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Exit Strategies by Private Equity Firms in the Nordic Region

An empirical assessment of IPO performance across private equity-backed- and non-backed firms and a qualitative assessment of exit strategies by private equity firms

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Master thesis in Financial Economics

NORWEGIAN SCHOOL OF ECONOMICS

Abstract

This study investigates underpricing of private equity (PE)- backed IPOs and the various exit routes available to PE firms. First, we examine whether IPO underpricing differ across PE-backed- and non-backed (NB) firms employing different empirical techniques. Our final dataset consists of 60 PE-backed- and 155 NB IPOs listed on Nordic exchanges (2005-2014). Second, we investigate exit strategies- and (potential) interrelation between entry and exit by PE firms, through interviews with partners from renowned PE firms (Altor, EQT, FSN Capital, Herkules Capital and HitechVision).

We found PE-backed IPOs to be significantly less underpriced than NB IPOs, consistent with prior research. Interview respondents attribute our result to i) PE-sponsors may be superior at timing- and promoting IPOs and/or ii) PE-sponsors may strive to maximise the offer price to boost proceeds. Consensus in prior research attributes our finding to PE-sponsors being able to certify true firm value in IPOs. Moreover, we document significantly lower underpricing of venture capital - compared to buyout-backed IPOs. Finally, we find that underpricing increases with the aftermarket volatility (and thereby the risk) related to an issue, independent of PE-backing.

Respondents from interviews listed price, transaction risk and divestment efficiency as the most important factors determining choice of exit route. The majority expressed strong preference for trade sales (ceteris paribus) as it enables efficient divestment and commonly provides superior pricing. In contrast, IPO appeared to represent the least favourable exit channel due to inefficient divestment and extensive regulation. However, the respondents underlined that IPOs may represent the preferred exit for particularly successful (and large) portfolio firms, as it "*enables participation in future value creation while at the same time taking some "risk off the table""* - Respondent 4. Finally, we find that exit opportunities related to an investment case may have decisive implications for whether PE-sponsors enter or not.

Preface

This thesis represents the completion of our Master of Science in Financial Economics at the Norwegian School of Economics (NHH). Writing our thesis has been challenging and sometimes frustrating, but above all it has been an entertaining, educational and rewarding journey.

Our interest in corporate finance and IPO performance in particular has mainly been stimulated through the inspiring finance courses offered at NHH in addition to first-hand work experience with investment banks. Thus, we were certain that IPO performance would constitute the fundamental theme of our thesis.

Furthermore, we both find private equity (PE) interesting as a fundamental understanding of the asset class requires insights from all aspects of our economic education; micro- and macroeconomics, finance, strategy, business administration and -management. Moreover, our interest in PE increased considerably when discovering the outstanding growth it has experienced in the *Nordic* region (both in terms of fundraising and investments) over the last decade. This makes our study of the Nordic PE industry as topical as ever. In total, we consider the combination of IPO performance and PE as the perfect theme for our study, aligning our interests, work experience and educational background.

In addition, we would like to express gratitude to those who have contributed, encouraged and motivated us through the writing process. Their inputs were indispensable for the conclusion of this study. First, we thank our supervisor, Tommy Stamland, for giving us precise, valuable and highly useful feedback during the entire writing process. We are certain his advice enhanced the quality of our analysis. Second, Ulf Persson (Nordic OMX Nasdaq), Truls Evensen (Oslo Børs), Stefan Slemdal (Carnegie Investment Bank) and Dr. Carstein Bienz (Director at NHH's Argentum Centre for PE) deserve gratitude for providing us with essential data on Nordic IPOs and PE transactions. Third, we would like to thank Jostein Lillestøl (NHH) for useful guidance regarding econometric techniques. Finally, a special appreciation is given to the interview respondents who gave us valuable insights about various aspects of the PE industry and life cycle; Hugo Maurstad (Altor), Gert W. Munthe (Herkules), Anders Misund (EQT), Pål Reed (HitechVision), Ulrik Smith (FSN Capital) and Jan Kjærvik (A.P. Møller Mærsk). Their first-hand experience- and thoughts regarding PE served as an interesting supplement to our empirical analysis.

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BO	Buyout
CEO	Chief executive officer
CSE	Copenhagen Stock Exchange
EBITDA	Earnings before interest, taxes, depreciation and amortization
EW	Equally weighted
GP	General Partner
HSE	Helsinki Stock Exchange
ICB	Industry Classification Benchmark
IPO	Initial public offering
IR	Initial return
LBO	Leverage buyout
LP	Limited Partner
M&A	Mergers and acquisitions
NB IPO	Non-backed IPO (refers to IPOs that were not backed by PE-sponsors)
NPV	Net present value
OLS	Ordinary least squares
OSE	Oslo Stock Exchange
OVB	Omitted variable bias
PE	Private equity
RLBO	Reversed leverage buyout
Ri	(Interview) respondent i (i=1,2…6)
SSE	Stockholm Stock Exchange
STD	Standard deviation
US	United States of America
VC	Venture capital
VW	Value weighted

1 Introduction

1.1 Background

"In the early 2000s, the PE industry was dominated by generalists who managed to deliver abnormal returns due to being "world champions" in excel modelling. Today, everybody are "world champions" in excel. Hence, profitability in the PE industry now requires industry-specific knowledge and experience unique to the particular PE firm" – Interview respondent 2.

This study can be viewed as a two-step analysis employing both empirical- and qualitative approaches. First, we examine whether underpricing of Nordic IPOs differ across PE-backed and NB firms using various empirical techniques. Second, we investigate exit strategies- and the (potential) interrelation between entry and exit by PE-sponsors, through in-depth interviews with key industry players in the Nordic PE landscape.

The fact that the average IPO is significantly underpriced is well-documented in academic research. Despite this, there appears to be universal consensus explaining the phenomenon. However, most theoretical concepts and empirical research attribute the underpricing puzzle to information being asymmetrically distributed between relevant stakeholders in IPOs.

1.2 Research questions

Prior research suggests PE-backed IPOs exhibit significantly lower underpricing (on average) than NB IPOs (see Table 3-2). However, most existing studies on PE-backed IPOs focus on the US market, implying there are few empirical studies on PE-backed IPOs in the *Nordic* region (see Table 3-2). In addition, exit strategies by PE-sponsors have received limited attention in prior research. Hence, the objective of this thesis is to contribute to the limited academic literature on i) Nordic PE-backed IPOs and ii) exits by PE-sponsors. More specifically, we aim to answer the following research questions:

1. **What is the effect (if any) of PE-backing on the degree of underpricing for IPOs listed on Nordic exchanges?**
2. **What are key drivers behind choice of exit route by Nordic PE-sponsors and how may entry- and exit of portfolio firms represent interrelated events?**

To answer *research question 1*, we conducted a time-consuming, but rewarding data gathering process. Thorough research and screening resulted in 60 PE-backed IPOs and 155 NB IPOs listed on Nordic exchanges (excl. Iceland) between January 2005 and December

2014. The PE-backed sample was compared to i) 1:1 matched-control IPOs based on industry classification and offer size and ii) the entire pool of control IPOs. We relied on both univariate testing (parametric- and non-parametric tests) and multivariate regressions when analysing the effect of PE-backing on IPO underpricing.

To answer *research question 2*, we conducted in-depth interviews with key industry players representing the renowned Nordic PE firms; Altor Equity Partners, EQT, FSN Capital, Herkules Capital and HitechVision. More precisely, we spoke to one deputy CEO, one former CEO (now chairman and partner) and three partners (one is also head of the Norwegian subsidiary) of Nordic PE firms in addition to one industry-expert with experience from Acquisition Finance (i.e. acquisitions related to LBOs). The interviews gave us first-hand information about key factors driving the choice of exit route, the interrelation between the entry- and exit of portfolio firms, trends in the Nordic PE industry in addition to thoughts regarding our empirical results.

1.3 Structure

The structure of the thesis is as follows; Chapter 2 presents an overview of PE as an asset class, i.e. definition of key terminology, organisation and structure of PE transactions, brief history and a short description of PE in the Nordic region. Chapter 3 and 4 summarise prior research- and relevant theory on the underpricing phenomenon, underpricing of PE-backed IPOs in particular and PE exits. Chapter 5 and 6 present detailed descriptions of the research methodology (empirical and qualitative) applied in our analysis, matching procedure, data gathering and sample selection process, how we obtained firm-specific information necessary (i.e. offer prices, closing prices, underwriters etc.) and how we distinguished between venture capital (VC)- and buyout (BO)-backed IPOs. Chapter 7 presents our results and a discussion of the results in relation to established empirical research and theoretical concepts. Finally, we present our overall conclusion regarding i) the effect of PE-backing on IPO underpricing in the Nordic region and ii) key factors determining choice of exit route and how entry- and exit of portfolio firms may represent interrelated events.

2 Private equity: Structure, history and the Nordic market

2.1 Structure and organization

Cendrowski, Marin, Petro and Wadecki (2012, p. 4) define "private equity" (PE) as a *"medium or long-term equity investment that is not publically traded on an exchange".* PE represents a possible funding source for start-up- and growth firms (ventures), more mature firms (buyouts) and firms in financial distress[1]. Thus, PE transactions are usually separated into two main categories, namely venture capital- (VC) and buyout (BO) transactions (see Figure 2-1)[2].

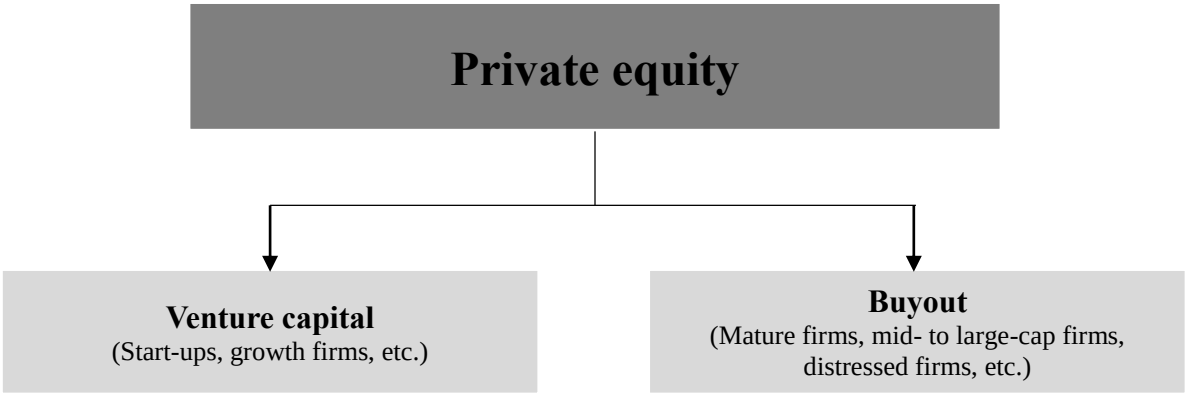

Figure 2-1: Types of PE transactions (Argentum Private Equity, 2015a)

VC encompasses investments in both early stage (seed) and expansion (growth) ventures (Argentum Private Equity, 2015a). The BO classification typically include public-to-private- and private-to-private BOs, in addition to subsidiaries of private and public companies (Schöber, 2008). BO transactions characterised with considerable debt financing are usually referred to as *leveraged* BOs (LBOs). It is worth mentioning that the PE market for BOs is considerably greater than that of VC, in terms of funding (Splid, 2013).

Figure 2-2 depicts the typical organisational structure of the PE investment process and the involved parties. The different stakeholders are:

- Portfolio firms: A portfolio firm represents a firm in which a PE fund has made direct investments. The private ownership period is typically between 2 and 7 years (Cendrowski et al., 2012).
- General Partners (GPs): The GPs represent a group of partners organised as a PE firm responsible for managing the PE fund[3]. In addition, the GPs (often) represent "active

[1] The term "private equity" encompasses both VC- and BO firms in our study (see section 6.1.2 for classification of VC and BO).
[2] We refer to venture capitalists as "VC-sponsors". Sponsors of BO transactions are referred to as "BO-sponsors".
[3] We use "PE firm" and "PE-sponsor" interchangeably when referring to the formal organisation of GP.

managers" of the portfolio firms, meaning they attempt to add value during the (private) ownership period. The GPs are often compensated based on the performance of the PE funds.

- Limited Partners (LPs): LPs represent the investors providing capital to the PE funds (i.e. the Limited Partnership). They are typically institutional investors or high net worth individuals and are not involved in the management of the PE fund.

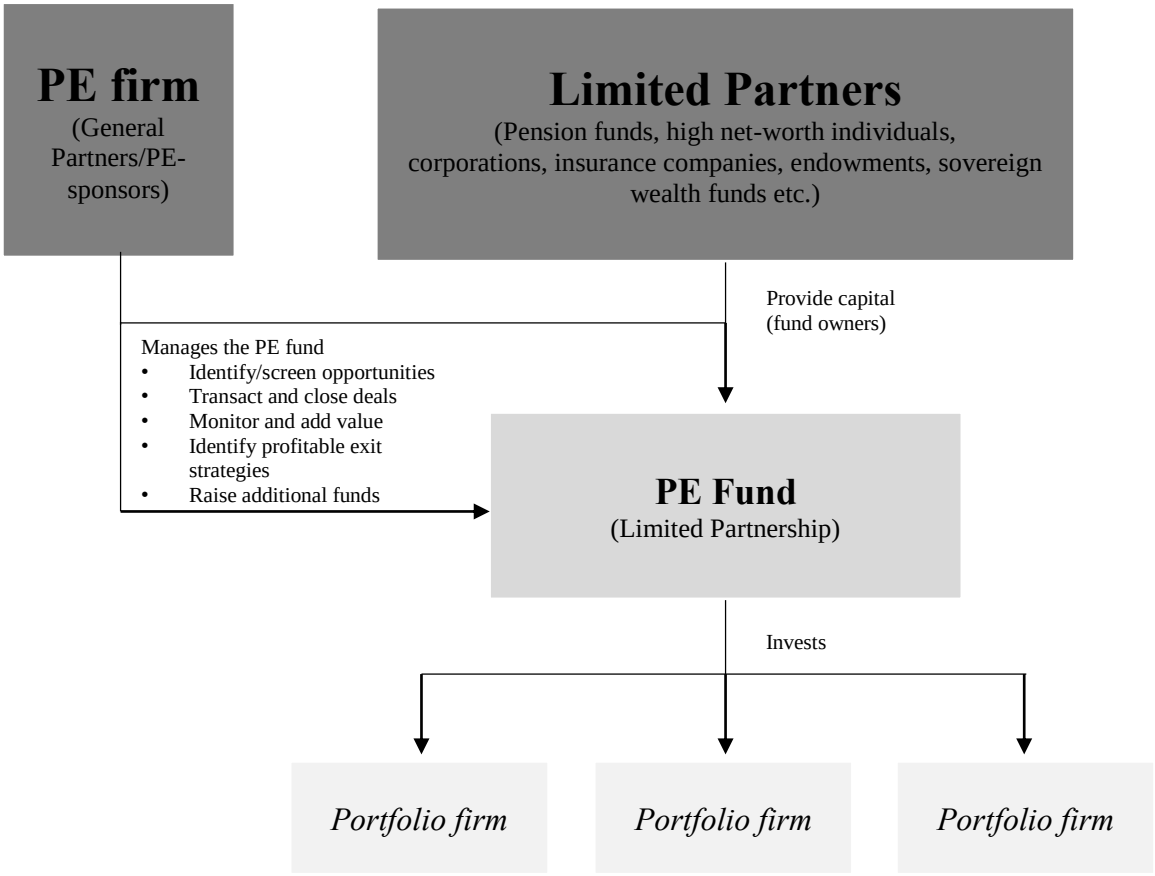

Figure 2-2: The PE process and structure. Authors' chart inspired by Exhibit 1.3 (p. 15) in "Private Equity: History, Governance, and Operations" by Cendrowski et al. (2012)

The main objective for GPs is to add value to its portfolio firms during the ownership period and realising satisfying profits through various exit strategies (e.g. M&A, IPO etc.). The average PE fund has a fixed life of ten years, during which the GPs identify, monitor/manage and exits a selection of portfolio firms (Fenn, Liang, & Prowse, 1997). The GPs typically assist in design of corporate strategy, optimise the capital structure, have members on the board of directors, choose the (potentially new) management and monitor management behaviour. The LPs, on the other hand, are not involved with day-to-day operations of the portfolio firms.

In summary, the main rationale behind the structure outlined in Figure 2-2, is to align interests and incentives of the GPs and LPs. GPs have incentives to pursue the interests of the LPs (i.e. maximise fund return), not only to receive their stake of the fund return, but also in order to raise new funds in the future (through good reputation).

2.2 Life cycle of PE funds

The life cycle of PE funds involve four distinct stages; Fundraising, investment, management and divestment (exit) (see Figure 2-3). In concordance with our focus on PE in the *Nordic* region, the following discussion will focus on the *Nordic* PE market. The term "Nordic" in this study refers to Denmark, Finland, Norway and Sweden (i.e. excluding Iceland).

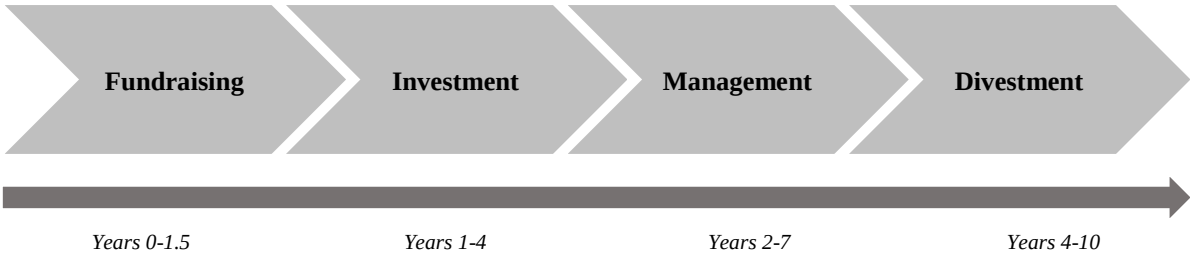

Figure 2-3: Stages related to the life-cycle of PE-funds. Chart inspired by Exhibit 1.2 in "Private Equity: History, Governance and Operations" by Cedrowski et al. (2012)

2.2.1 Fundraising

The fundraising typically takes 0.5 to 1.5 years, and involves recruiting LPs (investors) in addition to establishing a strategy and investment focus for the PE fund (Cendrowski et al., 2012). The fund closes for additional investors when it reaches a pre-determined size (e.g. EUR 500 million). As depicted in Table 2-1, the majority of LPs in the Nordic region are *funds-of-funds and other asset managers* in addition to *pension funds*. Combined, they contributed with almost 60% of the overall fundraising by Nordic PE-firms in 2014 (EVCA, 2015a).

Table 2-1: Nordic[4] fund distribution by type of investor (LP) (2014)

Fundraising by investor-type by Nordic PE-firms. Statistic provided by EVCA (2015a).

	% of fund		% of fund
Academic inst./Endowments/ Foundations	14.4%	Sovereign wealth funds	7.1%
Family offices & Private individuals	9.0%	Capital markets	1.3%
Pension funds	27.4%	Government agencies	6.4%
Banks	0.7%	Corporate investors	0.5%
Funds of funds & other asset managers	28.4%	Insurance companies	4.8%

[4] Denmark, Finland, Norway and Sweden.

2.2.2 Investment

During the investment phase, the GPs identify and screen investment opportunities in line with the fund's strategy and focus. Potential targets represent publically listed- or private companies and subsidiaries of public/private companies. The investment phase typically stretches from year 1 to 4 of the fund's life cycle (Cendrowski et al., 2012).

2.2.3 Management

The management phase commonly encompass year 2 through year 7 of the fund's life cycle. During this stage, the GPs aim to increase the value of the portfolio firms through active management in addition to making financial, operational and strategic improvements. To support the development and growth of the portfolio firms (e.g. built-on acquisitions and/or substantial investments) additional funds may be raised during this period (Cendrowski et al., 2012).

2.2.4 Divestment (exit)

The divestment period usually begins around year 4 and lasts until the liquidation of the PE fund at the end of its life cycle. During this period, the GPs aim to realise all investments prior to the liquidation of the fund (Cendrowski et al., 2012). The investments may be divested through various exit channels, such as sale to industrial players (trade sale), sale to another financial investor (secondary buyout) or sale to public investors (IPO), among other exit channels (see Figure 4-1). As depicted in Figure 2-4, trade sale constituted by far the most common exit route in the Nordic region in 2014, accounting for almost 50% of all divestments. However, during the financial crisis (2008-2009), the majority of portfolio investments in Europe were forced to exit through write-offs[5] (EVCA , 2010).

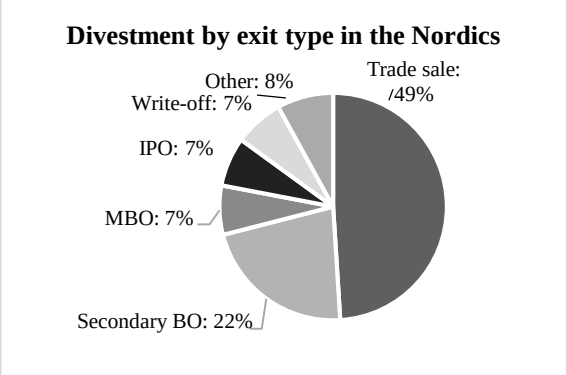

Figure 2-4: Divestment by exit type (in terms of number of firms) by PE-funds in the Nordic region in 2014 (Argentum Private Equity, 2015b)

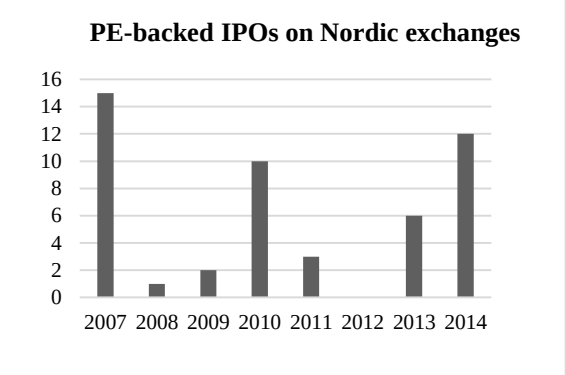

Figure 2-5: The number of PE-backed IPOs listed on Nordic exchanges between 2007 and 2014 (Argentum Private Equity, 2015b)

[5] Total/partial write-down of the investment (e.g. portfolio firm), implying return to investors close to 100% (i.e. value of investment is eliminated).

Furthermore, IPO appears to represent a relatively uncommon exit-route in the Nordic region, especially during the financial crisis (2008-2009) (see Figure 2-4 and Figure 2-5). The latter can likely be attributed to challenging and volatile stock markets (i.e. "cold" IPO markets) resulting in less attractive IPO valuations compared to market "peaks" (Argentum Private Equity, 2015). However Figure 2-5 suggests IPO as an exit-strategy is approaching pre-crisis levels with 2014 representing the "turn-around" year. IPO as an exit route is discussed in greater detail in section 4.1.3.

2.3 History

The emergence of the PE industry can be dated back to 1946, with the establishment of a closed-end investment company called American Research and Development Corporation (ARD). Prior to World War II, there were considerable concerns regarding the lack of funding- and long-term financing for new and small ventures. Consequently, ARD was formed as a response to these concerns with an objective to represent a private-funding solution for small ventures. In addition, ARD also aimed to provide managerial expertise to new ventures as they believed capital alone was insufficient to ensure healthy development of new businesses (Fenn et al., 1997).

