's reputation rank), leverage (first reported total debt divided by total assets), firm size (natural logarithm of one plus IPO date market capitalization) and book-to-market (first reported book value of equity divided by the closing market capitalization of IPO date). The sample consists of IPOs issued in the US during 1990-2008. T-statistics are reported in parenthesis below each variable. *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Panel A

Market-adjusted model BHAR

	3 months		6 months		1 year	
Intercept	0.71***	0.71***	1.56***	1.47***	2.32***	2.2***
	(2.93)	(3.06)	(3.20)	(3.21)	(3.33)	(3.36)
LBO duration	-0.01**	-0.01***	-0.02*	-0.02*	-0.01	-0.01
	(-2.30)	(-2.65)	(-1.91)	(-1.93)	(-0.81)	(-0.85)
Reputation proxies						
Capital under management	0.003		-0.01		0.01	
(N = 420)	(0.32)		(-0.42)		(0.38)	
PE firm age		0.0003		-0.001		-0.001
(N = 444)		(0.24)		(-0.53)		(-0.47)
Control variables						
Underwriter rank	0.0002	0.002	-0.01	-0.004	-0.03	-0.02
	(0.02)	(0.19)	(-0.21)	(-0.15)	(-0.81)	(-0.58)
Leverage	-0.05	-0.06*	-0.09	-0.09	-0.15	-0.14
	(-1.57)	(-1.75)	(-1.26)	(-1.32)	(-1.49)	(-1.55)
Firm size	-0.02*	-0.02*	-0.05*	-0.05**	-0.08*	-0.07*
	(-1.68)	(-1.82)	(-1.82)	(-1.99)	(-1.91)	(-1.95)
Book-to-market	-0.05*	-0.05**	-0.12**	-0.11**	-0.22***	-0.23***
	(-1.96)	(-1.99)	(-2.10)	(-2.10)	(-2.79)	(-2.89)
Prob > F	0.04	0.02	0.03	0.04	0.02	0.02
R^2	0.03	0.03	0.03	0.03	0.03	0.03

Panel B

Market-adjusted model CAR

	3 months		6 months		1 year	
Intercept	0.6***	0.61***	1.02***	0.98***	1.75***	1.74***
	(3.15)	(3.31)	(3.42)	(3.46)	(4.73)	(4.97)
LBO duration	-0.01***	-0.01***	-0.01**	-0.01**	-0.01	-0.01*
	(-2.89)	(-3.21)	(-2.48)	(-2.50)	(-1.65)	(-1.69)
Reputation proxies						
Capital under management	-0.0005		-0.01		-0.01	
(N = 420)	(-0.08)		(-0.68)		(-0.52)	
PE firm age		0.0003		-0.001		0.001
(N = 444)		(0.34)		(-0.78)		(0.61)
Control variables						
Underwriter rank	-0.001	0.0001	0.01	0.01	0.01	0.01
	(-0.08)	(0.00)	(0.39)	(0.44)	(0.28)	(0.44)
Leverage	-0.05*	-0.05**	-0.08*	-0.08**	-0.08	-0.09*
	(-1.85)	(-2.05)	(-1.96)	(-2.10)	(-1.55)	(-1.76)
Firm size	-0.02	-0.02*	-0.03*	-0.03**	-0.06***	-0.06***
	(-1.51)	(-1.75)	(-1.82)	(-2.05)	(-2.85)	(-3.38)
Book-to-market	-0.05**	-0.05**	-0.09***	-0.09***	-0.15***	-0.15***
	(-2.21)	(-2.26)	(-2.63)	(-2.69)	(-3.42)	(-3.72)
Prob > F	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.04	0.05	0.05	0.04	0.06	0.06

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Panel C
Fama-French-Carhart BHAR

	3 months		6 months		1 year	
Intercept	0.66**	0.59**	1.59***	1.47***	2.58***	2.39***
	(2.55)	(2.44)	(3.17)	(3.12)	(3.32)	(3.27)
LBO duration	-0.01*	-0.01*	-0.01	-0.01	-0.01	-0.01
	(-1.88)	(-1.77)	(-1.56)	(-1.56)	(-0.90)	(-1.09)
Reputation proxies						
Capital under management	0.003		-0.004		0.02	
(N = 383)	(0.39)		(-0.23)		(0.86)	
PE firm age		-0.0001		-0.001		0.001
(N = 405)		(-0.13)		(-0.70)		(0.34)
Control variables						
Underwriter rank	0.01	0.01	0.0001	0.001	-0.02	-0.01
	(0.58)	(0.54)	(0.00)	(0.05)	(-0.51)	(-0.31)
Leverage	-0.04	-0.04	-0.06	-0.06	-0.07	-0.06
	(-1.02)	(-1.10)	(-0.95)	(-0.95)	(-0.65)	(-0.63)
Firm size	-0.03*	-0.02	-0.06**	-0.05**	-0.1**	-0.09**
	(-1.71)	(-1.52)	(-2.01)	(-2.06)	(-2.26)	(-2.16)
Book-to-market	-0.06**	-0.05*	-0.1*	-0.1*	-0.19**	-0.19**
	(-2.00)	(-1.90)	(-1.86)	(-1.85)	(-2.23)	(-2.32)
Prob > F	0.13	0.18	0.08	0.09	0.08	0.08
R^2	0.03	0.02	0.03	0.03	0.03	0.03

Panel D
Fama-French-Carhart CAR

	3 months		6 months		1 year	
Intercept	0.52***	0.48**	1.05***	0.99***	1.59***	1.49***
	(2.62)	(2.57)	(3.52)	(3.51)	(3.89)	(3.88)
LBO duration	-0.01**	-0.01**	-0.01*	-0.01*	-0.01*	-0.01*
	(-2.48)	(-2.28)	(-1.80)	(-1.83)	(-1.86)	(-1.83)
Reputation proxies						
Capital under management	0.0002		-0.002		0.003	
(N = 383)	(0.02)		(-0.23)		(0.24)	
PE firm age		-0.0002		-0.001		0.0003
(N = 405)		(-0.26)		(-0.70)		(0.18)
Control variables						
Underwriter rank	0.01	0.004	0.01	0.01	0.01	0.01
	(0.54)	(0.43)	(0.68)	(0.69)	(0.47)	(0.52)
Leverage	-0.03	-0.03	-0.05	-0.05	-0.02	-0.02
	(-1.13)	(-1.25)	(-1.28)	(-1.29)	(-0.38)	(-0.39)
Firm size	-0.02	-0.01	-0.04**	-0.04**	-0.06**	-0.05**
	(-1.45)	(-1.35)	(-2.28)	(-2.34)	(-2.57)	(-2.60)
Book-to-market	-0.05**	-0.05**	-0.07**	-0.07**	-0.14***	-0.14***
	(-2.34)	(-2.25)	(-2.24)	(-2.27)	(-2.99)	(-3.18)
Prob > F	0.04	0.06	0.03	0.03	0.01	0.01
R^2	0.03	0.03	0.04	0.03	0.04	0.04