In the 1980s, favourable regulatory changes and tax reforms in the US combined with the emergence of the Limited Partnership structure, created the first "boom" for the PE industry (in terms of fundraising). Organising the PE transactions as Limited Partnerships contributed to aligning the interests of different stakeholders; GPs are incentivised to pursue the interests of fund-owners and possesses authority to influence managers accordingly.

The emergence of the high-yield bond market in the 1980s resulted in increased use of leverage in BO transactions (i.e. LBOs). Examples of renowned LBOs are Wometco Enterprises (1984), Revco Drug Stores (1986) and Marvel Entertainment (1988). However, as a consequence of the collapse of the junk bond market in 1989, the activity of highly leveraged deals decreased considerably (Splid, 2013). In the subsequent years (the early 1990s) PE investments were less based on exploiting the benefits of leverage (e.g. interest tax shields) and more focused on making operational improvements. In the mid-2000, the PE industry experienced another "boom" and flourished with high levels of fundraising and a large number of deals (Preqin Ltd., 2014).

However, during the financial turmoil in 2008 and 2009, the industry was challenged by poor global economic conditions and plummeting returns on their PE funds. Several fund investors

(LPs) faced liquidity problems, as they found themselves over-allocated in alternative investments. This resulted in investors fleeing the PE landscape and thereby leaving the PE funds with historically low levels of fundraising and investments (Cendrowski et al., 2012). As indicated by Figure 2-6, the European PE industry has still not recovered from the financial crisis (neither in terms of fundraising nor investments).

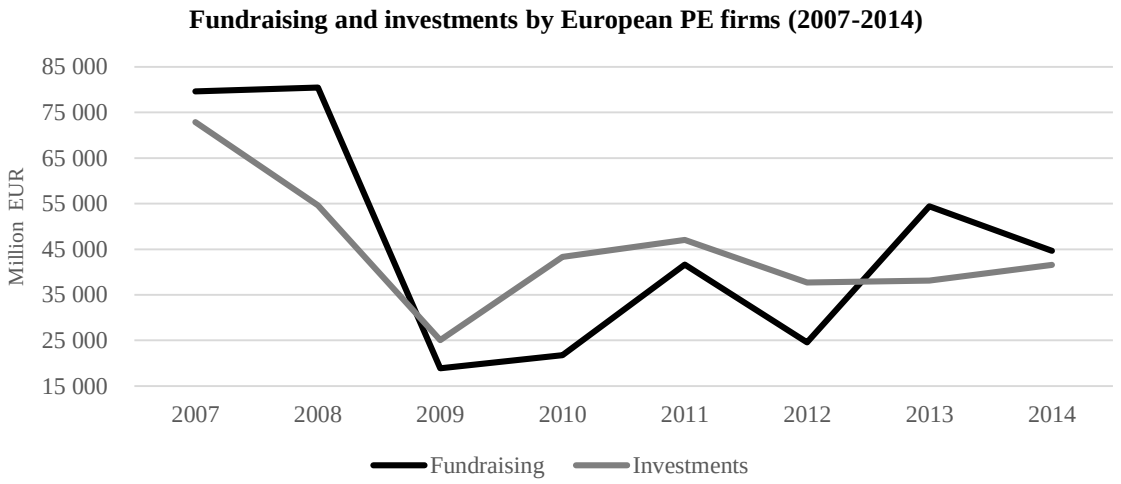

Figure 2-6: Annual fundraising and investments by European PE firms. Authors' calculations based on statistics from EVCA (2015b)

2.4 The Nordic PE industry

PE as an asset class emerged in the Nordic region in the beginning of the 1990s, along with the shift towards focus on operational improvements (Splid, 2013). Since its somewhat late start, the Nordic region has become one of the most active markets in the European PE industry, both in terms of fundraising and investments (Splid, 2013). In 2014, fundraising by Nordic GPs totalled EUR 5.9 billion, corresponding to more than 13% of total funds raised in Europe. Investments in Nordic portfolio firms summarised to EUR 3.9 billion in 2014, which constituted 10% of all investments in European portfolio firms (EVCA, 2015a). Sweden has historically represented the Nordic country associated with the largest annual PE investments (Argentum Private Equity, 2014). However, the Norwegian PE market passed the Swedish one in 2013 and now represents the most active country in the Nordic PE market, both in terms of investments and fundraising (see Figure 2-7 and Figure 2-8).

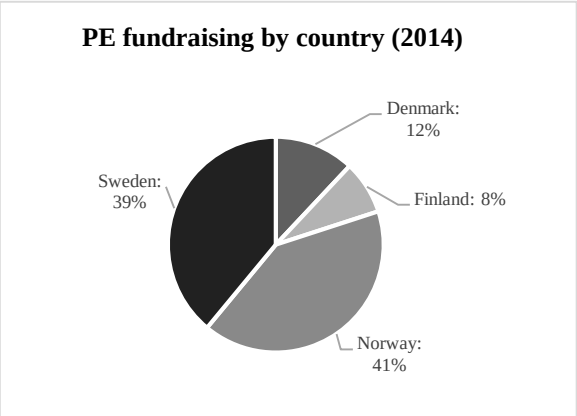

Figure 2-7: Geographical distribution of fundraising by Nordic PE funds in 2014. (Argentum Private Equity, 2015b)

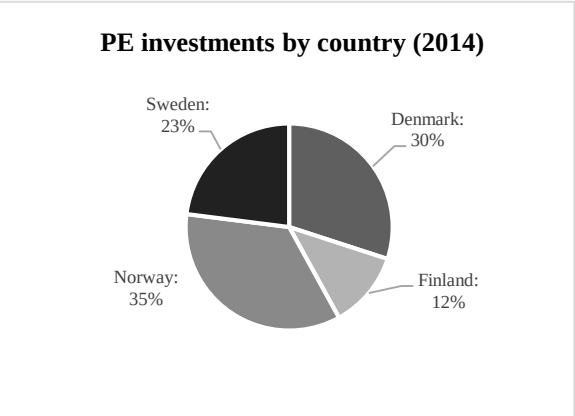

Figure 2-8: Relative PE investments in 2014 by country of portfolio firm (Argentum Private Equity, 2015b)

The Nordic PE market appear to be recovering more rapidly from the financial crisis than remaining parts of Europe (compare Figure 2-6 and Figure 2-9). Splid (2013) postulates several potential explanations for the (potentially) more rapid recovery of the Nordic PE market. First, Nordic PE funds raised considerable amounts of capital prior to the crisis and thereby accumulated large amounts of capital to be invested. Second, their funds included relatively few distressed companies. Third, their main creditors (i.e. the Nordic banks) are relatively solid and stable compared to the banking sector in other parts of Europe (particularly southern parts). These factors ensured the Nordic PE funds maintained their solidity throughout the crisis, and subsequently gave the GPs the opportunity to buy targets at considerable discounts (Splid, 2013).

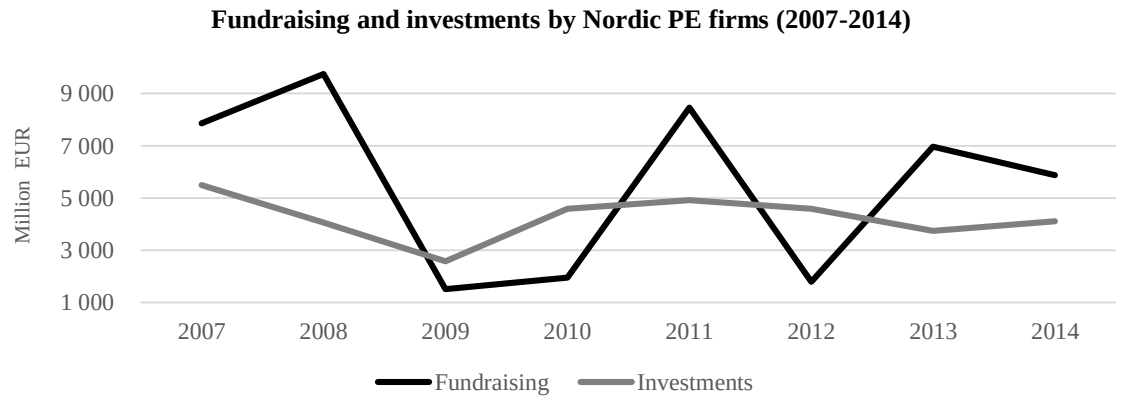

Figure 2-9: Annual fundraising and investments by Nordic PE firms. Authors' calculations based on statistics from EVCA (2015b)

Figure 2-10 depicts the relative distribution of PE investments by industry in the Nordic region, and the remaining parts of Europe, in 2014. The majority of overall PE investments in Europe and the Nordics were mainly associated with two industries, namely *industrial* and *life sciences*. However, firms operating in the *energy* sector represent a large share of investments in the Nordics compared to remaining parts of Europe. This can likely be attributed to Norway's high activity in the oil and gas sector. Figure 2-10 also reveals that investments in the retail sector is more prominent in Europe (excl. Nordics) than in the Nordic region.

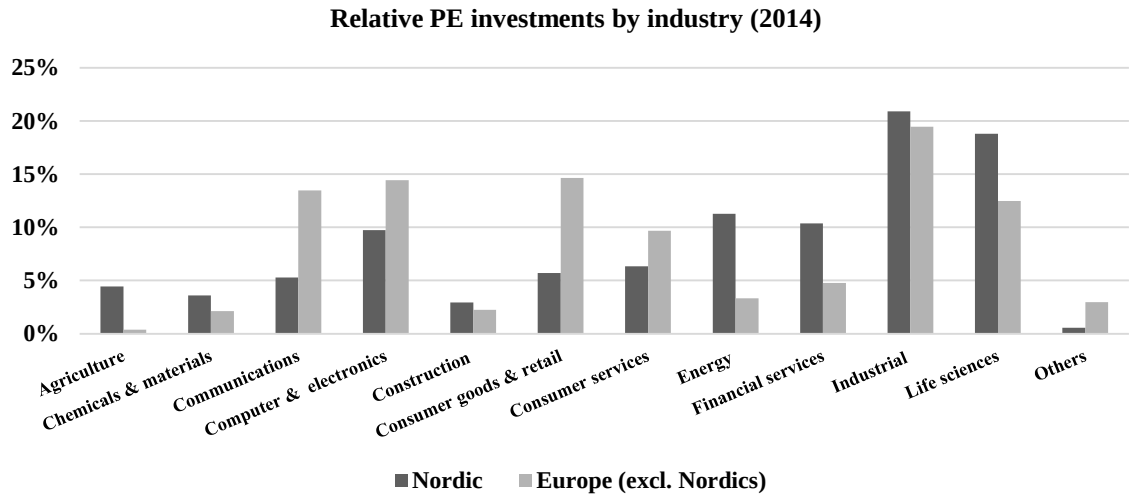

Figure 2-10: Relative PE investments by industry, in the Nordic region and Europe (excl. Nordics) in 2014. Authors' calculations based on statistics from EVCA (2015a)

3 Underpricing: Theory and literature review

Underpricing of IPOs refers to the phenomenon that the average IPO tend to yield (abnormal) positive initial returns. The initial return represents the percentage change from the offering price to an aftermarket price within a short period (first day, week or month) after the offering. In the following sections we will first present existing empirical research on underpricing followed by theory on underpricing in general and variations between IPOs (see Figure 3-1). Subsequently, we follow the same structure when presenting previous research- and theory on underpricing of PE-backed IPOs in particular (see Figure 3-2).

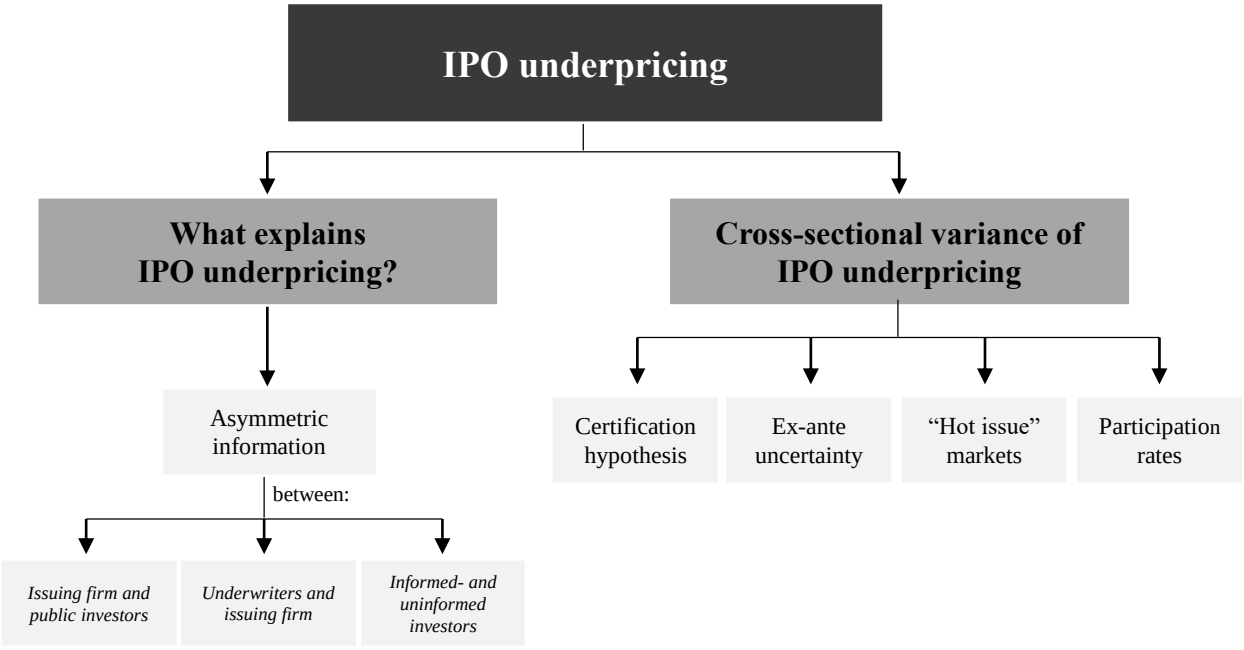

Figure 3-1: Overview of theories on IPO underpricing (in general and variation between issues) presented in our study.. Authors' chart based on elements/theories relevant for our analysis/study

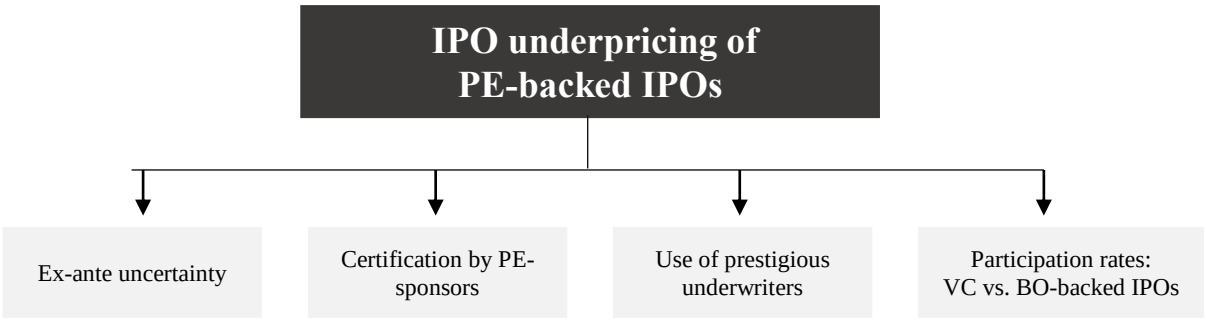

Figure 3-2: Theories and literature review of IPO underpricing of PE-backed IPOs in particular. Authors' chart based on elements/theories relevant for our analysis/study

3.1 Underpricing of IPOs

The fact that the average IPO is significantly underpriced is well documented in academic literature and has been examined by researchers since the 1960s (see Table 3-1).

Table 3-1: Prior empirical research on IPO underpricing

Authors	Market (Period)	Size	Underpricing	Comment
Hatfield & Reilly (1969)	US (1963-1966)	53	9.90% (mean)	- Price on the first Friday after offering - Raw initial returns
McDonald & Fisher (1972)	US (1961)	142	28.50% (mean)	- Price one week after the offering - Initial returns adjusted for OTC average of the National Quotation Bureau
Ibbotson & Jaffe (1975)	n/a (1960-1970)	128	16.83% (mean) 12.64% (median)	- Closing bid price on the first day of the calendar month
Ritter (1984)	US (1977-1982)	1028	26.50% (mean)	- First day closing bid price
Beatty & Ritter (1986)	US (1981-1982)	545	14.10% (mean)	- First day closing bid price - Raw initial returns
Miller & Reilly (1987)	US (1982-1983)	510	9.87% (mean)	- First day closing bid price - Initial returns adjusted for return on NASDAQ Industrial Index (OTC stocks)
Ljungqvist & Wilhelm (2003)	US (1996-2000)	2178	35.70% (mean) 13.90% (median)	- First day closing price - Raw initial returns
Loughran & Ritter (2004)	US (1980-2003)	6391	18.70% (mean)	- First day closing price - Raw initial returns
Hahn , Ligon, & Rhodes (2013)	Global (1988-2009)	2693	27.80% (mean) 11.10% (median)	- First day closing price - Raw initial returns
Pukthuanthong, Shi, & Walker (2013)	Global (1995-2002)	6025	29.30% (mean) 18.80% (median)	- Price on the 15th calendar day after offering - Adjusted initial returns - Nordic underpricing (excl Iceland): 7.50% (mean)

As depicted in Table 3-1, the mean underpricing varies considerably among the studies, ranging from 9.9% to 35.7%. However, when comparing the results listed in Table 3-1, it is worth noting that both the aftermarket price and method (e.g. raw vs. adjusted returns) applied when calculating the initial returns, differ between the studies. Some studies use raw initial returns, while others adjust the returns using a benchmark (e.g. a stock market index). The earlier studies such as Hatfield and Reilly (1969), McDonald and Fisher (1972) and Ibbotson and Jaffe (1975) use aftermarket prices post the first trading day. On the contrary, more recent studies by Ljungqvist & Wilhelm (2003) Loughran and Ritter (2004) and Hahn et al. (2013), use *first day* closing prices as proxy for aftermarket prices. In the context of *Nordic* IPOs, Pukthuanthong et al. (2013) document lower levels of IPO underpricing in the Nordic

countries compared to other countries[6]. They find the mean underpricing of Nordic IPOs to be 7.5%, which is considerably lower than the overall average (for 34 countries) of 29.3%.

3.2 What explains IPO underpricing?

There are numerous theories attempting to explain the underpricing phenomenon. The most prominent theories are based on the assumption that information about "true" firm (stock) value is asymmetrically distributed between relevant stakeholders in IPOs (i.e. issuing firm, investor and underwriters). Hence, we start by elaborating on how theories of asymmetric information may explain the underpricing phenomenon *in general*, before describing explanations to why we see cross-sectional variations between issues. It is worth noting that the theories do not necessarily represent substitutes, but rather compliments, as they assess different aspects of the process of going public (Ibbotson & Ritter, 1995).

3.2.1 Asymmetric information

Most models and theories of underpricing are based on informational asymmetry between the relevant stakeholders in IPOs. The different explanations depend on which stakeholder is assumed to have superior (relevant) information about "true" firm value.

In the context of IPOs, information asymmetries may arise in (particularly) three relationships between stakeholders in IPOs. First, informational asymmetries may arise between insiders (initial owners and management) and outside investors, in which the former tend to have superior knowledge about the future prospects of the firm (Berk & DeMarzo, Corporate Finance, 2011). This may encourage insiders of IPOs to behave opportunistically at the expense of outsiders (e.g. to "cash out" prior to publication of bad news). Hence, outside investors may question insiders' motivation behind the IPO and thereby reduce the price they are willing to pay for the offer (Booth & Smith (1986), Berk & DeMarzo (2011)).

Second, informational asymmetries may arise between insiders and underwriters, in which the underwriters are assumed to possess superior knowledge about the market conditions and demand for IPOs (Baron (1982), Muscarella & Vetsuypens (1989)). Underwriters may then be incentivised to offer recurrent investors positive initial returns, through deliberate underpricing and targeted marketing (in order to enhance future business) (Loughran and Ritter (2002, 2004), Bergström, Nilsson and Wahlberg (2006)) (see section 3.3.1).

[6] Pukthuanthong et al. (2013): Studied underpricing of 6025 IPOs in 34 different countries listed between 1995 and 2002.

Third, some scholars argue informational asymmetries between informed and uninformed investors may explain IPO underpricing (Beatty & Ritter (1986), Rock (1986), Levis (1990), Ibbotson & Ritter (1995)) See section 10.9, Appendix (the "Winner's curse" problem) for detailed discussion of the consequences of information being asymmetrically distributed between informed- and uninformed investors.

Previous research postulate several different proxies for the level of asymmetric information related to an issue. First, high-risk IPOs tend to be more underpriced than low-risk issues, due to the former being associated with higher levels of asymmetric information than the latter (Ritter, 1984). Normal proxies for risk are industries characterised by high levels of uncertainty (technology and telecommunications), aftermarket volatility, firm size (smaller firms riskier than large firms) and firm age (younger firms riskier than older/more mature firms). Supporting this, Helwege and Liang (2004) find that abnormally underpriced IPOs tend to be younger than less underpriced IPOs. Second, underpricing appear to ameliorate with the level of transparency associated with the IPO (Schöber, 2008). High levels of transparency (e.g. through informative prospectus, media coverage, prior trading history) may reduce the degree of asymmetric information related to an issue (and thereby also its underpricing).

3.3 Cross-sectional variation of IPO underpricing

As noted by Schöber (2008), past studies reveal considerable cross-sectional variations in underpricing *between* IPOs. The theories discussed in this section attempt to explain why some IPOs are more (or less) underpriced than other IPOs.

3.3.1 Certification hypothesis: Underwriter reputation

Klein and Leffler (1981) were among the first to discuss reputational signalling as potential certification of quality. They suggest that "non-salvageable investments" (i.e. costs related to an investment are considered sunk) can provide quality assurance of a firm's products, since consumers may view such investments as commitment to produce high-quality products. In this thesis, the two certification mechanisms we deem the most relevant are *underwriter reputation* and *PE-sponsor presence/reputation.*

Regarding underwriter reputation, Beatty and Ritter (1986), Booth and Smith (1986) and Carter and Manaster (1990) extend the reputational signalling hypothesis in an attempt to explain how underwriter reputation can certify the pricing of equity issues. It follows that underwriters frequently interact with capital markets through repeated issues and thereby have

reputational capital at stake. Hiring "prestigious" underwriters[7] may represent a trustworthy signal that the price range reflects relevant (inside) information, since such underwriters may be incentivised to maintain their reputation through low levels of mispricing (Schöber, 2008). In line with these arguments, Carter and Manaster (1990) document that IPOs associated with "prestigious" underwriters are significantly less underpriced than other IPOs. Similarly, Beatty (1989) examines certification effects in relation to auditor reputation. He documents a negative relationship between underpricing and auditor reputation, consistent with the certification hypothesis.

In contrast, other scholars argue that underwriters may be incentivised to deliberately underprice new issues. Baron (1982) argues that underwriters may intentionally underprice new issues to reduce IPO marketing costs and risk. Loughran and Ritter (2004, p. 9), on the other hand, suggest that underwriters may deliberately underprice an IPO if they expect "*commission business in return for leaving money on the table*[8]" (i.e. to induce investors to participate in additional issues).

The (potential) certification effect by PE-sponsors is discussed in section 3.4.2.

3.3.2 Ex-ante uncertainty hypothesis[9]

Beatty and Ritter (1986) examine the relationship between (expected) IPO underpricing and the level of ex-ante uncertainty related to an issue[10]. They argue that the level of underpricing increases with ex-ante uncertainty, since the "winner's curse" problem[11] amplifies with the uncertainty. This suggests, issuing firms may be incentivised to disclose information voluntarily in order to reduce the ex-ante uncertainty (and thereby the underpricing) associated with the issue. This reasoning is backed with empirical evidence provided by Beatty and Ritter (1986)[12] and Miller and Reilly (1987).

3.3.3 "Hot" issue markets

Ibbotson and Jaffe (1975) and Ritter (1984) were among the first to document the cyclicality of IPO activity and the existence of "hot" and "cold" issue markets. They define "hot issue markets" as periods when new issues yield abnormally high initial returns. In contrast, "cold"

[7] The «prestige» is determined by a ranking developed by Carter and Manaster; the "Carter-Manaster (CM) rank".
[8] Money on the table: Number of share sold*initial return (Loughran & Ritter, 2002).
[9] Also called: The asymmetric information hypothesis.
[10] Ex-ante uncertainty: Uncertainty about firm value once it starts trading.
[11] See section 10.9, Appendix for explanation of the "Winner's curse"-problem in relation to IPO underpricing.
[12] Beatty and Ritter (1986) use two proxies for ex-ante uncertainty: i) log (1+ number of uses of proceeds listed in the prospectus). Issues with high numbers of uses are assumed related to higher ex-ante uncertainty as SEC requires speculative issues to provide detailed descriptions of use of proceeds, while more established firms are not required to be very specific. ii) Inverse of gross proceeds from the offer (as smaller offerings tend to be more speculative/associated with higher ex-ante uncertainty than larger issues, see Ritter (1987)).

issue markets refer to periods with below-average initial returns. To illustrate, the average underpricing was 48% in the "hot" issue market of 1980, while the average underpricing during the period 1977-1982 was 16% (Ritter, 1984). More recently, Loughran and Ritter (2004) document that the average underpricing was 65% in the "hot" dot-com years of 1999-2000, while the corresponding number was "only" 12% during the "colder" IPO years of 2001-2003.

As noted by Ibbotson and Ritter (1995), it appears difficult to find rational explanations for the existence of "hot" issue markets. Despite this, prior research documents a strong positive correlation between IPO underpricing and market returns (Loughran, Ritter, & Rydqvist, 1994). This indicates that "hot" issue markets tend to follow periods of high stock market returns. Ljungqvist, Nanda and Singh (2006) suggest that "hot" issue markets may be caused by irrational investor behaviour. They argue that such markets may be explained the presence of investors who are "irrationally exuberant about the prospects of IPOs" (e.g. from a specific industry or market).

3.3.4 Participation rates

Habib and Ljunqvist (2001) attribute cross-sectional differences in IPO underpricing to wealth incentives of existing owners in new issues. It follows that existing owners may be incentivised to avoid underpricing in order to minimise the amount of "money left on the table"[13]. Habib and Ljunqvist (2001) argue that insiders' incentives to reduce underpricing depend on the fraction of shares retained in the IPO. When retention rates are high, insiders may care less about underpricing than when retention rates are low, since the cost of "leaving money on the table" is lower in the former. They stress that existing owners can affect the level of underpricing through the promotion choices they make, such as which underwriter- and exchange to use. Hence, they expect IPOs associated with high participation rates to be less underpriced than those with low participation rates. Empirical evidence from Habib and Ljunqvist (2001) and Hogan, Olson and Kish (2001) backs this proposition.

3.4 Underpricing of PE-backed IPOs

In this study, we address IPOs backed by PE-, VC- and BO-sponsors as "PE"-, "VC"- and "BO-backed IPOs" respectively (in which "PE" refers to "VC" and "BO" collectively) and IPOs not backed by PE as "NB IPOs" (i.e. non-backed IPOs).

[13] Money on the table: Number of share sold*initial return (Loughran & Ritter, 2002).

We have identified nine studies that compare the level of underpricing across PE-backed and NB IPOs (see Table 3-2). As revealed in Table 3-2, the average PE-backed IPO appears to yield positive initial returns, consistent with evidence presented on the underpricing phenomenon (see Table 3-1). The most recent studies of Schöber (2008) and Cao and Lerner (2009) document considerably higher levels of underpricing than earlier studies do. This can likely be explained by their studies including IPOs listed in the "hot" dot-com years of 1999-2000 (Schöber, 2008).

However, as indicated by Table 3-2, the majority of prior research find PE-backed IPOs to exhibit significantly *lower* levels of underpricing than NB IPOs. One study suggests greater underpricing of VC-backed- compared to non-VC-backed, but the difference is not statistically significant (Barry, Muscarella, Peavy, & Vetsuypens , 1990).

Table 3-2: Prior empirical research on underpricing of PE-backed IPOs

This table reports existing empirical evidence comparing underpricing across PE-backed and NB IPOs. Reverse LBOs (RLBOs) refer to LBOs that were publically traded prior to the buyout.
*P< 10%, ** P< 5%, *** P< 1%.

Authors	Size & PE-type	Market (Period)	Underpricing PE-backed IPOs	Underpricing control IPOs	Diff.	Comment
Muscarella and Vetsupypens (1989)	RLBO: 74 Control: 1114	US (1983-1987)	2.04% (mean) 0.00% (median)	7.97% (mean) 1.78% /(median)	***-5.93%**** ***-1.78%****	- No matching
Barry et al. (1990)	VC: 433 Control: 1123	n/a (1978-1987)	8.43% (mean)	7.47% (mean)	***0.96%***	- No matching
Ainina and Mohan (1991)	RLBO: 92 Control: 92	US (1983-1987)	2.07% (mean)	2.78% (mean)	***-0.71%***	- Matching (1:1) based on distribution of assets
Megginson and Weiss (1991)	VC: 320 Control: 320	US (1983-1987)	7.10% (mean)	11.90% (mean)	***-3.62%****	- Matched 1:1 by industry and offer size
Hogan et al. (2001)	RLBO: 232 Control: 232	n/a (1986-1998)	7.64% (mean)	13.00% (mean)	***-5.36%****	- Matched 1:1 by industry offer size and - date
Ang and Brau (2002)	BO: 334 Control: 334	n/a (1981-1996)	5.47% (mean)	8.04% (mean)	***-2.57%****	- Matched 1:1 by offer size and -date (Mean between bid/ask)
Bergström et al. (2006)	PE: 152 Control: 1370	Paris & London (1994-2004)	9.33% (mean)	12.87% (mean)	***-3.47%***	- No matching
Schöber (2008)	BO: 461 Control: 461	US (1973-2007)	11.56% (mean) 6.33% (median)	16.34% (mean) 11.56% (median)	***-4.78%**** ***-5.23%****	- Group matching by industry, date, offer - and asset size[14]
Cao and Lerner (2009)	RLBO: 437 Control: 5706	n/a (1981-2003)	12.88% (mean)	22.18% (mean)	***-9.30%***	- No matching

[14] Schöber used 6 different control samples, in which 4 were based on previous matching principles. This represents Schöber's proprietary matching procedure, which matches each PE-backed IPO with a synthetic control IPO based on industry, IPO date, asset size, offer size.

3.4.1 Ex-ante uncertainty hypothesis[15]

As described in section 3.3.2, the ex-ante uncertainty hypothesis attributes the (abnormal) underpricing to the level of ex-ante uncertainty related to an issue. Vetsuypens and Muscarella (1989), Fall Ainina and Mohan (1991) and more recently, Hogan et al. (2001) and Ang and Brau (2002), specifically study the ex-ante uncertainty hypothesis in relation to *reverse* LBOs (RLBOs). The hypothesis predicts that RLBOs should exhibit lower underpricing than non-reverse IPOs, since the former should be associated with greater transparency as they have been previously traded (Muscarella & Vetsuypens, 1989)[16]. Greater transparency is expected to reduce the level of ex-ante uncertainty related to an IPO and thereby also its underpricing. Consistent with this hypothesis, the studies referred to above find RLBOs to be significantly less underpriced than NB IPOs, even when controlling for key factors assumed to interrelate with initial returns.

Based on abovementioned findings, Schöber (2008) hypothesises that lower underpricing of BO-backed IPOs in *general* (i.e. not only RLBOs) may solely be driven by the presence of RLBOs in the sample. However, when excluding the RLBOs, he finds the remaining BO-backed IPOs to still be significantly less underpriced than NB equivalents, even though both samples should exhibit similar levels of asymmetric information.

Schöber (2008) supplements the ex-ante uncertainty hypothesis by stating that BO-backed IPOs may exhibit lower levels of uncertainty than NB IPOs as the former are generally older and larger than the latter. This suggests firm age and - size is negatively related to the level of asymmetric information.

3.4.2 Certification by PE-sponsors

Most research on certification by PE-sponsors are based on samples of VC-backed IPOs. Prior research postulate several reasons to why the presence of PE-sponsors in IPOs may have certifying effects in IPOs (analogous to the certification by underwriter reputation). First, in their study of the certification role of venture capitalists in IPOs, Barry et al. (1990) and Megginson and Weiss (1991) argue that VC-sponsors repeatedly interact with capital markets and thereby possess/develop superior expertise and experience in monitoring their investments. Second (and partly supporting the latter), Schöber (2008) suggests that VC-sponsors may have stronger monitoring incentives than other owners, since VC-sponsors

[15] Also called: The asymmetric information hypothesis.
[16] RLBOs: Assumed to be more transparent than non-RLBOSs as they exhibit prior trading history and thereby have been required to disclose certain information.

typically have larger equity shares at stake. Third, Barry et al. (1990) argue that VC-sponsors may be incentivised to maintain their reputation through accurate IPO pricing, as underpricing may also be costly to the VC firm and entrepreneurs. In summary, these arguments suggest the presence of owners with reputational capital at stake (in IPOs) may represent a trustworthy signal that the offer price reflects all relevant (inside) information. Consistent with this, Barry et al. (1990), Megginson and Weiss (1991) and Lee and Wahal (2004) find that underpricing tend to ameliorate with the *quality* of the VC-sponsor(s)[17].

On the other hand, Habib and Ljunqvist (2001) stress that one cannot infer that VC-sponsors have certifying effects in IPOs, simply based on the evidence provided by Barry et al. (1990) and Megginson and Weiss (1991). They argue that owners of VC-backed IPOs typically sell more shares in new issues (than owners of non-VC-backed IPOs) and thereby have greater incentives to reduce underpricing (see section 3.3.4). To the best of our knowledge, this proposition is not backed with empirical evidence. However, in his empirical study of BO-backed IPOs, Schöber (2008) emphasise that he cannot provide sufficient empirical evidence supporting the certification hypothesis.

3.4.3 Sponsor-backed IPOs associated with "prestigious" underwriters

Prior research documents that PE-backed firms tend to hire more reputable underwriters when going public, than NB firms (Barry et al. (1990), Megginson & Weiss (1991), Schöber (2008)). Furthermore, prior research find that underwriter reputation is negatively related to underpricing (see section 3.3.1). Hence, as noted by Schöber (2008), PE-backed IPOs may be less underpriced than other IPOs, simply because they employ more reputable underwriters than NB IPOs.

3.4.4 Participation rates: VC- and BO-backed IPOs

Prior research indicates that VC- and BO- sponsors exhibit different selling behaviour when taking their investments public. Megginson and Weiss (1991) find that VC-sponsors on average contribute with 6.9% of total offered shares in IPOs. The corresponding number found by Lin and Smith (1998) was 4.2%. In contrast, Schöber (2008) finds that BO-sponsors on average contribute with 11.8% of all shares sold in their IPOs. Based on these findings, Schöber (2008) suggests that BO-sponsors may be "more aggressive sellers" when taking their portfolio firms public than VC-sponsors.

[17] Proxies for monitoring skill/quality of VC-sponsors: Age, experience, number of previous IPOs, ownership share of the PE-sponsors.

4 Divestments by PE-sponsors: Theory and literature review

There are several exit opportunities available to PE-sponsors, when they want to divest their portfolio firms. As depicted in Figure 4-1, the most common exit routes are i) taking the portfolio firm public (IPO), ii) sell it to an industrial player (trade sale), iii) sell it to a financial buyer, e.g. another PE-firm (secondary buyout), iv) sell it back to existing shareholders or management (buy-back) and v) full or partial write-down of firm value[18] (write-downs) (Cumming & MacIntosh, 2003a).

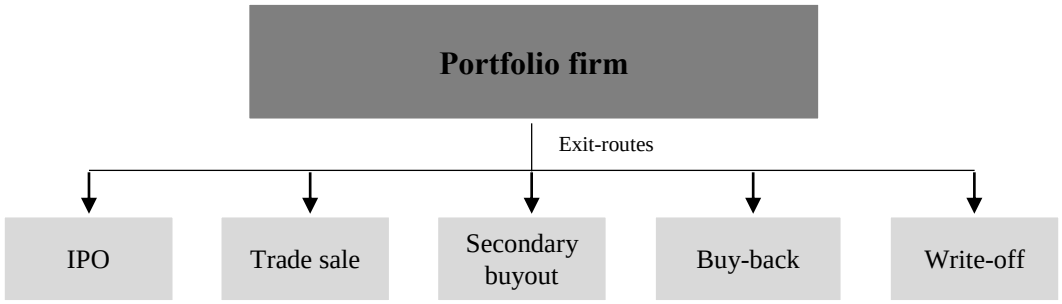

Figure 4-1: Exit strategies by financial sponsors. Authors' chart based on Cumming and MacIntosh (2003a)

The chapter starts by presenting previous literature on factors affecting the choice of going public (both in general and for portfolio firms in particular), followed by theory and previous research related to choice of exit-routes by PE-sponsors.

4.1 Why do PE-sponsors take their portfolio firms public?

In the following sections, we will first introduce the mechanics related to an IPO, followed by a discussion regarding the motivation for going public. Finally, we discuss potential reasons to why PE-sponsors in particular take their portfolio firms public.

4.1.1 The mechanics of IPOs

The initial public offering (IPO) refers to the first time a company offers shares of its stock to the public (Berk & DeMarzo, 2014). The shares offered can either be newly issued stocks (primary shares) or existing shares (secondary shares).

A traditional IPO process contains underwriter(s) who manage the IPO deal and act as an intermediate between the issuing firm and the public market. In larger IPOs it is common to hire several underwriters, who together form a syndicate. One of the underwriters will then

[18] Write-down: Least favourable option. May imply return to investors close to 100%.

act as the lead manager and advisor, while the rest of the syndicate contributes to the marketing- and selling of the shares (Berk & DeMarzo, 2014).

The role of underwriter(s) in an IPO process involves several steps and responsibilities. First, the lead underwriter (together with the IPO-firm) typically propose an indicative price range based on reasonable valuation techniques and analysis. Second, after the price range is determined, the issuing firm and its underwriter(s) commonly arrange road shows. The main objectives behind road shows are to promote the offer to potential buyers (e.g. usally high-net worth individuals or institutional investors) and justify the price range. Third, the underwriters often conduct a book building process in which they register allotment orders from interested investors (Berk & DeMarzo, 2014). Fourth, when approaching the IPO date, the underwriters typically estimate the total demand for the issue, and adjust the final offer price accordingly. The stocks are then allocated in line with each investor's willingness to pay. Finally, the firm (normally) starts trading within a couple of days after the completion of the issuance process (Jenkinson & Ljungqvist, 2001).

4.1.2 Reasons to go public (in general)

According to previous literature, the most common motivations for going public are:

(i) Allow initial owners to diversify and "cash out" on their investment (increase liquidity). Pagano (1993) argues that firms go public when the diversification advantage for initial owners more than compensates the indirect- and direct costs of going public (e.g. underwriter fees, auditing and regulation requirements).

(ii) Provide access to public capital markets and thereby finance future growth- and takeover activity (Brau & Fawcett, 2006).

(iii) Reduce leverage and rebalance the capital structure (typically after periods of high growth) through IPO proceeds and subsequent SEOs (Pagano, Panetta, & Zingales, 1998).

(iv) Strategic move (e.g. to increase firm publicity or reputation) (Brau & Fawcett, 2006).

4.1.3 Why PE firms take their portfolio firms public

To the best of our knowledge, "Buyout-Backed Initial Public Offerings" by Schöber (2008) is the only empirical study investigating why PE-sponsors take their portfolio firms public.

More specifically, he studied 552 BO-backed IPOs[19] and investigated four (complementing) potential reasons to why the firms were taken public:

(i) Initiate the exit process: PE-sponsors (typically) represent the majority owner in their portfolio firms and thereby likely possess dominant influence in the IPO decision. Based on this, Schöber (2008) hypothesises that PE-sponsors take their portfolio firms public to initiate the divestment process. The exit process is initiated through sale of common shares and (potential) exercise of over-allotment options.

(ii) Reduce leverage: As implied by the name, LBOs represent acquisitions characterised by substantial debt financing. Many firms continue to be highly leveraged after the LBO, which in turn may restrain the firm's opportunity set (e.g. unable to fund positive NPV[20] investments) (Schöber, 2008). Schöber (2008) argues that using the proceeds from an IPO to repay debt, represents a method for firms to deleverage considerably.

(iii) Enhance access to public capital markets: Private firms usually face higher financing costs (both debt and equity) than public firms, due to lower transparency. Furthermore, private firms often lack access to public bond markets due to absence of debt rating. Hence, limited access to capital markets may harm the financial flexibility of private firms.

(iv) Finance- and facilitate acquisitions: Schöber (2008) postulates two reasons to why going public may contribute to financing of acquisitions. First, the issuer may use proceeds from the IPO (and subsequent SEOs) to finance takeovers. Second, listed firms can use their stocks as "acquisition currency".

(v) Other reasons: By examining IPO prospectuses Schöber (2008) identifies various other reasons for going public, although more vague than the four mentioned above. He finds that other reasons for going public may be increased company visibility, enhanced compensation programs for employees and to ensure long-term viability for customers and creditors. He does not test these reasons empirically, but discusses them in relation to prior research.

Schöber (2008) investigates hypothesis i)-iv) through extensive analytical research, which resulted in two prominent findings. First, he finds that the principal motive PE-sponsors for taking their portfolio firm public is to initiate the exit. However, he emphasises that PE-sponsors do not necessarily use IPOs for complete exits as they on average own 47% of the

[19] Schöber's BO sample consists of: Public-to-private, private-to-private, subsidiaries of public/private entities (i.e. not only reverse LBOs).
[20] Net Present Value (NPV).

equity stake post IPO. Concordantly, he finds that the exit process is typically completed through subsequent equity offers or sale of the firm. Second, he finds that reduction of leverage represents an important motive for taking portfolio firms public. He documents that almost all BO-backed issuers use significant portions of the IPO proceeds to reduce leverage. More specifically, he finds that the average debt-asset ratio[21] for the BO-backed firms falls from 64% to 38% following an IPO.

4.2 Choice of exit route

As highlighted by Povaly (2006), exit strategies by PE-sponsors have attracted limited theoretical attention in academic research. To the best of our knowledge, there are no established theories on PE exits in particular. However, as noted by Povaly (2006), theory on asymmetric information can be used when explaining the motivation behind choice of exit route by PE-sponsors.

4.2.1 Asymmetric information

The process of selling a portfolio firm to the public or to a private buyer, may be characterised by information being asymmetrically distributed between sellers (PE-sponsors and other owners) and the potential buyers (public equity market, industrial- or financial buyer). The PE-sponsors likely possess superior information about firm quality compared to the buyers, and may therefore be more capable of valuing the firm correctly. As noted by Cumming and MacIntosh (2003b), the degree of asymmetric information related to an exit may affect the buyers' willingness to pay for the portfolio firm. The more severe informational asymmetries related to a transaction is, the larger discount may be required by the buyers. Hence, the buyers most capable to resolve informational asymmetries will likely place the most lucrative offers, provided that the information is positive. This reasoning suggests PE-sponsors sell their portfolio firms to the buyer most capable of overcoming informational barriers if the firm is of high quality (i.e. contain positive information) (Cumming & MacIntosh, 2003b).

Cumming and MacIntosh (2003b) present a ranking related to preferred exit channels for firms characterised by high degrees of asymmetric information (see Figure 4-2). They hypothesise that IPO likely represents the exit-strategy associated with the greatest degree of asymmetric information as the buyers (public investors) are more dispersed and unsophisticated compared to buyers associated with other exit routes. It follows that each public investor may be incentivised to allow other investors to collect information about the

[21] Book-values.

offer (free rider problem). In contrast, buyers in buy-backs, trade sales and secondary buyouts may represent more concentrated and professional buyers compared to public investors (Cumming & MacIntosh, 2003b). Sale to existing owners or management (buy-backs) is likely characterised by low degrees of asymmetric information as it is reasonable to assume existing owners/management and PE-sponsors possess similar knowledge regarding the internal state of the firm. However, information regarding valuation and market conditions may be asymmetrically distributed between PE-sponsors and managers/existing owners. For instance, some entrepreneurs may overestimate their own abilities and value of their own firm.

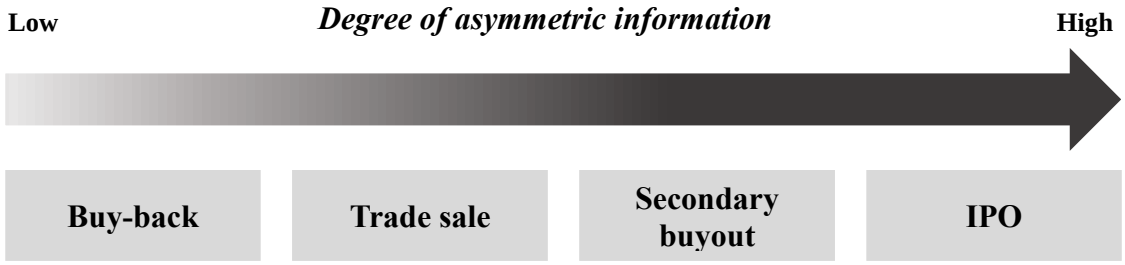

Figure 4-2: Degree of asymmetric information between seller (PE-sponsor) and buyer of a portfolio firm at exit. Authors' chart inspired by Cumming and MacIntosh (2003b) and Exhibit 60 by Povaly (2006)

4.2.2 Literature review: Choice of exit route

As highlighted by Povaly (2006) and Jenkinson and Sousa (2015), the majority of prior research on PE exits focuses on different aspects of IPO as an exit strategy. Furthermore, consensus in prior research appear to present IPO as the "preferred" exit route (as noted by Povaly (2006) and Jenkinson and Sousa (2015)). However, recent empirical evidence reveal that trade sale and secondary buyout represent the most common exit routes (at least in the European PE-market).

Table 4-1 Frequency of exit route (by type) in Europe and the Nordic region (2014)

The frequency of exit route by European and Nordic GPs (measured in numbers of exits).

	Europe (EVCA, 2015a)	**Nordics** (Argentum Private Equity, 2014)
Trade sale	26.5%	49.0%
IPO	18.9%	7.0%
Secondary BO	24.3%	22.0%
Buy-backs	3.3%	7.0%
Write-Off	7.2%	7.0%
Other	19.8%	8.0%

Evidence from prior research suggests exit-route preferences differ between the North American- and European PE markets. In his qualitative analysis of PE exits, Povaly (2006) finds that European PE-sponsors prefer trade sale over other exit routes[22]. Supporting this, trade sale represented the most common exit route by European (and Nordic) PE-sponsors in 2014 (see Table 4-1). In contrast, Cumming and MacIntoch (2003b) find that the frequency of IPO and trade sale as exit routes was equal in the US (both constituted 27% of all exits)[23]. Povaly (2006) suggests IPOs are less common in the European PE market compared to the US market, due to the former being characterised by less liquid public equity markets than the latter. However, the North American study by Cumming and MacIntoch (2003b) may be outdated for representative comparison to the European studies, as their sample covers exits between 1992 and 1995[24].

In his comparison of trade sales and IPOs in the PE industry, Bienz (2004) documents higher rates of return for IPOs compared to trade sales[25]. However, he argues the result may be attributed to selection bias as highly profitable firms tend to be taken public, while less profitable firms more commonly are divested through trade sales. Supporting this, Cumming and MacIntosh (2003b) find that IPO represents the preferred exit route for high quality and -valued firms.

A recent trend in the European PE industry, is the growth of secondary buyouts. In their study of 1022 European PE exits, Jenkinson and Sousa (2015) find that 44% of all exits between 2000 and 2014 were secondary buyouts. The corresponding numbers for trade sales and IPOs were 42% and 14% respectively. They argue that secondary sales are gaining popularity as they are characterised by providing quick exit processes, certain proceeds and low risk of regulatory issues. Furthermore, they present evidence on several factors that appear to influence choice of exit route. First, they find that the choice between IPO and secondary buyout seem to depend crucially on the conditions in credit- and equity markets. IPO appears to be the preferred exit route when stock markets are strong, while secondary buyouts are more common when credit is easily accessible and cheap. Second, they find that firm characteristics appear to influence the choice between trade sales and secondary buyouts. Trade sales seem to represent a more common exit route than secondary buyouts, when the

[22] Povaly's research design: He conducted a qualitative study of European divestments by questioning 56 active European BO firms.
[23] Cumming and Macintoch (2003b) studied 35 VC-backed and 246 BO-backed exits in the US and Canada between 1992 and 1995, using a qualitative research approach (proprietary surveys).
[24] We were not able to retrieve more recent data on PE exits in North America.
[25] Bienz used data from CEPRES and compared 108 PE-backed IPOs to 423 trade sales (by PE firms). He found that the mean (median) internal rate of return was 123.4% (58.4%) for IPOs and 75.3% (18.3%) for trade sales. The result was within the 90% confidence interval (t=1.706).

portfolio firms are small and have exhibited strong growth. In summary, Jenkinson and Sousa (2015) find that PE-sponsors appear to take advantage of "windows of opportunities" in capital markets, and choose the exit route accordingly.

5 Methodology

We employed different research approaches when i) comparing underpricing accross PE-backed- and NB IPOs (empirical approach) and ii) examining the choice of exit route by PE-sponsors and the interrelation between entry and exit (qualitative approach) (see Figure 5-1).

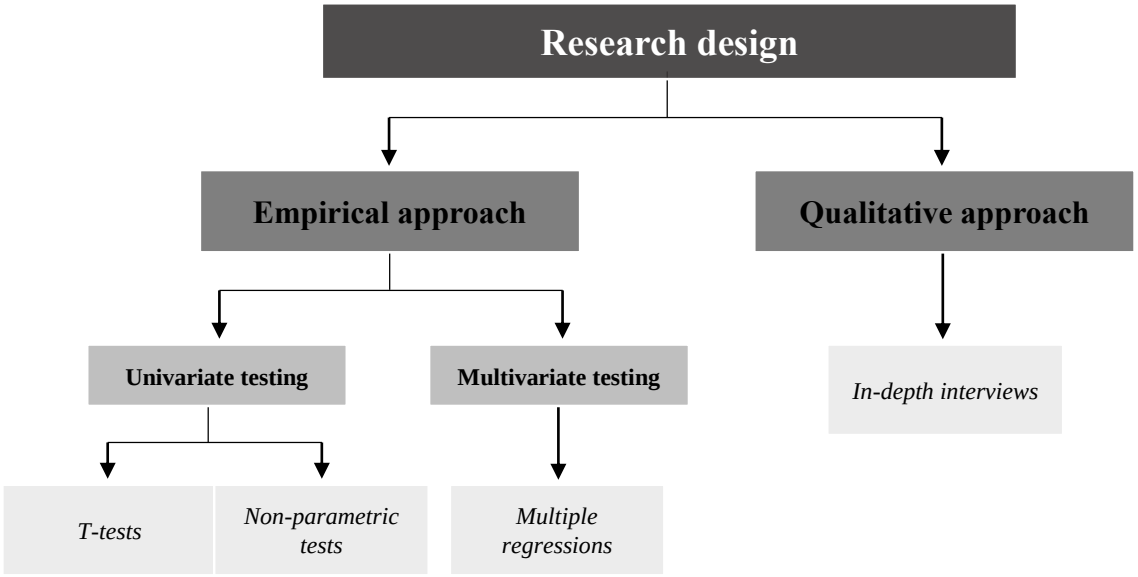

Figure 5-1: Methodology related to research design

5.1 Matched control sample

As noted by Schöber (2008), PE-backed IPOs contain certain characteristics (other than being backed by PE), which may affect initial returns. Potential sources of bias are offer size, firm size, industry, country and offer date (among others). Hence, in order to make inferences about the effect of PE-backing on underpricing, one should create a control sample that resembles the PE-backed sample along key dimensions assumed to affect initial returns. The ideal matching would involve comparing each PE-backed IPO with an identical IPO that did not receive PE backing. This allows for making causal conclusions related to the effects of PE-backing on IPO underpricing. Unfortunately, this is not feasible due to data limitations. In order to develop an appropriate matching procedure, one should therefore identify characteristics associated with PE-backed IPOs that interrelate with initial returns.

The majority of empirical studies comparing underpricing across PE-backed- and NB IPOs have used a *pair*-matching procedure, i.e. they choose one control IPO for each PE-backed IPO (see Table 3-2). However, a drawback with pair-matching involves that the underpricing of the control IPO may be influenced by individual characteristics related to that specific

offering (Schöber, 2008). Schöber (2008) attempts to overcome this weakness by creating a synthetic control IPO based on *several* resembling control IPOs (i.e. group-matching).

Most matching procedures are, to different extents, based on industry, offer size and/or IPO date (see Table 3-2). This is due to; i) *Initial returns* seem to be influenced by industry, offer size and market timing (Ritter (1984), Barry et al. (1990), Hogan et al. (2001), Schöber (2008)) and ii) *PE backed IPOs* tend to be clustered in certain industries and have above-average offer sizes than NB IPOs (Megginson & Weiss (1991), Schöber (2008)).

5.1.1 The authors' matching procedure

We employed a pair-matching procedure when creating a sample of control IPOs as limited sample size prevents identification of *several* resembling control IPOs (cf. Schöber's (2008) group-matching). We based our matching procedure on industry classification and offer size, following consensus in prior research. Specifically, for each PE-backed IPO we selected a control IPO within the same ICB supersector[26] with the (inflation-adjusted) offer size closest to the PE-backed IPO, as the matching firm. When we failed to identify a "match" within the same ICB *supersector*, we chose the most appropriate IPO within the same ICB *industry*, (partly) following Ritter's (1991) matching methodology.

However, a pair-matching procedure dismisses several observations due to exclusion of inappropriate matching partners. This may harm the statistical power of the empirical analysis, especially since our sample sizes are (somewhat) limited even prior to matching. Thus, we also compare the underpricing of PE-backed IPOs to the underpricing of the entire pool of control IPOs.

5.2 Calculation of initial returns

As depicted in Table 3-1, different methodologies have been applied when estimating IPO underpricing. Some scholars use aftermarket prices a week or month after the first trading day, to avoid manipulation of initial returns caused by price stabilisation by underwriters[27] (Lowry, Officer, & Schwert, 2010)[28]. Lowry et al. (2010) argue that using monthly (as opposed to daily) initial returns increase the probability that the aftermarket price captures the true stock value.

[26] Industry Classification Benchmark (ICB) is an industry classification system. It consists of 10 industries, 19 supersectors, 41 sectors and 114 subsector.
[27] Price stabilisation: The process in which underwriters stabilise/manipulate the stock price during the first period following the IPO. The underwriters are often granted an (over-allotment) option, which typically allows them to issue up to 15% additional shares.
[28] Aftermarket prices one week/month after the offering are especially common in older studies, possibly due to data limitations.

However, the majority of recent research uses prices quoted on the first trading day as the aftermarket price (Ljungqvist & Wilhelm (2003), Loughran & Ritter (2004), Schöber (2008), Vong & Zhao (2008), Hahn et al. (2013)) (see Table 3-1). Supporting this, McGuiness(1992) documents that most of IPO underpricing vanishes after the first trading day[29]. Following his research and consensus in recent literature, we used the first day closing price as proxy for the true aftermarket stock price.

Beatty and Ritter (1986) argue that adjusting initial returns for market returns (based on a benchmark such as a stock market index) is unnecessary since market returns are typically very small compared to (mean) initial returns. In addition, some scholars favour using market prices (i.e. trades) while others use bid prices or the mean between the bid- and ask prices, when computing initial returns (Schöber, 2008) (See Table 3-1 and Table 3-2).

Consistent with the methodology applied in recent research, we define the initial return as the percentage change from the offer price to the unadjusted closing price on the first trading day. The initial returns are therefore neither adjusted for market (index) returns nor adjusted backwards for possible stock splits and/or dividends.

$$(1)\ IR_i = \frac{Closing\ price_{i,1} - Offering\ price_{i,0}}{Offering\ price_{i,0}}$$

We used both equally-weighted (EW) and value-weighted (VW) returns, when comparing the degree of underpricing across PE-backed- and NB IPOs. We employed inflation-adjusted offer sizes as weights when calculating VW returns, which allowed for analysis of the relationship between offer size and initial returns.

The EW return of sample *s* (IR_s^{EW}) was calculated using the following formula:

$$(2)\ IR_s^{EW} = \frac{1}{n_s}\sum_{i=1}^{n_s} IR_i$$

where n_s refers to the number of observations in sample *s*.

The VW return of sample *s* (IR_s^{VW}) was calculated using the following formula:

$$(3)\ IR_s^{VW} = \sum_{i=1}^{n_s} w_i \times IR_i$$

$$w_i = \frac{OS_i}{\sum_{i=1}^{n_s} OS_i}$$

where w_i represents the weight associated with offer size of firm *i*.

[29] McGuiness (1992): Tests IPO underpricing using different holding-periods.

We adjusted the offer sizes (local currency) for effects of country specific inflation by utilising a time-varying GDP deflator[30]. The offer sizes were aligned to the base year of 2005. However, the effect of the deflation was relatively small in this sample, due to low inflation and limited time-period.

$$(4)\ Offer\ Size_{delfated\ (2005)} = \frac{Offer\ Size_{unadjusted}}{1+(\frac{delflator_{IPOyear} - delflator_{2005}}{deflator_{2005}})}$$

To eliminate currency risk we converted all deflated offer sizes to a common currency; namely the USD (see section 6.2).

5.3 Distribution characteristics- and trimming of initial returns

We trimmed our samples for severe outliers to improve distribution properties and align the distributions of the PE- and control samples (to enhance the validity of the empirical testing).

The untrimmed control samples encompassed some extreme values, with returns ranging from -19.2% to 119.3% see Table 10-3, Appendix). Furthermore, the *means* of untrimmed control samples severely exceeds the *medians*, indicating non-normal distributions (see Table 10-3, Appendix). Shapiro-Wilk tests confirmed the non-normality of returns related to these samples. We therefore removed approximately 2% of the most extreme values (in each direction) from the total-control sample, and adjusted the matched sample accordingly (i.e. did not include extreme observations as matching partners). Comparison of untrimmed- and trimmed distribution plots and characteristics reveal substantial improvements to the distribution properties post trimming (e.g. substantially lower skewness and kurtosis) [31].

In contrast, the untrimmed PE sample appeared to be approximately normally distributed and not distorted by extreme values (see Figure 10-1and Table 10-3, Appendix). A Shapiro-Wilk test verifies the normality of its distribution. We therefore refrained from trimming the PE sample (and its matched control sample) when employing EW returns, as we deemed the balance between distribution characteristics and statistical power satisfactory. However, we decided to remove the 2% most extreme values when comparing the PE sample to the total-control sample, to maintain methodical consistency (and as the larger control sample allows for trimming without severely harming the statistical power).

[30] GDP deflator = ratio of GDP in local currency to GDP in constant local currency (Worldbank).
[31] See Table 5-1 and Figure 5-2 B and C (trimmed) and Table 10-3 and Figure 10-1 B and C (untrimmed) in Appendix.

Despite our attempts of smoothing and aligning the distributions of the PE- and control samples, the trimmed control samples still appear to suffer from moderate non-normality (see Table 5-1 and Figure 5-2 B, C). More trimming would smooth the distributions further, but may in turn harm the statistical power of the results. Due to limited sample sizes, we therefore refrained from further trimming of our samples.

Table 5-1: Distribution characteristics of initial returns (trimmed samples)

The table summarises key characteristics related to the distribution of the (unadjusted) initial returns. Skewness measures whether the initial returns are symmetrically distributed to the left and right of the mean. Kurtosis measures the thickness of the tails of the distribution. The kurtosis of the normal distribution is 3.

	Obs.	Mean	Median	Min	Max	Std.	Skewness	Kurtosis
PE-backed	58	2.942%	2.119%	-17.105%	20.690%	7.137%	0.196	0.378
NB (matched-control)	60	7.121%	2.986%	-19.167%	72.727%	15.286%	2.337	7.084
NB (total-contol)	151	6.664%	2.593%	-13.333%	72.727%	13.916%	2.499	7.831

Exhibit A: PE sample **Exhibit B: Matched-control sample** **Exhibit C: Total-control sample**

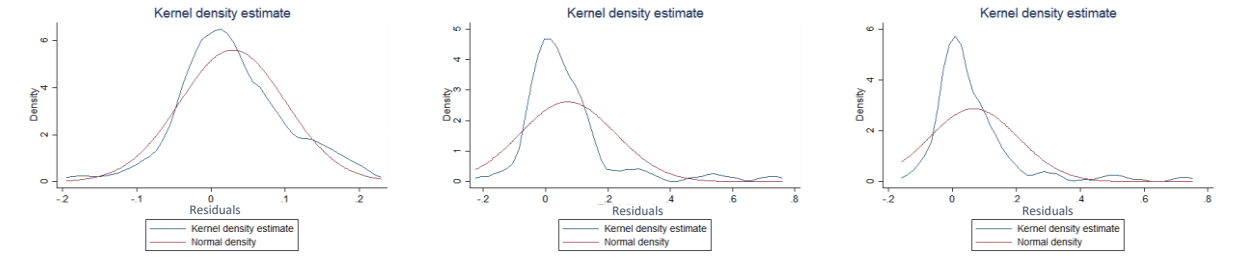

Figure 5-2: The Kernel density distribution of the initial returns together with the normal density distribution

It is worth mentioning that when estimating VW returns, we excluded Renewable Energy Corporation (REC) and ISS from the PE sample (and their matched partners). This because their abnormally large offer sizes (weight 10% and 12% respectively) and underpricing (23.6% and 14.2% respectively) had considerable effects on sample means (see Table 10-4 in Appendix).

Distribution characteristics of EW- and VW returns related to (trimmed) PE-backed- and NB samples are summarised in section 10.2.3 in Appendix.

5.4 Univariate testing: T-tests and non-parametric equivalents

The majority of prior research on underpricing have employed either t-tests or non-parametric counterparts, when whether the level of underpricing differs across PE- and NB IPOs. Non-parametric tests do not require assumptions regarding the sample distribution, but often at the expense of lower statistical power (Ball & Whitley , 2002). The t-tests generally offer higher

statistical power, but "in turn" requires normally distributed variables. However, the t-tests are valid when samples are "sufficiently" large[32], as the central limit theorem enables relaxation of the distribution requirements (Siegrist, 2015). Based on our sample sizes, we therefore deem the t-tests as valid and assess the robustness of the results by complementing with non-parametric equivalents.

5.4.1 T-tests – EW initial returns

As depicted in Table 5-2, we employed student t-statistics when testing the means- and differences in means, using EW returns. Welch's t-test is an adaption of the student t-test and is appropriate when testing for differences in means between two samples assumed to have *unequal* variances and sample sizes[33] (Welch, 1938).

Table 5-2: T-tests using EW initial returns (Keller, 2009)

0,8	**Two samples** (differences in means)		**One sample** (H0: mean=0, Ha: mean > 0)
	Paired t-test (matched pairs)	**Welch's t-test** (independent samples, unequal variances)	**Student t-test**
Test-statistic	$t = \frac{\bar{X}_D}{S_D * \sqrt{\frac{1}{n_D}}}$	$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2})}}$	$t = \frac{\overline{Xi}}{s * \sqrt{\frac{1}{n_i}}}$
Mean and std	$\bar{X}_D$= difference in mean IR between sample 1 and 2 S_D= std. of differences in IR n_D= number of matched pairs	$\bar{X}_i$= mean IR for sample *I* (i=1,2) s_i= std. of IR of sample *i* n_i= number of observations in sample *i*	$\overline{Xi}$ = mean IR for sample i Si = std. of IR for sample i n_i= number of observations in sample i

5.4.2 T-tests – VW initial returns

Table 5-3 presents the appropriate t-statistics when sample values are given *unequal* weights (and have unequal variances), following Goldberg, Kercheval and Kiseop's methodology (2005). The calculation of the alphas (α) in the denominator of the t-statistic implies the variance of values with large weights (i.e. large w_i) is emphasised *more* than the variance of those with smaller w_i. In contrast, when calculating the t-statistic for EW returns, the variances are weighted equally (i.e. $w=1/n_i$, where n_i= size of sample i). The t-statistics in Table 5-3 is approximated with a t-distribution with *df* degrees of freedom. We verified the methodology through consultation with Jostein Lillestøl, a professor at NHH with statistical modelling, time-series and risk analysis representing his main research areas.

[32] Rule of thumb: Greater than 30 observations (Siegrist, 2015).
[33] Statistical tests revealed the variances of the PE-returns and total-control-returns were unequal.

Table 5-3: T-tests using VW initial returns		
	Two samples (differences in means, unequal variances)	**One sample** (H0: mean=0, Ha: mean > 0)
Test-statistic	$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\hat{\alpha}_1 + \hat{\alpha}_2}}$	$t = \frac{\bar{X}}{\sqrt{\hat{\alpha}}}$
Mean[34] $(\bar{X}_1, \bar{X}_2)$	$\bar{X}_1 = \sum_{i=1}^{n}(w_i * X_i)$ where i=1,2,… n $\bar{X}_2 = \sum_{j=1}^{m}(w_j * X_j)$, where j=1,2,… m	$\bar{X} = \sum_{i=1}^{n}(w_i * X_i)$ where i=1,2,… n
Std	$\boldsymbol{S_1} = \sum_{i=1}^{n} w_i(X_i - \bar{X}_1)^2$ *and* $\boldsymbol{S_2} = \sum_{j=1}^{m} w_j(X_j - \bar{X}_2)^2$ $\boldsymbol{\hat{\alpha}_1} = \frac{S_1}{n-1}$ and $\boldsymbol{\hat{\alpha}_2} = \frac{S_2}{m-1}$	$\boldsymbol{S} = \sum_{i=1}^{n} w_i(X_i - \bar{X}_1)^2$ $\boldsymbol{\hat{\alpha}} = \frac{S_1}{n}$
Degrees of freedom	$\boldsymbol{df} = \frac{(\hat{\alpha}_1 + \hat{\alpha}_2)^2}{\frac{\hat{\alpha}_1^2}{n-1} + \frac{\hat{\alpha}_2^2}{m-1}}$	

5.4.3 Non-parametric tests

To assess the robustness of our results, we performed non-parametric equivalents of the two-sample t-tests (see Table 5-4).

Table 5-4: Non-parametric tests (Keller, 2009)		
	Wilcoxon signed-rank sum test (matched pairs)	**Wilcoxon rank sum test** (independent samples)
Test-statistic	$z = \frac{T - E(T)}{\sigma_T}$	$z = \frac{T - E(T)}{\sigma_T}$
Mean [E(T) and std [σ_T]	$E(T) = \frac{n(n+1)}{4}$ $\sigma_T = \sqrt{\frac{n(n+1)(2n+1)}{24}}$ *T=rank sum of sample 1*	$E(T) = \frac{n_1(n_1+n_2+1)}{2}$ $\sigma_{T=}\sqrt{\frac{n_1 n_2(n_1+n_2+1)}{12}}$ *T=rank sum of sample 1*

5.5 Multivariate testing: Regressions

We performed multivariate regressions in an attempt to isolate the effect of PE-sponsors on underpricing, from other determinants of initial returns such as aftermarket volatility, industry, market timing and national business cycles. The regressions allow us to exploit more observations compared to paired testing, as the matching procedure is unnecessary. This is beneficial for the statistical power. We included 59 PE-backed IPOs and 154 NB IPOs in our regression analysis, representing the firms we were able to identify the lead underwriter for.

We ran the following regressions (with estimated standard errors robust to heteroscedasticity[35]):

$$(1) IR_i = \alpha_1 + \beta_1 PE + \beta_2 PRESTund + \beta_3 \ln OS + \beta_4 HIGHTECH + \beta_6 DK + \beta_7 NO + \beta_8 FI + \beta_9 09 + \beta_9 10 + \varepsilon$$

$$(2) IR_i = \alpha_2 + \gamma_1 VC + \gamma_2 BO + \cdots + \beta_9 10 + \omega$$

$$(3) IR_i = \alpha_3 + \gamma_1 VC + \gamma_2 BO + \cdots \beta_5 STD + \cdots + \beta_9 10 + \epsilon$$

$$(4) IR_i = \alpha_4 + \beta_1 PRESTspons + \cdots + \beta_9 10 + \varphi$$

[34] X_i, X_j denotes the initial return of firm i and j respectively.
[35] See section 10.4 in Appendix for evaluation of model assumptions and diagnostics.

i) "IR_i" represents the initial return of firm i
ii) "PE" is a dummy variable equal to one if the firm was PE-backed, zero otherwise
iii) "VC" ("BO") is a dummy variable equal to one if the firm was VC (BO) backed, zero otherwise
iv) "PRESTund" is dummy variable equal to one if a "prestigious" underwriter was utilised, zero otherwise
v) PRESTspons is dummy variable equal to one if a "prestigious" PE-sponsor was utilised, zero otherwise
vi) "lnOS" is the natural logarithm of the (inflation-adjusted) offer size, following the methodology applied in previous literature (Ang & Brau (2002), Schöber (2008))
vii) "HIGHTECH" is a dummy variable equal to one if the firm belongs to ICB industry "Technology" or "Telecommunications", zero otherwise
viii) "DK", "NO" and "FI" represent market dummy variables for Denmark, Norway and Finland respectively. Hence, Sweden represents the reference category (i.e. when NO, DK and FI all are equal to zero)
ix) "STD" is the standard deviation of daily returns over 19 days, beginning the day after the IPO date (i.e. day 2 -20)

Aftermarket volatility ("STD") has been extensively used in prior research as a proxy for the degree of ex-ante uncertainty and asymmetric information related to an IPO (Ritter (1987), Barry et al. (1990), Ainina and Mohan (1991), Ang and Brau (2002)). As argued by Ritter (1987), firms with high aftermarket volatility is likely to have uncertain values before the IPO. The aftermarket volatility of an issue is usually defined as the standard deviation of daily returns from day 2 to day 20 post IPO (Ritter (1987), Barry et al. (1990), Ainina & Mohan (1991), Ang & Brau (2002)). Hence, following these studies we utilise "STD" as a proxy for ex-ante uncertainty and asymmetric information.

However, some studies document that aftermarket volatility is affected by (the expectancy of) price stabilisation activities by underwriters[36] (Hanley, Kumar, & Seguin (1993), Ruud (1993)). To illustrate, Hanley et al. (1993) found evidence suggesting issues associated with (the expectance of) price stabilisation tend to exhibit lower aftermarket volatility 10-15 days

[36] Price stabilisation: The process in which underwriters stabilise/manipulate the stock price during the first period following the IPO. The underwriters are often granted an (over-allotment) option, which typically allows them to issue up to 15% additional shares.

following the IPO. Hence, we acknowledge that "STD" in some cases may not capture the "true" aftermarket volatility as it may be affected by price stabilisation by underwriters.

Offer size and high-tech industries also represent proxies for the levels of ex-ante uncertainty and asymmetric information related to an issue (Schöber (2008)). As noted by Schöber (2008), small firms in high-tech industries tend to be characterised by greater uncertainty regarding firm value (and thereby risk), than larger firms in other industries.

"PE" ("PRESTspons") and "PRESTund" are included to capture the (potential) certification effect by PE-sponsors ("prestigious" PE-sponsors) and "prestigious" underwriters, respectively. The scoring procedures applied when determining whether an underwriter/PE-sponsor is considered "prestigious" or not, are described in section 10.3 in Appendix. The country-specific dummy variables are included to control for potential effects (on initial returns) by national business cycles and - market characteristics.

Certain assumptions regarding the residuals must be satisfied in order to make valid inferences based on the regression results. We have evaluated the model assumptions and diagnostics in section 10.4 in Appendix.

5.6 Qualitative approach: In-depth interviews

Through in-depth interviews with players in the Nordic PE-industry, we aimed to identify key drivers behind choice of exit strategies, elaborate on how entry and exit of portfolio firms may represent interrelated events, identify prominent trends in the PE industry going forward and discuss our empirical results with experienced industry players.

Our respondents have vast experience from the PE industry representing partners from the renowned Nordic PE firms; Altor, EQT, Herkules Capital, FSN Capital and HitechVision. More precisely, we spoke to one deputy CEO, one former CEO (now chairman and partner) and three partners (one is also the head of the Norwegian subsidiary) of Nordic PE firms in addition to one industry-expert with experience from Acquisition Finance (i.e. acquisitions related to LBOs). Some of our respondents preferred to remain anonymous in the analysis (but were comfortable with being listed as references in the bibliography, see References in Chapter 9) We therefore refer to our interview respondents as Respondent 1 (R1), R2 … R6 in our analysis. However, we do not deem this as a limitation to our study as revealing their identity is of no value to our analysis. The interviews were conducted in November 2015 through personal meetings and telephone calls.

We based the development of interview questions/themes on Povaly's (2006) qualitative study of PE exits and Schöber's (2008) empirical study of IPO as an exit strategy. However, Pavlov's (2006) questions were generally characterised by being closed-ended[37], while we aimed to ask more open and non-leading questions to encourage our respondents to answer freely.

[37] Closed-ended questions: Questions that limit the respondents with a list of answer choices

6 Sample selection and data collection

6.1 Sample identification

The underpricing analysis required two samples; one sample of PE-backed IPOs and one control sample of NB IPOs.

The overall sample of IPOs consisted of companies listed on the Oslo Stock Exchange (OSE), Nasdaq OMX Nordic[38] in addition to Oslo Axess and the Nasdaq First Norths. The latter typically serves as stock exchanges for younger and smaller companies compared to the Main Lists. There are mainly three reasons behind our choice of geographical area. First, there are few academic studies examining the underpricing phenomenon related to listings on Nordic exchanges (see Table 3-1). Second, there is limited research on differences in underpricing between PE- and NB IPOs listed on these exchanges (see Table 3-2). Third, the Nordic markets are characterised by being relatively transparent with respect to data availability (Pukthuanthong et al., 2013).

In order to obtain a sufficiently large sample, we selected a time-frame of 10 years. We thereby restricted our sample to firms listed between January 2005 and December 2014.

The first step of the data gathering process involved identifying all IPOs listed on Nordic exchanges between January 2005 and December 2014. We obtained relevant IPOs from OSE and Oslo Axess between 2005 and 2014 from OSE's website. However, such information was only available post 2010 for the Nasdaq OMX Nordic and the First Norths. Fortunately, Ulf Persson, Economic and Statistical researcher at Nasdaq OMX Nordic, was kind to provide us with the lacking IPOs listed prior to 2010.

Furthermore, to make our sample more suitable for analytical purposes, we excluded IPOs with the following characteristics:

- IPOs without prospectus available
- "Ambiguous" IPO deals (e.g. An equity carve-out, i.e. where the IPO- firm in question is a result of a demerger from a public traded company)
- Close-end funds, Special Purpose Entity, Specified Purpose Acquisition, bonds, trusts (e.g. Nordea Investment Funds - actively managed ETFs)

[38] Nasdaq OMX Nordics consists of: Stockholm Stock Exchange (SSE), Copenhagen Stock Exchange (CSE) and Helsinki Stock Exchange (HSE).

After excluding IPOs characterised by the criteria listed above, our final dataset consisted of 215 IPOs.

6.1.1 Identification of PE-backed IPOs

A time-consuming, but important part of the data gathering process, involved identifying the IPOs that were backed by PE-sponsors. We retrieved lists of PE- backed IPOs from the Argentum PE database, Bloomberg and Carnegie Investment Bank, which we exploited in the identification process.

Unfortunately, one cannot naively rely on the Argentum database and other retrieved samples, due to lack of transparency in the PE market. In other words, such samples do not necessarily include all relevant PE-backed IPOs. We therefore cross-referenced the samples with additional sources, such as desktop searches, previous research, IPO prospectuses and correspondence with industry players. We also excluded PE-backed IPOs with unavailable IPO prospectuses.

Overall, we ended up with a sample of 60 PE-backed IPOs

6.1.2 Classification of VC- and BO- backed IPOs

In this paper, the term "PE-backed firms" encompasses both VC- and BO-backed firms, while the term "PE-sponsor" refers to both VC- and BO-sponsors collectively. However, we distinguish between VC and BO for analytical purposes.

We separated the pool of PE-backed firms into two main categories, namely; VC-backed firms and BO- backed firms. VC firms are characterised by being young and relatively risky entrepreneurial ventures (Barry C. et al., 1990). VC includes both early stage (seed) ventures and expansion (growth) ventures (Argentum Private Equity, 2015a). BO-backed firms, on the other hand, are typically characterised by being relatively mature, delivering steady cash flows and having substantial assets (Schöber, 2008). The BO classification encompasses both public-to-private and private-to-private LBOs, in addition to subsidiaries of private and public firms (Schöber, 2008).

Our sample includes all types of BO backing, i.e. public-to-private, private-to-private and subsidiaries of public and private firms. This represents an extension of most previous research on BO-backing, which mainly focus on *reverse* LBOs (see Table 3-2). It is worth noting that the boundaries between VC- and BO- backed firms are often blurred, as both PE

types may contain the others' "typical" characteristics. This makes the classification process somewhat challenging as one cannot simply follow certain rules when classifying the pool of PE-backed firms.

We distinguished between VC and BO (mainly) based on the classification defined in Argentum's database for PE-backed firms. Additionally, we both verified and attempted to improve Argentum's classification through information expressed in news-articles and press-releases, on the homepages of relevant industry players and in IPO prospectuses. We also turned to these sources when classifying entities not identified in Argentum's database.

In summary, the classification process resulted in 25 VC-backed- and 35 BO- backed IPOs (see Table 6-1)

6.2 Data collection: Firm specific characteristics

Certain company specific information was required to conduct the matching procedure and underpricing analysis. Relevant information related to the *matching procedure* included; i) The ICB industry code and ICB supersector for each IPO-firm[39], which were extracted from the Thomson Reuters DataStream and ii) offer price and shares issued (to calculate offer sizes). Relevant information related to the *underpricing* analysis encompassed; i) Offer price, ii) aftermarket stock price, iii) lead underwriter, iv) standard deviation of daily returns over 19 days post the IPO date v) participation rates by PE-sponsors (i.e. the share retention by owners in the IPO) and vi) pre-equity stakes and firm age related to PE-sponsors (for determining the "prestige" related to PE-sponsors).

Offer prices were obtained through the following sources: i) Offer prices related to Norwegian IPOs were available at OSE's website. Similarly, we obtained offer prices from CSE from its website. ii) Offer prices related to listings on the remaining exchanges proved more challenging to obtain. Fortunately, we were lucky to receive most offer prices from listings on SSE, HSE and their respective First Norths between 2010 and 2015 from Ulf Persson. iii) Finally, we obtained the lacking offer prices from listings on SSE, HSE and First Norths through Bloomberg, desktop searches for news articles and press releases.

Closing prices proved easier to obtain than the offer prices. The majority of closing prices for companies listed in Sweden, Denmark and Finland were obtained through manual searches on

[39] Industry Classification Benchmark (ICB) is an industry classification system. It consists of 10 industries, 19 supersectors, 41 sectors and 114 subsectors.

the Nasdaq OMX Nordic website, Yahoo Finance and Bloomberg. The closing prices for IPOs on OSE were not available online. However, Truls Evensen, statistical manager at the OSE, was kind enough to provide us with lacking closing prices.

Daily returns during the 19 days following the IPO (i.e. date 2-20) were calculated based on daily stock prices extracted from Thomson Reuters DataStream (main source), supplemented by stock quotes from Bloomberg and Yahoo Finance when necessary.

Calculation of offer size required information about the number of shares issued in each IPO (in addition to offer prices). For IPOs listed in Norway, we obtained the number of primary and secondary shares issued for each IPO from OSE's website. However, the other Nordic exchanges do not publish such information. The lacking data was therefore obtained through extensive desktop work, mail correspondence with relevant firms and help from Ulf Persson. We verified our findings with information regarding offer size expressed in IPO prospectuses. Finally, it is worth noting that we excluded over-allotment options, regardless of whether they were exercised or not.

The most time-consuming part of the data gathering process was obtaining the IPO prospectuses. These were identified through extensive manual desktop work in addition to mail-correspondence and conversations with relevant firms. Additionally, we were lucky to receive lacking prospectuses for IPOs listed in Norway from Truls Evensen. In total, we managed to gather 215 prospectuses, which defined our final dataset of IPOs.

In order to eliminate currency risk, we converted all (inflation-adjusted) offer sizes to a common currency; namely the USD. The IPOs were originally quoted in either NOK, SEK, DKK or EUR. The conversion was conducted by extracting daily exchange rates from the central bank of Norway (Norges Bank).

6.3 Descriptive statistics

Table 6-1 presents the frequency of PE-backed- and NB IPOs by geographical area. During the relevant time-period, Norway was the most active market in terms of VC-backed IPOs, while the majority of BO-backed IPOs took place in Sweden. The most active PE firms were EQT (7), Nordic Capital (5), Northzone (4), HitechVision (3) and NorgesInvestor (3).

Table 6-1: Sample distribution by country

Market	VC	BO	Total-control	Total
Denmark	4	5	15	**9**
Finland	1	2	6	**3**
Norway	13	13	91	**26**
Sweden	7	15	42	**22**
Total	**25**	**35**	**155**	**215**

Table 6-2 reports the frequency of PE-backed- and NB IPOs by year. In summary, the IPO activity of PE-backed and NB IPOs appear to be relatively similar; Years associated with high IPO activity among control firms seems to also be characterised many PE-backed IPOs and vice versa. Most IPOs took place between 2005 and 2007, while the IPO activity in the subsequent years appeared adversely affected by the financial crisis. In fact, there were no PE-backed IPOs in 2008 and 2009 in our sample. However, the IPO activity appears to have picked up over the last couple of years.

Table 6-2: Sample distribution by IPO year

IPO year	VC-backed	BO-backed	Total-control	Total
2005	7	6	18	**31**
2006	4	7	16	**27**
2007	7	4	38	**49**
2008	-	-	9	**9**
2009	-	-	3	**3**
2010	3	5	11	**19**
2011	1	1	10	**12**
2012	-	-	2	**2**
2013	2	3	16	**21**
2014	1	9	32	**42**
Total	**25**	**35**	**155**	**215**

Table 6-3 presents the concentration of the PE-backed sample and the control sample (non-matched) in certain industries. The IPOs in the control sample appear to be somewhat dispersedly distributed across several industries, with telecommunications and utilities as exceptions. The prominent exposure to natural resources by firms listed in Norway, likely explains the high frequency of IPOs related to the oil and gas sector. In contrast, both VC-backed and BO-backed IPOs appear to be notably more clustered in certain industries compared to NB IPOs. The majority of VC-backed IPOs were concentrated in health care and technology, while industrials, consumer goods and – services represent the most frequent industries for BO-backed IPOs. An apparent distinction between PE-backed and NB IPOs, is the low frequency of PE-backed IPOs originating from the financial sector. This can likely be explained by the fact that fund agreements are subject to investment constraints, which often prohibit GPs from acquiring financial firms.

Table 6-3: Sample distribution by industry

ICB Industry	VC-backed	BO-backed	Total control	Total
0001 Oil and Gas	5	1	37	**43**
1000 Basic Materials	1	2	11	**14**
2000 Industrials	2	12	27	**41**
3000 Consumer Goods	1	7	14	**22**
4000 Health Care	10	3	16	**29**
5000 Consumer Services	-	7	8	**15**
6000 Telecommunications	-	1	1	**2**
7000 Utilities			1	**1**
8000 Financials	-	1	28	**29**
9000 Technology	6	1	12	**19**
Total	**25**	**35**	**155**	**215**

Table 6-4 summarises key descriptive statistics for the VC-backed, BO-backed and the total-control sample. We find that PE-backed IPOs are associated with more reputable underwriters than NB IPOs. Furthermore, mean offer sizes differ considerably between the three IPO types, despite our attempt to match firms as closely as possible by offer size. In line with previous research, the mean offer size of BO-backed IPOs is significantly greater than NB IPOs[40] (Ainina & Mohan (1991), Bergström et al. (2006), Schöber (2008), Cao & Lerner (2009)). In contrast, the mean offer size of VC-backed IPOs was not significantly different from control IPOs. Finally, BO-backed IPOs seem to be associated with longer private ownership periods and more reputable PE-sponsors than VC-backed IPOs.

Table 6-4: Key descriptive statistics

	Offer size (inflation-adj, USD 1000)	**Use of prestigious underwriters[41]**	**Use of prestigious GPs[42]**	**Private ownership period (under PE)**
PE-backed IPOs	183 084.3	51.67%	36.67%	5.2
• *VC-backed*	*81 338.2*	*36.00%*	*4.00%*	*4.2*
• *BO-backed*	*255 760.1*	*62.86%*	*60.00%*	*5.8*
NB IPOs (total-control)	90 807.7	26.45%		-
PE- backed minus NB IPOs (total-control)	92 276.6** (t-stat: 2.1728)	25.22%[43]*** (t-stat: 3.4013)		-
Total IPO sample	**116 559.3**	**33.49%**		-

[40] Mean offer size BO vs total-control: The difference is statistically significant at the 1% level (t-stat= 2.706, P-value=0.51%).
[41] Prestigious underwriter: We developed a scoring procedure based on i) Nordic underwriter ranking by TNS Sifo and ii) the international underwriter ranking by Dealogic & WSJ Investment Banking Scorecard (see section 10.3.1 in Appendix).
[42] Prestigious GP: We developed a scoring procedure based on an overall assessment of the following four variables: i) Age of the GP, ii) nr. of IPOs associated with the GP, iii) average offer size associated with the IPOs, iv) average pre-equity stake held by the GP. The GP's were given a score on each criteria. A GP was ranked as "prestigious" if it obtained a total score of 3 or 4.
[43]Prestigious underwriters: The difference is statistically significant at the 1%-level (T-stat = 3.401, P-value=0.0005).

6.4 Potential biases

6.4.1 Outliers

Outliers refer to observations that deviate extremely from other values in a sample (NIST, 2012). If outliers are biased in one direction, they can potentially lead to considerable distortion of means. Hence, adjusting a sample for outliers may make the means more informative, but potentially at the expense of lower statistical power. In relation to the EW returns, we account for outliers in the PE- and total-control sample by removing approximately 2% most extreme observations in each direction. For the matched-control sample, we account for outliers by not including firms with distortive effects as matching partners. We considered the trimming sufficient to achieve satisfactory distribution properties, without severely harming the statistical power (see section 5.3).

When estimating VW returns, we excluded Renewable Energy Corporation (REC) and ISS from the PE sample (and their matched partners), as abnormally large offer sizes (weight 10% and 12% respectively) and underpricing (23.6% and 14.2% respectively) had considerable effect on the sample means.

6.4.2 Selection bias

One limitation to our analysis is the risk of selection bias in the sample selection process. Selection bias may arise when members of the target population is excluded from the sample due to the nature of the sampling process (Keller, 2009). This may in turn distort the validity of the inference, as sample characteristics may deviate from those of the actual population.

We have elaborated on two potential selection biases. First, the PE sample may become biased towards large, profiled IPOs backed by renowned PE-sponsors, as there is typically more information available about such IPOs compared to smaller, less profiled IPOs. Thus, when identifying PE-backed IPOs we used- and cross-checked several sources (Argentum, Bloomberg, Carnegie Investment Bank, extensive desktop work, correspondence with industry players) in order to avoid selection bias. Despite our thorough work in identifying relevant PE-backed IPOs, we acknowledge there is still risk our sample excludes relevant observations.

Second, in relation to the underpricing analysis, we found it challenging to identify final offer prices, closing prices and issue sizes, mainly due to lack of post-IPO reporting. This may also distort the sample towards larger, more profiled IPOs as these typically exhibit greater transparency than smaller, less profiled IPOs.

6.4.3 Omitted variable bias

Omitted variable bias (OVB) arises when a regression model leaves out a *relevant* variable ($\beta_1 \neq 0$) that *correlates* with at least one of the included variables ($cov(x_1,x_2) \neq 0$)[44] (Hopland, 2015). OVB implies OLS[45] no longer provides unbiased estimators, which in turn may invalidate the inference. We have attempted to avoid OVB by including all variables deemed relevant in prior research on underpricing and by estimating several regressions. First, we started by estimating a regression with few explanatory variables and added new variables (one-by-one) while carefully watching the behaviour of the variables and the adjusted R-squared. Second, we controlled for potential non-linear relationships by log-transforming offer sizes and including quadratic terms. Finally, we tested whether the effect of one variable (e.g. PE-backing) depends on another (e.g. offer size), by estimating the regressions with interaction terms. Based on the precautions mentioned above, we believe our results do not suffer from severe OVB.

6.4.4 Measurement errors

Measurement errors arise when the *observed* variable does not perfectly capture the *true* variable (Hopland, 2015). Measurement errors may generate biased estimators and thereby harm the validity of the inference. We acknowledge that measurement errors may be present in our empirical testing. To illustrate, the ranking procedures applied when measuring underwriter/PE-sponsor "prestige" may not perfectly reflect the *true quality* of the underwriter/PE-sponsor. We therefore take into account the risk of measurement errors when interpreting the coefficients, in particular when interpreting the magnitude of the coefficients.

6.4.5 Source inconsistency

Finally, it is worth noting that our dataset is created based on numerous different sources (e.g. Argentum, Bloomberg, Carnegie Investment Bank, correspondence with industry players, desktop research, news articles, etc.). When comparing and cross-checking the information obtained from the different sources, we occasionally discovered minor variations related to the information presented. We therefore acknowledge that the input applied in our statistical testing procedures and analysis, may exhibit minor errors.

[44] Assuming X1 represents the omitted variable, has effect on the independent variable ($\beta_1 \neq 0$) and correlates with the included variable X2 ($cov(x_1,x_2) \neq 0$).
[45] Ordinary least squares (OLS): A linear regression method, which selects estimators so that the sum of squared residuals (the variance of the residuals) is minimised.

7 Results and analysis

In this chapter we present the results- and interpretation of the results related to i) the various underpricing measurements (univariate- and multivariate testing) and ii) the responses from interviews with key industry players. The discussion of our findings is related to established empirical evidence and theoretical concepts.

Note that the terms "significant/significantly" refer to *statistical* significance, unless otherwise is specified. Finally, it is worth mentioning that comparing the *magnitudes* of our empirical results to those postulated in prior research should be done with care, as the method applied in computation of initial returns varies between scholars (see Table 3-1 and section 5.2).

7.1 Univariate testing: T-tests and non-parametric equivalents

7.1.1 Underpricing

Table 7-1 presents the mean initial returns for PE-backed IPOs and both control samples, when employing EW- and VW returns.

We find both PE-backed- and NB IPOs to be significantly underpriced (on average), regardless of weighting method. This is consistent with existing empirical research, which document significant underpricing of new issues (see Table 3-1).

Table 7-1: Initial returns of PE-backed- and control IPOs[46]

The table depicts the mean EW- and VW returns for i) PE-backed IPOs (incl. VC and BO), ii) matched-control sample and iii) total-control sample. The matching procedure was conducted as follows: For each PE-backed IPO, we selected a control IPO within the same *ICB industry* with the *offer size* closest to the PE-backed IPO, as the matching firm.

The initial returns were computed using unadjusted first day returns (i.e. change from offer price to closing price on the first trading day). The VW returns are weighted based on (inflation-adjusted) offer sizes. One-sample t-tests were employed to test if the mean returns differ significantly from zero. The standard deviation of the mean initial return was used when computing the t-statistics.

		Equally weighted			Value weighted[47]	
	Obs.	**Mean**	$\|T-stat\|$	**Obs.**	**Mean**	$\|T-stat\|$
PE-backed	58	2.942%	3.1397***	58	2.216%	2.4678***
• VC-backed	23	1.631%	0.9264	24	1.670%	0.9264
• BO-backed	35	3.804%	3.6824***	34	2.289%	2.0260**
NB (matched-control)	60	7.121%	3.6081***	58	4.853%	3.6084***
NB (total-control)	151	6.664%	5.8845***	151	3.891%	5.6450***
All	**209**	**5.631%**	**6.0510*** **	**209**	**4.654%**	**7.0363*** **

[46] * P < 10%, **P < 5%, *** P <1%

[47] T-test following Goldber et al. (2005): $\mathbf{t}=\frac{\bar{X}_1-\bar{X}_2}{\sqrt{\hat{\alpha}_1+\hat{\alpha}_2}}$, $\bar{\boldsymbol{X}}_{\mathbf{1,2}}=\sum_{i=1}^{n}(w_i*X_i)$, $\hat{\boldsymbol{\alpha}}_{\mathbf{1,2}}=\frac{S_{1,2}}{n-1}$, $\boldsymbol{S}_{\mathbf{1,2}}=\sum_{i=1}^{n}w_i(X_i-\bar{X}_{1,2})^2$.

However, the degree of underpricing for (almost) all samples decreases when weighting the returns using (inflation-adjusted) offer sizes[48]. This suggests *smaller* IPOs are associated with greater underpricing than *larger* offers, consistent with prior research (Ritter (1984), Barry et al. (1990), Bergström et al (2006), Schöber (2008)). Schöber (2008) explains the negative relationship between underpricing and offer size by larger offers exhibiting lower levels of asymmetric information (which is positively related to initial returns)[49], than smaller offers.

Finally, we find EW- and VW initial return of VC backed IPOs to be insignificantly different from zero, suggesting VC backed IPOs are not systematically underpriced (on average). This indicates the (significant) underpricing of PE-backed IPOs is driven by the returns of BO-backed IPOs.

7.1.2 Comparison with control IPOs

Table 7-2 reports the results from testing differences in mean initial returns between PE-backed IPOs and the two control samples, when employing both EW- and VW returns.

Based on EW returns, we find PE-backed IPOs to be significantly less underpriced than NB IPOs, both when compared to matched reference transactions and to the entire pool of control IPOs. Hence, the presence of PE-backing in IPOs appear to ameliorate underpricing, in line with prior research (Muscarella & Vetsuypens (1989), Megginson & Weiss (1991), Hogan et al. (2001), Schöber (2008), Cao & Lerner (2009)).

When employing VW returns, we find PE-backed IPOs to exhibit significantly (although marginally) lower underpricing than *matched*-control IPOs. In contrast, the underpricing difference is insignificant when comparing the PE sample to the entire pool of control IPOs. This suggests offer size affects the difference in mean initial returns across PE-backed- and NB IPOs. Bergström et al. (2006) obtained similar results in their study of PE-backed IPOs listed in London and Paris (between 1994 and 2004)[50].

Finally, it is worth mentioning that results from the univariate testing do not necessarily imply that the presence of PE-backing is solely responsible for lower underpricing of PE-backed IPOs, as there are other factors (e.g. industry, time) interrelating with initial returns. We

[48] VW return for VC-backed IPOs increases slightly, however we deem the difference (0.0004) insignificant (economically) to elaborate any further on this matter.
[49] Asymmetric information: Positively related to initial returns (Ritter (1984, 1987), Barry et al. (1990), Schöber (2008), Lowry et al. (2010)). Asymmetric information and risk are assumed to be positively related (Ritter, 1984)
[50] Bergström et al. (2006): Sample consisted of 152 PE-backed IPOs and 1370 NB IPOs listed on London Stock Exchange (both Main Market and Alternative Investment Market) and Paris Stock Exchange (Premier-, Second- and Nouveau Marché, Marché Libre). It is worth noting that they used market capitalisation as weights when computing VW returns. However, as large-cap firms tend to offer more shares at IPOs than small-cap firms, we believe our results are comparable to those of Bergström et al. (2006).

therefore find it more appropriate to discuss the potential certification by PE-sponsors (i.e. isolate the effect of PE-backing on underpricing) through multivariate regressions (see section 7.2).

Table 7-2: Comparison of initial returns between PE-backed- and control IPOs

The table compares the EW- and VW returns of PE-backed IPOs to NB IPOs, using both control samples. The t-statistics result from two-sample t-tests with the H0: "Mean initial returns of PE-backed IPOs and control IPOs do not differ significantly".

		Equally weighted			Value weighted	
	Obs.	**Difference**	$\|T-stat\|$	**Obs.**	**Difference**	$\|T-stat\|$
PE minus matched-control	60/60	-4.274%	1.8523**	58/58	-2.637%	1.6661*
PE minus total-control	58/151	-3.722%	2.5317***	58/151	-1.675%	1.4792

Table 7-3 summarises the results from testing differences in mean underpricing between PE-backed IPOs that were *not* RLBOs, and control IPOs.

PE-backed IPOs still exhibit significantly lower initial return than NB IPOs, despite exclusion of RLBOs. In fact, when we exclude RLBOs, the mean return *falls* from 2.94% to 2.52%, suggesting RLBOs have *higher* returns than non-reverse PE-backed IPOs. Our results are in line with empirical findings by Schöber (2008). However, both our - and Schöber's (2008) findings contradict consensus in academic *theory*. According to theoretical reasoning, RLBOs should exhibit lower underpricing compared to non-reverse IPOs. It follows that RLBOs exhibit prior trading history and thereby should enjoy lower levels of asymmetric information (Muscarella & Vetsuypens (1989), Ainina & Mohan (1991), Hogan et al. (2001), Ang & Brau (2002)).

On the other hand, we acknowledge that the initial LBO does not represent an exogenous event, but rather a result of careful evaluation by the PE-sponsor (i.e. the LBO is not randomly chosen)[51]. Firms selected for public-to-private LBOs may be characterised by volatile stock prices and uncertain valuations as the PE-sponsors aim to exploit potential stock discounts (Preqin, 2014). Hence, circumstances surrounding the LBO may imply that RLBOs exhibit greater levels of asymmetric information (and thereby higher risk) than other IPOs. Furthermore, the "additional" information related to RLBOs may be outdated at the time of the second IPO, due to changes implemented by PE-sponsors (Schöber, 2008). The reasoning above contradicts existing theory suggesting lower underpricing of RLBOs compared to non-reverse IPOs, but may potentially explain our- and Schöber's (2008) findings. However, as

[51] The interrelation between the entry- and exit of portfolio firms is assessed when analysing responses from interviews in section 0.

we could only identify 10 RLBOs in our sample, we acknowledge that our results may be attributed to limited sample size.

Table 7-3: Comparison of initial returns between PE-backed (excl. RLBOs)- and control IPOs

The table compares the EW returns of PE-backed IPOs, when excluding RLBOs, to the EW returns of control IPOs.

		Equally weighted	
	Obs.	**Mean**	**T-stat**
PE-backed (excl RLBOs)	48	2.518%	2.3268***
NB (total-control)	151	6.664%	5.8845***
Difference (PE-backed, excl RLBO minus NB)	**48/151**	**-4.785%**	**4.1956*** **

7.1.3 Cross-sectional difference across PE-backed IPOs: VC vs. BO

Table 7-4 presents i) differences in EW- and VW initial returns between the two PE types (BO and VC) and their matched-control IPOs, *separately* and ii) "difference-in-difference"[52] between VC- and BO-backed IPOs (compared to their matched-control IPOs).

We find VC-backed IPOs to be significantly less underpriced than matched reference transactions, based on both EW and VW returns. This is consistent with prior research on the effect of VC backing on underpricing (Megginson & Weiss, 1991). In fact, we deem the magnitude of underpricing difference as relatively extreme, as VC-backed IPOs on average yield 7.09% (EW) lower returns than matched non-VC-backed IPOs. This is larger than the difference postulated by Megginson and Weiss (1991), who find that VC-backed IPOs are 3.6% less underpriced (also using unadjusted first day returns) than matched-control IPOs.

In contrast, we find that BO-backed IPOs do not exhibit significantly lower underpricing than matched-control IPOs, regardless of weighting method. Contradicting this, findings in prior research suggest significantly lower underpricing of BO-backed IPOs compared to NB IPOs (both matched and non-matched) (Muscarella & Vetsuypens (1989), Hogan et al. (2001), Ang & Brau (2002), Schöber (2008), Cao & Lerner (2009)).

When testing "difference-in-difference", we find the *difference* between the *differences* of VC- and BO samples compared to their respective control samples, to be significant when employing EW returns. This suggests VC-backed IPOs are significantly less underpriced (on average) than BO-backed IPOs, all else equal. Hence, our initial finding (lower underpricing of PE-backed IPOs compared to control IPOs, see Table 7-2) appears driven by the VC-backed offerings in our PE sample. However, one can question the robustness of this result as "difference-in-difference" based on VW returns is insignificant.

[52] Difference-in-difference: We tested whether the difference of 4.785% was significantly different from 0 using the standard deviation of the differences from "VC vs. Matched" and "BO vs. Matched".

To the best of our knowledge, it does not exist any published research *comparing* underpricing of VC- and BO-backed IPOs. However, Schöber (2008) presents a possible explanation to our result (i.e. lower underpricing of VC-backed IPOs) based on participation rates in IPOs. He argues that high participation rates in an IPO may signal that existing owners lack faith in the firm's prospects, and should thereby be associated with higher risk (than IPOs associated with low participation rates). Investors may therefore require greater discount (i.e. higher underpricing) from IPOs characterised by high participation rates as compensation for increased risk. Furthermore, Schöber (2008) argue that BO-sponsors appear to be more "aggressive sellers" in IPOs than VC-sponsors, and should thereby exhibit lower underpricing than VC-backed IPOs. Supporting this, we find that sponsors of BO-backed firms sell significantly larger stakes at IPOs than sponsors of VC-backed firms. The BO sponsors in our sample sold (on average) 45.27% of their shares at IPOs, while the corresponding number for VC sponsors is 17.88%[53]. This line of argumentation may explain why we observe greater underpricing of BO-backed IPOs (which are associated with higher participation rates) than VC-backed IPOs.

Table 7-4: Comparison of initial returns between VC- and BO-backed IPOs

The table depicts the difference in EW and VW initial return between: i) The two PE types (VC and BO) and their matched-control IPOs, *separately* and ii) "difference in difference" between VC and BO (vs their matched-control IPOs).

		Equally weighted			Value weighted	
	Obs.	**Difference**	**$\|T-stat\|$**	**Obs.**	**Difference**	**$\|T-stat\|$**
VC minus matched-control	25/25	-7.085%	1.6160**	24/24	-3.148%	1.3216*
BO minus matched-control	35/35	-2.265%	0.9360	34/34	-2.573%	1.1934
Diff-in-Diff[54] ((VC-matched)- (BO-matched))	-	**-4.820%**	**1.2934***	-	**-0.575%**	**0.1771**

7.1.4 Robustness

The robustness of the results related to the t-tests has been assessed using non-parametric equivalents.

We find PE-backed IPOs to be significantly less underpriced than *matched* NB IPOs, also when employing non-parametric testing. This is consistent with the results provided by the equivalent t-test and thereby provides additional robustness of our results. However, we neither obtain similar robustness verification when comparing PE-backed IPOs to the total-

[53] Participation rates: The difference (27.40%) is statistically significant at the 1% level. The participation rates are calculated based on information extracted from IPO prospectuses, press-releases and news articles.
[54] Difference-in-difference: We tested whether the differences of 4.82% and 0.58% were significantly different from 0 using the standard deviation of the differences from "VC vs. Matched" and "BO vs. Matched".

control sample, nor when comparing VC- and BO-backed IPOs to their respective matched-control samples.

Table 7-5: Robustness assessment using non-parametric tests

The table compares the EW returns of PE-backed IPOs to other IPOs, using non-parametric tests. Wilcoxon signed-rank sum test was applied when testing for differences in underpricing based on the matched-control sample, while Wilcoxon rank sum test was used when testing for differences in underpricing based on the total-control sample.

	Observations	Z-value	(P-value)
Difference between PE-backed and matched-control sample	60/60	1.730*	8.360%
Difference between PE-backed and total control sample	151/58	1.132	25.750%
Cross-sectional differences			
Difference between VC-backed and total-control sample	25/25	1.197	23.120%
Difference between BO-backed and total-control sample	35/35	0.164	86.990%

7.2 Multivariate regression

We performed multivariate regressions in an attempt to isolate the (potential) effect of PE-backing on underpricing, from other determinants of initial returns (e.g. aftermarket volatility, industry, market timing etc.) (see *Table 7-6*).

Table 7-6: Multivariate regressions

The table below reports the coefficients and the corresponding standard error (in parenthesis) and (absolute) t-values from three regressions. The regressions are run with initial returns (IR) as the dependent variable, and variables assumed to affect initial returns as independent variables. The regressions are estimated with standard errors that are robust to heteroscedasticity.

$(1) IR_i = \alpha_1 + \beta_1 PE + \beta_2 PRESTund + \beta_3 \ln OS + \beta_4 HIGHTECH + \beta_6 DK + \beta_7 NO + \beta_8 SE + \beta_9 09 + \beta_9 10 + \varepsilon$

$(2) IR_i = \alpha_2 + \gamma_1 BO + \gamma_2 VC + \cdots + \beta_9 10 + \omega$

$(3) IR_i = \alpha_3 + \gamma_1 BO + \gamma_2 VC + \cdots \beta_5 STD + \cdots + \beta_9 10 + \varphi$

"PE"/"BO"/"VC" - dummy variable equal to one if the IPO is PE/BO/VC-backed and zero otherwise. "PRESTund" - dummy variable equal to one if the firm's underwriter is "prestigious". "lnOS" - the natural logarithm of (deflated) offer sizes. "HIGHTECH"- dummy variable equal to one if the firm belongs to the telecommunication or technology industry. "STD" - the standard deviation of daily returns over 19 days, beginning the day after the IPO date. "DK", "NO" and "FI" – country-specific dummy variables for Denmark, Norway and Finland respectively. Hence, Sweden represents the reference category. "2009" and "2010" – time specific dummy variables for 2009 and 2010.

	(REGRESSION 1)	(REGRESSION 2)	(REGRESSION 3)
VARIABLES	IR	IR	IR
PE	-0.0554***		
	(0.01919)		
	|t|: 2.8868		
VC		-0.0833***	-0.0664**
		(0.03153)	(0.02764)
		|t|: 2.6431	|t|: (2.4035)
BO		-0.0308*	-0.0140
		(0.01666)	(0.01580)
		|t|: 1.8487	|t|: 0.8886
PRESTund	0.0338*	0.0301	0.0260
	(0.01825)	(0.01853)	(0.01848)
	|t|: 1.8512	|t|: 1.6220	|t|: 1.4065
lnOS	-0.0114**	-0.0124**	-0.0024
	(0.00543)	(0.00567)	(0.00608)
	|t|: (2.1019)	|t|: (2.1924)	|t|: (0.3992)
HIGHTECH	0.1353*	0.1416*	0.0988
	(0.07568)	(0.07696)	(0.06507)

	|t|: (1.7879)	|t|: (1.8403)	|t|: (1.5181)
STD			2.5803**
			(1.06744)
			|t|: (2.4173)
DK	0.02547	0.02753	0.01006
	(0.04879)	(0.04863)	(0.04350)
	|t|: (0.52203)	|t|: (0.56600)	|t|: (0.23120)
NO	-0.05169*	-0.04821*	-0.04327*
	(0.02713)	(0.02634)	(0.02379)
	|t|: (1.90508)	|t|: (1.83022)	|t|: (1.81862)
FI	-0.10852**	-0.10651**	-0.07549*
	(0.04545)	(0.04521)	(0.03886)
	|t|: (0.02547)	|t|: 0.02753	|t|: 0.01006
2009	-0.1495***	-0.1463***	-0.2136***
	(0.04758)	(0.04711)	(0.07850)
	|t|: (3.1422)	|t|: (3.1063)	|t|: (2.7216)
2010	-0.0751***	-0.0755***	-0.0787***
	(0.02031)	(0.01978)	(0.02087)
	|t|: (3.6976)	|t|: (3.8153)	|t|: (3.7697)
Constant[55]	0.1789*	0.1962**	-0.0136
	(0.10727)	(0.11132)	(0.12508)
	|t|: (1.8739)	|t|: (1.9741)	|t|: (0.1167)
F-value[56]	F(9,203) = 3.44	F(10,202)= 3.38	F(11,201) = 2.65
	Prob>F=0.0006	Prob>F=0.0004	Prob>F=0.0034
Observations	213	213	213
R-squared[57]	0.1727	0.1791	0.2907

7.2.1 Certification by PE-sponsors in general

Based on regression 1, we find that the presence of PE-sponsors in IPOs reduce the degree of underpricing, consistent with findings from our univariate testing (see section 7.1.2) and prior academic contributions (Muscarella & Vetsuypens (1989), Hogan et al. (2001), Ang & Brau (2002), Schöber (2008), Cao & Lerner (2009)). As we distinguish between VC- and BO-backed IPOs in our study, we have decided to not elaborate further on the PE-dummy, but rather examine the effects of VC- and BO-backing *separately*.

7.2.2 Certification by VC- and BO sponsors in particular

We find VC-backed IPOs to be significantly less underpriced than control IPOs. This is consistent with our findings from univariate testing (see section 7.1.2) and in line with previous research on VC backing in IPOs (Megginson & Weiss, 1991). Hence, the presence of venture capitalists in IPOs appear to ameliorate underpricing, even when controlling for other factors assumed to affect initial returns. Consensus in previous literature attribute this result to venture capitalists being able to *certify* the true firm value in IPOs, as they have

[55] An interpretation of the constant is not particularly informative as our sample does not include obs. with lnOS and STD equal to zero
[56] F-value: F-tests assess multiple coefficients simultaneously and tests H0: All independent variables are insignificant simultaneously. Hence, the F-value presents the overall significance of the regression.
[57] R-squared (the explanatory power of the regression) represents the variation in the dependent variable (initial returns), which is explained by the variation of the independent variables included in the model. To illustrate, R-Squared is 29% in regression 3, implying the independent variables in regression 3 model explain 29% of the variation in initial returns.

reputational capital at stake (due to frequent interaction with capital markets) (Barry et al. (1990), Megginson & Weiss (1991), Lee & Wahal (2004)). It follows that VC backing *certifies* that the offer price reflects relevant inside information and thereby reduce ex-ante uncertainty (and asymmetric information) related to the IPO[58]. As ex-ante uncertainty is positively related to risk, investors should require lower risk premiums (in terms of initial returns) when investing in VC-backed IPOs compared to NB IPOs. (Partly) supporting this, Schöber (2008) argues that VC-backed firms receive lower underpricing in IPOs as a "reward" for their experience and expertise in monitoring their investments.

Contradicting the certification hypothesis, Habib and Ljunqvist (2001) argue that owners of VC-backed IPOs typically sell larger stakes at IPOs than the "average" owner, and thereby have greater incentives to reduce underpricing. However, to the best of our knowledge, this claim is not backed by empirical evidence.

In the context of BO-sponsors, we find "BO" to be marginally significant in regression 2. This suggests BO backing reduces underpricing, in accordance with existing empirical evidence (Muscarella & Vetsuypens (1989), Ainina & Mohan (1991), Hogan et al. (2001), Cao & Lerner (2009)). However, once we control for aftermarket volatility ("STD"), which exhibits a significant and positive coefficient, the coefficient of "BO" approaches zero and turns insignificant (see regression 3). This suggests a negative correlation between "BO" and "STD"[59]. Hence, "BO" appears significant in regression 2, simply because BO-backed IPOs are associated with low aftermarket volatility (which in turn is positively related to initial returns)[60]. We can thereby not deliver sufficiently strong evidence that certification by BO-sponsors reduce underpricing. These findings are in line with univariate testing results (see section 7.1.3) and resemble Schöber's (2008) findings in his study of BO-backed IPOs in the US[61].

Schöber (2008) suggests that lack of evidence supporting the certification hypothesis, may be due to the *strength* of certification depending crucially on the *quality* of the PE-sponsor. Supporting this, Barry et al. (1990), Megginson and Weiss (1991) and Lee and Wahal (2004) document a significant and positive relationship between underpricing and the quality of the

[58] Ex-ante uncertainty: Uncertainty about firm value once it starts trading.
[59] Confirmation of correlation: The correlation between "STD" and "BO" is -18.5%*** (see Table 10-7 (correlation matrix) in Appendix).
[60] The estimator for BO is likely underestimated and biased in Regression 2, which leaves the impression that BO-backing affects initial returns (See section 10.5 in Appendix for mathematical explanation of the consequences of OVB).
[61] Schöber (2008): In his regression analysis he studies 432 BO-backed IPOs and 591 (group) matched-control IPOs listed in the US between 1973 and 2007.

PE-sponsors[62]. Contradicting this, we find no significant relationship between the *quality* of the PE-sponsor and the level of underpricing (see Table 10-11 in Appendix).

7.2.3 Certification by "prestigious" underwriters

Surprisingly, results from regression 1 suggest firms taken public by "prestigious" underwriters are *more* underpriced than firms associated with less reputable underwriters. In contrast, prior research documents a negative relationship between underpricing and use of "prestigious" underwriters (Carter & Manaster, 1990). It follows that as underwriters repeatedly interact with capital markets, they may be incentivised to maintain their reputation through accurate pricing (i.e. low levels of mispricing).

Our result resemble those outlined in the more recent studies by Beatty and Welch (1996), Kirkulak and Davis (2005) and Schöber (2008) who also document a positive relationship between underpricing and use of "prestigious" underwriters. To the best of our knowledge, there are no rational explanations for this relationship outlined in prior research. However, the result could potentially be attributed to an endogeneity[63] (self-selection) issue. Issuers who expect (abnormal) underpricing choose "prestigious" underwriters hoping they are able to reduce (the expected) underpricing. However, "prestigious" underwriters may only partly be able to improve the IPO pricing and demand, still leaving the firms with abnormal levels of underpricing. It is worth noting that "PRESTund" turns insignificant when controlling for "BO" and "VC" in regression 2, in line with evidence from Barry et al. (1990).

7.2.4 Asymmetric information and ex-ante uncertainty

We use aftermarket volatility ("STD"), offer size ("lnOS") and a dummy-variable for high-tech industries ("HIGHTECH") as proxies for the degree of ex-ante uncertainty related to "true" firm value, following Ritter (1984, 1987), Barry et al. (1990), Schöber (2008), Lowry et al. (2010). These studies document a positive relationship between underpricing and ex-ante uncertainty. The degrees of ex-ante uncertainty and asymmetric information associated with an issue are closely interrelated, and in turn (positively) related to the risk associated with an IPO. This suggests investors should require greater initial returns from firms

[62] Proxies for monitoring skill/quality of PE-sponsors:Age, experience, number of previous IPOs, fund raising ability, ownership share of the PE-sponsors.
[63] Endogeneity can arise when an independent variable represent the dependent variable (two-way causality). In this case, the independent variable correlates with the variation of the dependent variable, which in turn is relegated to the error term (i.e. breaches Assumption 3 (see Section 10.4.1, Appendix) (Medvedev, 2012).

associated with high levels of ex-ante uncertainty than firms with more certain valuations, as compensation for higher risk.

Based on regression 2, the results for "lnOS" and "HIGHTECH" are in line with what one can expect based on prior research (Barry et al. (1990), Loughran & Ritter (2004), Schöber (2008)). First, offer size is negatively related to the level of IPO underpricing. As argued in prior research, underpricing decreases with offer size since it is negatively related to the degree of asymmetric information and ex-ante uncertainty (Schöber, 2008). Second, we find that firms operating in high-tech industries, are significantly more underpriced than firms from other industries. Prior research attributes this result to firms in high-tech industries being associated with relatively high levels of ex-ante uncertainty and asymmetric information (i.e. are riskier than firms from other industries) (Schöber, 2008).

From regression 3, we find the coefficient related to aftermarket volatility ("STD") to be significantly- and positively related to initial returns. This is consistent with prior research (Ritter, 1984) (Barry et al., 1990) (Ainina & Mohan, 1991). It follows that firms with high aftermarket volatility tend to be associated with uncertain firm values before the IPO (Ritter, 1987). This suggests investors in IPOs characterised by high aftermarket volatility should require greater initial returns to compensate for high ex-ante uncertainty (and thereby risk)[64].

However, when controlling for aftermarket volatility in regression 3, the coefficients of both "lnOS" and "HIGHTECH" approaches zero and turn insignificant. Furthermore, we find that "lnOS" ("HIGHTECH") is significantly negatively (positively) correlated with "STD"[65]. This suggests small offers operating in high-tech industries exhibit higher aftermarket volatility than larger offers in other industries, in line with Schöber's (2008) reasoning. Hence, when omitting "STD", the estimator of "lnOS" ("HIGHTECH") appears to underestimate (overestimate) the effect of offer size (operating in high-tech industries) on underpricing (i.e. regression 2 suffers from omitted variable bias).

In summary, our finding that aftermarket volatility is positively related to initial returns is consistent with previous research. We believe this relationship can be attributed to the close interrelation between aftermarket volatility and asymmetric information/ex-ante uncertainty, as outlined in prior research. In contrast, offer size and high-tech firms do not appear to be

[64] This strategy is difficult to follow in practice, as aftermarket volatility related to an issue is known post IPO.
[65] The correlation between "STD" and "lnOS" is -34.3***% and +25.0%*** between "STD" and "HIGHTECH" (see **Feil! Fant ikke referansekilden.**(correlation matrix) in Appendix).

independently related to underpricing, inconsistent with previous research. We suspect this can be explained by multicollinearity problems as the correlations between "STD" and "OS"/"HIGHTECH" are highly significant (see Table 10-7, Appendix). The multicollinearity may potentially be due to "lnOS", "HIGHTECH" and "STD" measuring the same underlying cause (risk, ex-ante uncertainty and asymmetric info), in which "STD" outperform the other measures.

7.2.5 Country specific market conditions

We document that firms listed in Norway and Finland were significantly less underpriced than listings in Sweden (based on all regressions). The former relationship is consistent with empirical findings by Pukthuanthong et al. (2013)[66], who document considerably lower underpricing of IPOs in Norway (1.67%) compared to Sweden (6.62%). The same study documents higher underpricing of IPOs in Finland (14.09%) compared to Sweden, which contradicts our result.

7.2.6 Time specific market conditions

We find that IPOs listed in 2009 and 2010 were significantly less underpriced than IPOs listed in other years. Our results can possibly be explained by cyclicality of IPO activity and the existence of "hot"- and "cold" issue markets (Ibbotson & Jaffe (1975), Ritter (1984), Loughran & Ritter (2004))[67]. To illustrate, Loughran and Ritter (2004) document that the average underpricing was 65% in the "hot" dot-com years of 1999-2000, while the average underpricing was "only" 12% during the "colder" IPO markets in 2001-2003. Furthermore, prior research documents strong positive correlation between IPO underpricing between IPO underpricing and stock market returns (1994). Hence, the "cold" nature of the stock market years between 2008 and 2010 represents a possible explanations for the low initial returns characterising listings in 2009 and 2010[68].

7.3 Qualitative approach: Analysis of in-depth interviews

In this section, we present the analysis based on in-depth interviews with industry players representing the renowned PE firms; Altor Equity Partners, EQT, FSN Capital, Herkules Capital and HitechVision. More precisely, we spoke to one deputy CEO, one former CEO (now chairman and partner) and three partners (one is also head of the Norwegian subsidiary)

[66] Pukthuanthong et al. (2013): Studied underpricing of 6025 IPOs in 34 different countries listed between 1995 and 2002.
[67] Ibbotson and Jaffe (1975) define "hot" ("cold") issue markets as periods with abnormally high (low) initial returns.
[68] We used FTSE Nordic index as a proxy for the "temperature" of the stock market.

of Nordic PE firms in addition to one industry-expert with experience from Acquisition Finance (i.e. acquisitions related to LBOs).

There are several exit opportunities available to PE-sponsors when they want to divest their portfolio firms. According to our respondents, the most common exit routes are i) taking the portfolio firm public (IPO), ii) sell the portfolio firm to an industrial player (trade sale) and iii) sell the portfolio firm to another PE-sponsor (secondary buyout) (see Figure 7-1).

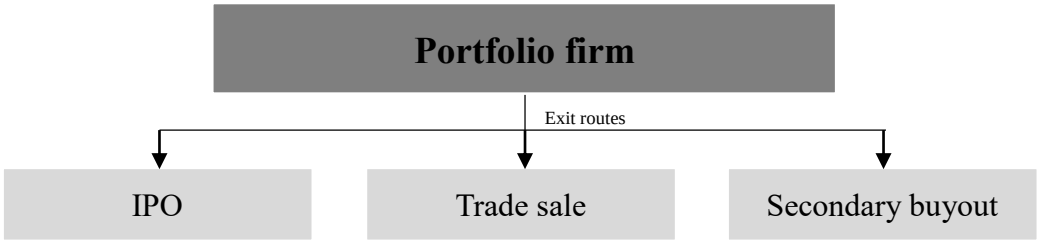

Figure 7-1: The most common exit routes according to our respondents

7.3.1 The relationship between entry and exit of portfolio firms

The link between choice of portfolio firms (entries) and the subsequent exits became apparent through discussions with the GPs. They told us that identification and thorough analysis of potential exit routes represent a highly integrated part of the investment phase. One participant emphasised they rarely enter new investments unless at least two- out of the three exit routes outlined in Figure 7-1 are open.

"I cannot express how important liquidity at exit is for our business. The value-creation during the ownership period can be as outstanding as ever, but is of little comfort when there are no interested buyers or available exit routes." – Respondent 2 (R2)

"Prior to new entries, we spend a substantial amount of time analysing how exchanges, financial and industrial buyers will value the potential investment at exit. We never enter new investments when the window of exit opportunities is considered too narrow." – R4

"If we see limited exit opportunities for a potential target, for instance if there is only one relevant industrial buyer, it may represent a deal-breaker for realisation of an entry." – R5

Hence, the exit routes chosen by PE-sponsors appears to be closely interrelated with the entry of the particular firms. PE firms may drop an investment if, for instance, the M&A environment in the relevant industry is poor or they see too few buyers. This implies the exit opportunities relevant to an investment case may have decisive implications for whether the

PE-sponsors enter or not. In relation to our empirical analysis, this suggests a sample of PE-backed IPOs may systematically differ from NB IPOs, due to selection criteria determining the entry of the firm.

7.3.2 Choice of exit route

When asked about the main factors driving the choice of exit strategy, five respondents emphasised the importance of satisfying pricing and efficient divestment. R1 and R2 stated they preferred immediate and complete divestment, as the "passive ownership role" following a gradual selling process contradicts their business model. They want to possess full control and influential power to change the management, implement operational improvements and customise the capital structure. Two respondents also expressed the importance of minimising the transaction risk, as running exit processes require considerable costs to lawyers, auditors, consultants and underwriters. *"Fees to lawyers alone may accumulate to 2-3 million (NOK)"* – R2. Similarly, Povaly (2006) finds "certainty of execution" to represent the second most important factor determining the choice of exit route (after "state of capital markets"), in his qualitative study of divestments by European PE firms [69].

Five out of six respondents expressed a strong preference for *trade sales* over other exit channels, all else equal, while one respondent stated that no single exit route was preferred over other routes. *"The preferred exit route for an investment, depends on firm characteristics, timing, industry and other circumstances surrounding that specific divestment."* – R4

Supporting the preference for trade sales, almost 50% of all exits completed by Nordic sponsors in 2014 represented sales to industrial buyers (Argentum Private Equity, 2014). This supports findings by Povaly (2006), who documents that the majority of his respondents preferred trade sales over other exit routes[70]. In contrast, IPO appears to be the preferred divestment by PE-sponsors in the US PE market, as noted by Povaly (2006) and Jenkinson and Sousa (2015).

Our respondents listed several reasons for their preference for trade sales over other exit routes. First, it enables a complete and immediate divestment of the portfolio firm, as opposed to IPOs, which commonly require continuous ownership through contractual lock-up agreements. Second, trade sales are generally not subject to the levels of regulations,

[69] Povaly's research design: He conducted a qualitative study of European divestments by questioning 56 active European BO firms
[70] Povaly's findings: 37 firms (66%) preferred trade sales, 14 firms (25%) expressed no single exit route was preferred over others, 2 firms (4%) preferred secondary buyout, while 1 firm (2%) preferred IPO.

disclosures and rules required when going public. Third (and emphasised as the most important reason), trade sales often provide the best pricing as the buyer may be willing to pay a premium for potential synergies. In addition, competition among industrial buyers may put upward pressure on the price. *"All else equal, we prefer the exit which offers the best price, and motivated industrial players are by far the most generous."*- R2. *"We prefer trade sales, all else equal, as industrial buyers are often willing to pay premium for potential synergies."* – R6. The pricing argument is backed by evidence from Povaly (2006), whose respondents marked trade sales as the exit route that historically has generated the highest returns. In contrast, Bienz (2004) documents that IPOs yield higher rates of return than trade sales[71]. However, he argues the result may be attributed to selection bias as highly profitable firms tend to be taken public, while less profitable firms are more often divested through trade sales. Supporting this, Cumming and Macintosh (2003b) find that IPO represents the preferred exit route for high quality and - valued firms.

R2 remarked that trade sales often complicate the exit process as it is more time-consuming and bureaucratic than secondary buyouts. He stated that PE firms usually spends 6-8 weeks on determining the price and purchase conditions, while the same process may take up to one year when the buyer is an industry player. Moreover, PE-sponsors often run sales-dialogues with industrial and financial buyers at the same time (i.e. multi-track selling process), in order to pressure the price and limit the transaction risk. This implies PE-sponsors must commence the sales-dialogue with the trade buyers before contacting financial buyers. This can result in informational leakage to the market, which in turn may prevent other buyers from exhibiting interest in the portfolio firm. As stated by R2; *"The time consuming nature of trade sales compared to secondary buyouts is "high-risk", as information about our exit may reach buyers who feel "kept in the dark" since they were not included from the beginning. This may result in fewer buyers, lower competition and worse pricing."*

When discussing differences in exit strategies between VC- and BO firms, all respondents agreed the main dissimilarity was higher required rate of return related to exiting VC firms. They emphasised that despite blurred boundaries distinguishing VC- and BO firms, VC firms are generally riskier as they tend to be smaller, younger and operating in "newer" industries

[71] Bienz (2004) used data from CEPRES and compared 108 PE-backed IPOs to 423 trade sales (by PE firms). He found that the mean (median) internal rate of return was 123.4% (58.4%) for IPOs and 75.3% (18.32%) for trade sales. The result was within the 90% confidence interval (t=1.706).

(e.g. high-tech industries) than BO firms. *"We generally require higher rates of return when exiting VC firms, as these firms tend be riskier than the more mature BO firms."* – R2.

7.3.3 IPO as an exit route

Four respondents expressed an aversion towards using IPO as an exit strategy, while two exhibited a somewhat more positive attitude towards it. To illustrate, R3 referred to IPO as the exit of "last resort". They listed several disadvantages related to divesting portfolio firms through IPOs.

First, it is challenging to achieve efficient divestment through IPOs, as offerings often require continuation of ownership through contractual lock-up agreements. R1 stated that*: "IPOs often require PE owners to retain a passive ownership stake post IPO, which is not compatible with our strategy of always possessing an ownership stake ensuring controlling- and influential power."* Supporting this, R2 argued that: *"Following an IPO, we are often required to maintain minimum 50% ownership, which implies full responsibility without full freedom to do whatever we want."* However, R6 underlined that the degree of control following an IPO also depends on the cooperation between the PE firm and other (major) owners. *"We have continued to be active owners post IPO in some cases, due to mutual agreement and trust between us and other major owners"* – R6.

R4 stated that being public limits their ability to implement changes efficiently as regulations and the existence of other owners increase the bureaucracy of the firm. However, the respondent argued that this does not necessarily represent a disadvantage with IPOs and added; *"We never take firms public before we have implemented all intended changes. In my opinion, going public is just a way of signalling that the firm is ready to "live" without our backing, experience and expertise. Hence, taking a more passive role is a natural result of the decision to take an investment public."*

R2 commented on a new trend that may reduce the disadvantage of the slow divestment achieved through IPOs. *"Investors appear to be less naive and exhibit greater acceptance of our objective with IPOs [i.e. to achieve efficient divestment] than in the early 2000s. Hence, in line with what we have seen recently, PE-sponsors are now more often required to sell as much as possible at IPOs, in order to avoid cascades of subsequent sales putting downward pressure on the stock price."* To illustrate, R2 referred to Orkla's public offering of Borregaard, in which Orkla was required to retain maximum 20% ownership share post IPO.

Second, three of the respondents stated the exchange is a complicated place to enter and stay. They noted that the extent of requirements, regulations and rules associated with the listing- and being listed represent disadvantages of using IPO as an exit strategy. Furthermore, one respondent stated that going public drives an unfortunate short term focus with maximisation of next quarter's performance representing the main objective.

Third, the majority of the respondents claimed that IPOs often imply worse pricing than other exit channels. *"Investors may perceive IPO of portfolio firms as a "hit and run" by the PE firms, as they believe their main objective is to achieve the best price before "escaping" as fast as possible. This perception may in turn result in PE firms being forced to offer investors a discount when taking their portfolio firms public."* – R2. This proposition suggests PE-backed IPOs should be more underpriced than NB IPOs, in contrast with our empirical results and evidence outlined in prior research (see Table 3-2).

However, as there are numerous PE-backed offerings on Nordic exchanges annually, there must be some factors causing IPOs of portfolio firms. The respondents listed a few reasons to why PE firms in some instances use IPO as an exit route.

First, R2 and R6 stated that IPOs are sometimes (partly) caused by pressure from fund-investors (LPs), (especially) when the relevant firm is abnormally successful, sufficiently large and exhibit further growth expectations. In such cases, the fund-investors generally want to realise parts of the investment while still being able to harvest from future value creation. Two respondents stated the motivation of going public by fund-investors also applies to the PE-sponsors themselves: *"Exiting through public offerings enables participation in future value creation of successful portfolio firms, while at the same time taking some "risk off the table""* – R6. *"IPO may represent the favourable exit for successful, large- and growing firms, as it enables realisation of parts of the investment without abandoning future growth opportunities."* – R4.

Supporting this, Cumming and MacIntosh (2003b) document that IPO represents the preferred exit route for high-quality and -valued portfolio firms. This suggests a sample of PE-backed IPOs may be biased towards containing firms that are more "successful" than the average NB IPO. This may explain the lower underpricing of PE-backed- compared to NB IPOs observed in our- and prior empirical studies. It follows that particularly "successful" firms may be subject to high demand among investors prior to the IPO, putting upward pressure on the offer price.

Second, the respondents agreed that favourable market sentiment and -timing may justify taking a portfolio firm public. This is consistent with findings by Jenkinson and Sousa (2015), who document that PE-sponsors tend to take their portfolio firms public when equity valuations are high (i.e. the IPO markets are "hot"). Supporting this, we document that there were many PE-backed IPOs in the "hot" IPO markets of 2005, 2006 and 2007, while there were *no* PE-backed IPOs in the "colder" markets of 2008 and 2009[72].

Finally, the respondents stated they are sometimes forced to exit through IPOs, when the other exit routes are "closed". For instance, IPO may represent the only exit route for large BO firms as there may not exist industrial or financial buyers with sufficient capital to acquire the firm. This suggests that taking a portfolio firm public may represent the "exit route of last resort" in some instances.

Schöber (2008) argue that reduction of leverage represents an important motive for taking portfolio firms public. Contradicting this, R4 stated that reducing leverage is rather a *requirement* of going public; *"When private, our portfolio firms have leverage ratios around 4x EBITDA, while the maximum ratio allowed by exchanges I believe is around 2x EBITDA. Hence, when deciding to go public you also choose to pay off debt, which is typically done through issuance of primary shares."* This reasoning suggests Schöber's (2008) analysis of the causality related to IPO and reduction of leverage may be misleading; PE firms do not necessarily take their portfolio public to reduce leverage, but reducing leverage is rather a requirement related to the decision to go public.

In relation to debt financing, R5 emphasised how public bond financing may affect equity pricing of IPOs. The respondent stated that the performance of publically traded bonds are typically used as a reference when pricing IPOs of firms associated with the bonds. *"Well-performing publically traded bonds may increase the credibility of the portfolio firm in a subsequent IPO, and thereby enhance firm valuation."* – R5. This suggests PE-backed firms with (well-performing) publically traded bonds may possess higher probability of being exited through a public listing than firms without (or with poorly-performing) publically traded bonds.

In summary, the interviews leave us with an impression that PE-sponsors take their portfolio firms public primarily when the portfolio firm is particularly "successful" (and sufficiently large) or in absence of other available exit channels. The latter contradicts consensus in prior

[72] Number of PE-backed IPOs in parenthesis: 2005 (13), 2006 (11), 2007 (11), 2008 (0) and 2009 (0).

literature presenting IPO as the "ultimate goal" for PE-sponsors, as noted by Povaly (2006) and Jenkinson and Sousa (2015)).

7.3.4 When do PE firms exit?

All the GPs in our sample stated they exit their investments when they have achieved predetermined goals rather than exiting after a certain number of years. *"We pursue an overall goal of doubling EBITDA of our investments within five years. Depending on the development of the company and market conditions, doubling EBITDA can both happen before- and after the initial five-year timeline, and the exit is thus adjusted accordingly."* – R5.

They also exit if an abnormally lucrative opportunity becomes available. Supporting this, R2 expressed the importance of exhibiting a pro-active divestment strategy by always staying one step ahead of other market participants. *"After an ownership period of two to three years, we usually conduct thorough analysis of the company, in order to be prepared for the subsequent exit. We always want to be the party with superior knowledge about every detail concerning our portfolio firms."* – R2.

In addition, they expressed the importance of exiting investments not satisfying expectations as it is expensive to incubate losing projects. This is particularly relevant today, following the challenging financial and economic environment. "*The exit related to the oil-and gas firms we did not manage to sell by December 2014, will probably be postponed for several years due to the challenging market. This is costly, both due to expensive exit processes [that do not materialise] and due to the fact that these firms generally lack profitability in today's market."* – R2.

7.3.5 Choice of underwriter

All the GPs in our sample emphasised they generally do not turn to the same underwriter for assistance in PE transactions. Instead, they aim to choose the underwriter appropriate for each transaction in terms of industry-specialisation (e.g. Clarksons Platou specialise in shipping, offshore and oil service), exchange (e.g. SSE, OSE) and transaction type (e.g. M&A, IPO). Furthermore, R2 and R4 claim they deliberately do not use the same underwriter in order to ensure no underwriter believe they get the deals "automatically". *"We want to encourage the investment banks to really work for our proposals in order to ensure they do not "rest on their laurels" believing they get our deals anyways."* – R2. Hence, our respondents suggest the choice of underwriter is not (mainly) determined by reputation (i.e. "prestigious"

underwriters), but rather the "fit" between the underwriter and the specific case. This (partly) contradicts our finding that PE-backed IPOs appear to be taken public by more reputable underwriters than NB IPOs[73].

One respondent also stated they usually invite 2 or 3 underwriters to pitch their offers and subsequently select the superior proposal. However, the respondent added that this strategy is somewhat risky with respect to exits: *"The rejected underwriters will immediately turn around and approach potential buyers in hopes of obtaining a purchase mandate."*- R2.

R1 stated they commonly use international underwriters as they believe foreign investment banks work harder and deliver better results than their Nordic counterparts. This is in line with our finding that international underwriters are more commonly used in IPOs by Nordic PE-backed firms compared to NB firms[74].

7.3.6 Comments to our empirical results

The majority of the respondents exhibited mixed feelings related to discussing underpricing of IPOs and refrained from sharing their thoughts regarding our empirical results. Some stated they were uncomfortable with their knowledge of the phenomenon, while others found it difficult to discuss it informally as there is no unambiguous definition of underpricing (also discussed in section 3.1). However, two respondents still proposed potential explanations to why PE-backed IPOs appear less underpriced than other IPOs (as observed in our- and prior empirical studies).

First, R3 argued that lower underpricing of PE-backed IPOs may be attributed to PE-backed IPOs being timed- and promoted better than NB IPOs. *"GPs may be better at timing and promoting offers than "normal" owners, as they engage in several IPOs. This may in turn provide lower discount to investors of IPOs backed by PE and thereby explain their lower underpricing."* – R3.

Second, R5 stated that some PE-sponsors may strive to maximise the offer price when exiting through IPOs in order to boost the proceeds from their participation in IPO exits. This can in turn lead to lower discounts to fair valuation and thereby lower underpricing compared to NB IPOs. However, the respondent emphasised his aversion towards this strategy. *"We believe this [i.e. maximise the offer price at IPOs] represents short-term thinking, as it is important*

[73] "Prestigious" underwriters: 54% of PE-backed IPOs and 26% of NB IPOs used "prestigious" underwriters. The difference is statistically significant at the 1%-level (T-stat = 3.401, P-value=0.0005).
[74] 24% (14/59) of PE-backed IPOs in our sample use international underwriters, while the corresponding number for control IPOs is 6% (8/141).

for us [i.e. PE-sponsors] to maintain a good track-record among investors since we frequently interact with equity markets. Overpricing of IPOs today could therefore harm the demand in future IPO exits as overpricing is not well-received by investors." – R5.
Supporting this, R6 stated he preferred to set the offer price lower than implied by actual valuation/expected demand in order to reduce the risk of overpricing.

7.3.7 The PE industry: Recent development and new trends

Our respondents underlined recent development- and new trends in the PE industry (see Figure 7-2).

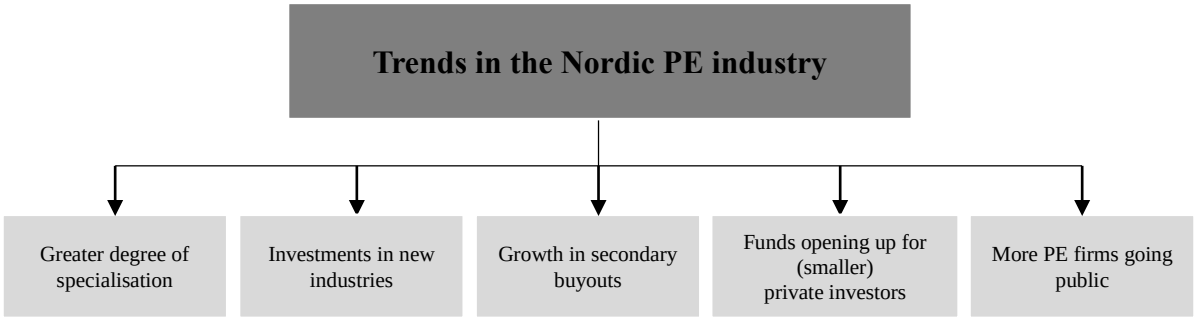

Figure 7-2: Current trends in the PE industry. Authors' chart based on information acquired through interviews

First, the most notable development (according to our respondents) is the trend towards greater degree of industry specialisation among PE firms. They explained the development as a natural result of fiercer competition in the PE industry and other investment classes (e.g. investment funds, hedge funds). This makes it more difficult for the PE firms to deliver returns beyond index-, fund- and stock market returns.

"In the early 2000s, the PE industry was dominated by generalists who managed to deliver abnormal returns due to being "world champions" in excel modelling. Today, everybody is "world champions" in excel. Hence, profitability in the PE industry now requires industry-specific knowledge and experience unique to the particular PE firm." – R2.

R4 emphasised that intensified competition in the PE industry will amplify the competition in bidding rounds for new targets, making it more difficult to enter investments at large discounts. The respondent argued that going forward, the return in the PE industry will mainly be achieved during the private ownership period and not through bargain entries. *"I believe the distinction between PE firms that are good value creators and those that are just good bargainers will become apparent through greater return spreads between PE firms. In my opinion, the intensified competition surrounding PE investments, will drive the latter out of the market."* – R4.

Second, the respondents agreed that an already prominent development is the trend towards investing in new industries. Previously, as noted by R2, PE firms mainly invested in retail and pharmaceutical industries as these industries are characterised by being "immune" to business cycles. *"PE firms have started to enter more cyclical industries such as shipping and oil-services. Going forward, I believe PE firms will examine and enter new industries as a reaction to intensified competition."* – R1.

Third, three respondents stated that it is becoming more common to exit through secondary buyouts. R6 emphasised this trend as already apparent in the (remaining) European PE market and expects secondary sales to become more common in the Nordic region as well. This supports findings by Jenkinson and Sousa (2015), who document that the majority of the 1022 European PE exits in their sample were secondary buyouts[75]. One respondent listed several advantages associated with secondary sales: *"Secondary sales are generally quicker, simpler and of lower transaction risk compared to other exit channels, as PE players are familiar with the process, procedures and formalities related to exits."*- R2. (Partly) supporting this, Jenkinson and Sousa (2015) argue that secondary buyouts are gaining popularity as they are characterised by providing quick exit processes, certain proceeds and low risk of regulatory issues.

Forth, two of the respondents suspect there is a trend towards approaching private (and smaller) investors *directly* when raising new funds. R1 claims this is due to i) avoiding the complexity of handling- and satisfying large industrial players (who dominate the PE funds today) and ii) there is unexploited demand among the smaller, private investors. To illustrate, R1 noted that KKR[76] is considering accepting fund-contributions down to USD10 000 and thereby targeting a larger audience than today's minimum requirements[77]. Following this trend, R1 expects funds-in-funds will struggle going forward, simply due to the possibility for private investors to invest directly in the PE funds and thereby eliminating a fee-demanding intermediate. Contradicting the trend underlined by R1, R6 argued that the extent of regulations and requirements drives the trend in the opposite direction (i.e. towards even more sophisticated investors), at least in Europe.

Fifth, two of the respondents believe we will see more PE firms going public themselves. *"Public PE firms are more attractive to investors as they exhibit greater transparency and*

[75] Jenkinson and Sousa (2015): Studied 1022 European PE exits between January 2000 and December 2014. Found that secondary buyouts, trade sales and IPOs constituted 44%, 42% and 14% of all PE exits, respectively.
[76] KKR (previously called Kohlberg Kravis Roberts) is an American PE firm, founded in 1976, that specialises in LBOs.
[77] The typical requirement for fund contributions are between 1 and 5 million USD – R1.

have better access to capital markets, than comparable private PE firms. I believe this trend is pressured by the lack of transparency characterising the industry today." – R1.

7.4 Limitations and further analysis

The most prominent limitation of our study is the (somewhat) limited sample sizes used for empirical testing. The final dataset encompassed 215 IPOs, in which 60 were identified as PE-backed and 155 as control IPOs. Our individual PE samples of RLBOs, VC-backed BO-backed IPOs contained 12, 25 and 35 observations respectively. These sizes are on the lower end of what is considered "valid" when conducting empirical testing. Hence, despite our empirical testing yielding several (statistically) significant results, we acknowledge the *individual* sample sizes may be insufficient to draw causal conclusions. One could therefore enhance our study by investigating underpricing between PE-backed- and NB IPOs (employing the same methodology as outlined in Chapter 5) based on larger samples (e.g. use a wider time-span and larger geographical area).

In addition, a larger sample would yield more valid inference regarding (some of) the independent variables. For instance, it would be interesting to isolate the effect of RLBOs on underpricing employing *larger* samples sizes (i.e. particularly include more RLBOs and non-reverse PE-backed IPOs) to allow for further analysis of the relationship between the level of underpricing and asymmetric information.

We also suggest investigating other properties of PE-backed- and NB IPOs, by retrieving additional information regarding each IPO. First (and as proposed by a respondent from in-depth interviews), it could be interesting to examine the relationship between bond-performance (pre-IPO) and IPO pricing. The respondent suggested that the IPO pricing of a firm with publically traded bonds, could be influenced by the bond performance. This could be investigated by analysing the interrelation between underpricing and bond-performance[78]. Second, it could be interesting to investigate the (potential) effect of participation rates by principal owner(s) of PE-backed- and NB IPOs on underpricing.

Furthermore, we believe the interrelation between the entry- and exit of portfolio firms would be interesting to investigate further. Such analysis could examine whether (certain) selection criteria determining entry (or characteristics related to portfolio firms when entered) can be related to characteristics surrounding the portfolio firms at exit. In relation to IPO exits and

[78]This requires a sample with (enough) firms possessing publically traded bonds prior to the IPO.

LBOs, further analysis could thereby investigate how/whether circumstances surrounding the initial LBO (potentially) affect the performance of the subsequent IPO.

Section 6.4 discusses potential biases resulting from our data gathering- and selection process in addition to limitations related to applied methodologies.

8 Conclusion

This study focused on i) examining differences in IPO underpricing across PE-backed- and NB IPOs listed in Nordic countries between 2005 and 2014 (empirical approach) and ii) identifying key factors affecting choice of exit route by PE-sponsors and (potential) interrelation between entry- and exit of portfolio firms (qualitative approach).

8.1 Underpricing of PE-backed- and NB IPOs

We found both PE-backed- and NB IPOs to exhibit significant underpricing (on average), consistent with prior research. The mean initial return (EW) of PE-backed IPOs was 2.9%, while it was 6.7% and 7.1% for the total-control- and matched-control sample, respectively. However, IPOs backed by VC-sponsors were not significantly underpriced, implying the (significant) underpricing of PE-backed IPOs was driven by the BO-backed listings in our sample.

Furthermore, we found PE-backed IPOs to be significantly less underpriced than NB IPOs, in line with existing empirical research (and thereby also with *research question 1*). Our result appears robust as we reach the same conclusion based on both univariate- and multivariate testing procedures. Respondents from in-depth interviews postulated two potential explanations to our finding. First, PE-sponsors may be better at timing- and promoting their IPOs than managers/owners of NB IPOs. Second, some PE-sponsors may attempt to maximise the offer price in order to boost the proceeds from their participation in IPOs. However, consensus in prior research attributes the result to the *presence* of PE-sponsors in IPOs *certifying* that the offer price reflects all relevant (inside) information. It follows that through repeated interaction with capital markets, PE-sponsors have reputational capital at stake and (potentially) superior expertise and experience in monitoring their investments. PE-sponsors may also have greater monitoring incentives than owners of NB IPOs as the former commonly possess larger equity stakes than the latter.

Our empirical analysis suggests lower underpricing of PE-backed- compared to NB IPOs is primarily driven by VC-backed IPOs. We find that listings backed by VC-sponsors are significantly less underpriced than both BO-backed- and NB IPOs, based on all testing procedures. In contrast, we cannot document (statistically significant) lower underpricing of BO-backed- compared to NB IPOs. This suggests VC-sponsors are able to reduce the level of underpricing in IPOs, while the same result does not appear to hold for BO-backed offerings.

Finally, we found aftermarket volatility to be significantly- and positively related to initial returns, independent of PE backing, consistent with prior research. It follows that investors in IPOs associated with high aftermarket volatility require greater initial returns as compensation for higher ex-ante uncertainty (and thereby risk) than IPOs with low aftermarket volatility.

8.2 Exit strategies by PE-sponsors (in-depth interviews)

Related to *research question 2*, respondents from in-depth interviews listed price, transaction risk and divestment efficiency as the most important factors (in descending order) determining the choice of exit route. The majority of the respondents expressed strong preference for trade sale (ceteris paribus) due to several reasons. First, trade sale enables complete and immediate divestment. Second, (potential) synergies and competition among industrial bidders often result in trade sale providing superior pricing over other exit routes.

IPO, on the other hand, was emphasised as the least preferred exit route by the majority of the respondents, due to inefficient divestment and extensive regulation. However, some respondents underlined that IPOs may represent the preferred exit for particularly "successful" (and large) portfolio firms, as it "*enables participation in future value creation while at the same time taking some "risk off the table""* - (R4). This suggests a sample of PE-backed IPOs may be biased towards containing firms that are more "successful" than the average NB IPO.

The interviews left us with the impression that exit- and entry of portfolio firms represent interrelated events. PE firms spend substantial amounts of time analysing exit opportunities related to a potential target already *prior* to entry. Moreover, they may in fact refrain from entering an investment when they see a challenging exit market. Hence, the exit opportunities related to an investment case may have decisive implications for whether the entry is realised or not.

Finally, our respondents underlined several trends in the PE industry. The most prominent trends were: i) Growth in secondary buyouts as such exits are characterised by being quick and of low transaction risk (although not necessarily providing the best price) and ii) greater industry specialisation among PE firms as a result of intensified competition in the PE landscape (see quote in Chapter 1).

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Evensen, Truls	Statistical Manager, Oslo Stock Exchange
Kjærvik, Jan	Head of Group Finance and Risk Management, A.P. Møller Mærsk
Lillestøl, Jostein	Researcher at NHH, Time Series Analysis, Risk Analysis, Statistical Modelling
Maurstad, Hugo	Partner, Altor Equity Partners
Misund, Anders	Partner and head of EQT Partners AS
Munthe, Gert W.	Founding Partner and Chairman (and former CEO), Herkules Capital
Persson, Ulf	Economic and Statistical Researcher at Nasdaq OMX Nordic
Reed, Pål M.	Senior Partner and Deputy CEO, HitecVision
Slemdal, Stefan	Associate (ECM), Carnegie Investment Banking (Norway)
Smith, Ulrik	Partner, FSN Capital

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10 Appendix

10.1 PE-backed IPOs: Sample characteristics

Table 10-1: Characteristics of the PE-backed IPOs included in our sample

BO/ VC	Company (PN: Previously named)	Exch.	ICB Industry	General Partner	Entry date	IPO date
VC	Advanced Production and Loading[79]	OSE	Oil & Gas	HitecVision	28.01.2004	18.03.2005
VC	Affecto Genimap	HSE	Technology	CapMan	01.11.1999	27.05.2005
BO	Akva Group	OSE	Industrials	Teknoinvest, Norvestor	30.06.1997	10.11.2006
VC	Asetek	OSE	Industrials	Northzone, Sunstone	01.01.2006 (estimate)	20.03.2013
VC	Bactiguard	SSE	Health Care	Industrifonden	21.12.2011	19.06.2014
VC	Badger Explorer	Oslo Axess	Oil & Gas	Convexa Capital, Procom Venture	02.09.2005	25.05.2007
BO	BE Group	SSE	Basic Materials	Nordic Capital	15.12.1999	24.11.2006
VC	Biotec Pharmacon	OSE	Health Care	NorgesInvestor	01.11.1997	04.11.2005
BO	Bufab	SSE	Industrials	Nordic Capital	30.12.2004	21.02.2014
BO	Bulten (PN: FinnvedenBulten)	SSE	Consumer Goods	Nordic Capital	30.12.2004	20.05.2011
BO	Byggmax	SSE	Consumer Services	Altor Equity Partners	08.12.2005	02.06.2010
VC	CellCura	Oslo Axess	Health Care	Maturo Kapital[80]	01.01.2005 (estimate)	06.10.2010
BO	Cermaq	OSE	Consumer Goods	NorgesInvestor	15.12.1999	24.10.2005
BO	Chr. Hansen	CSE	Health Care	PAI Partners	01.07.2005	03.06.2010
VC	Clavis Pharma	OSE	Health Care	Neomed Management, MVM	15.08.2001	07.07.2006
VC	Dibs Payment Services	First North (SE)	Industrials	Verdane Capital	02.06.2005	18.06.2007
BO	Duni	SSE	Consumer Goods	EQT	30.01.2997	14.11.2007
VC	Endomines	First North (SE)	Basic Materials	Noweco Partners, Finnish Industry Investment	15.01.2003	19.06.2007
VC	Exiqon	CSE	Health Care	Teknoinvest, SLS Venture[81], BioFund Management	05.12.2003	29.05.2007
VC	Funcom	OSE	Consumer Goods	Northzone, Verdane Capital	01.07.2003	13.12.2005
VC	HMS Networks	SSE	Technology	Segulah Advisors	16.08.2004	19.10.2007
BO	Inwido	SSE	Industrials	Ratos	30.06.2004	26.09.2014
VC	Isconova	First North (SE)	Health Care	InnovationsKapital	15.07.2008	10.11.2010

[79] Advanced Production and Loading (Acquired by National Oilwell Varco (NOV) in 2010).
[80] PN: BTV Invest.
[81] Scandinavian Life Science (SLS): Result of a merger bt. Sixth Swedish National Pension Fund, Medicon Valley Capital and Innoventus.

BO	ISS	CSE	Industrials	EQT, Goldman Sachs PE	09.05.2005	13.03.2014
BO	KappAhl Holding	SSE	Consumer Services[82]	Accent Equity Partners, Nordic Capital	28.10.2004	23.02.2006
BO	Kongsberg Automotive	OSE	Consumer Goods[83]	FSN Capital, IK Investment Partners	01.08.2001	24.06.2005
BO	Lindab International	SSE	Industrials	Ratos	03.07.2001	01.12.2006
BO	Marine Farms	OSE	Consumer Goods	Marin Forvaltning	15.06.2004	12.10.2006
BO	Matas	CSE	Consumer Services	CVC Capital Partners	28.02.2005	28.06.2013
BO	MQ Retail	SSE	Consumer Services	CapMan	01.04.2006	18.06.2010
BO	Munksjö	HSE	Basic Materials	EQT	01.03.2005	07.06.2013
VC	Napatech	OSE	Technology	Northzone, Ferd Capital, SEED Capital DK	24.03.2006	06.12.2013
BO	NEAS	OSE	Financials	Reiten & Co	15.11.2000	23.03.2007
BO	Nederman Holding	SSE	Industrials	EQT	17.12.1999	16.05.2007
VC	Norwegian Energy Corp. (NORECO)	OSE	Oil & Gas	HitecVision	01.10.2005	09.11.2007
BO	Odim	OSE	Industrials	Verdane Capital, Norvestor	01.12.2002	18.11.2005
VC	Orexo	SSE	Health Care	HealthCap	01.01.2005 (estimate)	09.11.2005
BO	OW Bunker	CSE	Industrials	Altor Equity Partners	16.05.2007	28.03.2014
VC	QT Software (PN: Trolltech)	OSE	Technology	Northzone, Teknoinvest[84]	01.06.2000 (estimate)	05.07.2006
BO	Polimoon	OSE	Industrials	CVC Capital Partners	01.01.1999	26.04.2005
VC	Powel	OSE	Technology	Norvestor, Viking Venture Management	n/a	24.10.2005
BO	Pronova Biopharma	OSE	Health Care	Herkules[85]	01.01.2004	11.10.2007
VC	Renewable Energy Corporation (REC)	OSE	Oil & Gas[86]	Hafslund Venture	n/a	09.05.2006
BO	RenoNorden	OSE	Industrials	CapVest, Accent Equity Partners	27.09.2011	01.12.2014
BO	Revus Energy	OSE	Oil & Gas	HitecVision	24.02.2003	27.06.2005
BO	Salcomp	HSE	Technology	EQT	01.10.1999	13.03.2006
BO	Sanitec	SSE	Industrials	EQT	15.04.2005	10.12.2013
BO	SCAN Geophysical	Oslo Axess	Oil & Gas	Norvestor	03.10.2005	31.05.2007
BO	ScandBook	First North (SE)	Consumer Services	Accent Equity Partners	27.09.2006	31.03.2010

[82] ICB Supersector 5300: Retail.
[83] ICB Supersector 3300: Automobiles and Parts.
[84] Teknoinvest entered less than 1 year prior to the IPO.
[85] PN: Ferd Equity Partners.
[86] ICB Sector 0580: Alternative Energy.

BO	Scandi Standard	SSE	Consumer Goods	CapVest	03.04.2013	27.06.2014
BO	Swedish Orphan Biovitrum	SSE	Health Care	Priveq Investment	01.03.2004	15.09.2006
BO	TDC	CSE	Telecomm-unications	Providence Equity Partners, Blackstone, Apax Partners	20.01.2006	23.12.2010
BO	Thule	SSE	Consumer Goods	Nordic Capital	08.04.2008	26.11.2014
VC	Topotarget	CSE	Health Care	HealthCap	29.05.2002	10.06.2005
VC	Transmode	SSE	Technology	Amadeus Capital Partners	01.04.2001	27.05.2011
VC	Veloxis Pharmacon (PN: LifeCycle Pharma)	CSE	Health Care	NB Capital	28.06.2002	13.11.2006
BO	Via Travel Group	OSE	Consumer Services	FSN Capital, NorgesInvestor	15.06.2003	09.06.2005
BO	XXL	OSE	Consumer Services	EQT	02.06.2010	01.10.2014
BO	Zalaris	OSE	Industrials[87]	Reiten & Co	15.11.2000	01.06.2014
VC	Zealand Pharma	CSE	Health Care	BioFund Management, Sunstone Capital, BankInvest	30.06.2005	24.11.2010

Table 10-2: PE sample: Offer price, closing price and initial returns

Sample sorted by initial returns (small to large). Offer- and closing prices are quoted in local currencies.

BO/VC	**Company** (PN: Previously named)	**Market**	**IPO date**	**Offer Price**	**Close price**	**Initial return**	**Source: Offer price**	**Source: Closing price**
VC	CellCura	NO	06.10.2010	5.00	3.85	-23.00 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	Bactiguard	SE	19.06.2014	38.00	32.00	-17.11 %	Ulf Persson. Nasdaq OMX Nordic	Nasdaq OMX
VC	Funcom	NO	13.12.2005	15.00	13.50	-10.00 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	Isconova	SE	10.11.2010	58.00	53.00	-8.62 %	(SLU Holding, 2010)	Euroinvestor
VC	Zealand Pharma	DK	24.11.2010	86.00	79.50	-7.56 %	Nasdaqomxnordic.com	Bloomberg
BO	Inwido	SE	26.09.2014	68.00	65.00	-5.15 %	(News Cision, 2014)	Nasdaq OMX
BO	TDC	DK	23.12.2010	51.00	48.38	-5.14 %	Nasdaqomxnordic.com	Bloomberg
VC	Asetek	NO	20.03.2013	36.00	34.80	-3.33 %	Oslobors.no	Truls Evensen.

[87] ICB Sector 2790: Support Services.

								Oslo Stock Exch
BO	NEAS	NO	23.03.2007	33.00	32.00	-3.03 %	Oslobors.no	Bloomberg
BO	ScandBook	SE	31.03.2010	58.00	57.00	-2.59 %	(Affärs världen, 2010)	Nasdaq OMX
BO	RenoNorden	NO	01.12.2014	47.00	45.80	-2.55 %	Oslobors.no	Bloomberg
VC	Endomines	SE	19.06.2007	13.00	12.70	-2.31 %	Ulf Persson. Nasdaq OMX Nordic	Nasdaq OMX
VC	SCAN Geophysical	NO	31.05.2007	28.00	27.50	-1.79 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
BO	Via Travel Group	NO	09.06.2005	29.00	28.50	-1.72 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
BO	Marine Farms	NO	12.10.2006	14.00	13.80	-1.43 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
BO	Polimoon	NO	26.04.2005	21.50	21.20	-1.40 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	HMS Networks	SE	19.10.2007	74.00	73.00	-1.35 %	Ulf Persson. Nasdaq OMX Nordic	Bloomberg
BO	MQ Retail	SE	18.06.2010	32.00	32.00	-0.62 %	(MQ Retail, 2010)	Nasdaq OMX
BO	Akva Group	NO	10.11.2006	35.00	35.00	0.00 %	Oslobors.no	Bloomberg
BO	Bulten (PN: Finnveden Bulten)	SE	20.05.2011	49.00	49.00	0.00 %	(Reuters, 2011)	Nasdaq OMX
BO	Duni	SE	14.11.2007	50.00	50.00	0.00 %	Ulf Persson. Nasdaq OMX Nordic	Nasdaq OMX
BO	Munksjö	FI	07.06.2013	5.95	5.95	0.00 %	(Unquote, 2013)	Nasdaq OMX
VC	Napatech	NO	06.12.2013	57.75	57.75	0.00 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	Orexo	SE	09.11.2005	90.00	90.00	0.00 %	Ulf Persson. Nasdaq OMX Nordic	Bloomberg
VC	Powel	NO	24.10.2005	15.00	15.00	0.00 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
BO	Salcomp	FI	13.03.2006	3.20	3.20	0.00 %	Ulf Persson.	Bloomberg

							Nasdaq OMX Nordic	
VC	Affecto Genimap	FI	27.05.2005	4.80	4.81	0.21 %	Ulf Persson. Nasdaq OMX Nordic	Bloomberg
BO	Cermaq	NO	24.10.2005	44.00	44.10	0.23 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	Norwegian Energy Corp. (NORECO)	NO	09.11.2007	33.00	33.20	0.61 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	Biotec Pharmacon	NO	04.11.2005	24.50	25.00	2.04 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	Clavis Pharma	NO	07.07.2006	45.50	46.50	2.20 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
BO	Lindab International	SE	01.12.2006	110.0	113.0	2.50 %	(Lindab Group, 2006)	Nasdaq OMX
VC	Transmode	SE	27.05.2011	53.00	55.00	2.83 %	(Transmode, 2011)	Bloomberg
BO	Kongsberg Automotive	NO	24.06.2005	46.00	47.50	3.26 %	Oslobors.no	Bloomberg
BO	Matas	DK	28.06.2013	115.0	119.0	3.48 %	Nasdaqomx nordic.com	Bloomberg
BO	Pronova Biopharma	NO	11.10.2007	23.00	23.80	3.48 %	Oslobors.no	Bloomberg
BO	Revus Energy	NO	27.06.2005	42.00	44.00	4.76 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
BO	BE Group	SE	24.11.2006	62.00	65.00	4.84 %	Ulf Persson. Nasdaq OMX Nordic	Nasdaq OMX
BO	KappAhl Holding	SE	23.02.2006	56.00	59.00	4.91 %	Ulf Persson. Nasdaq OMX Nordic	Nasdaq OMX
BO	Odim	NO	18.11.2005	30.00	31.50	5.00 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
BO	Byggmax	SE	02.06.2010	46.00	49.00	5.43 %	Ulf Persson. Nasdaq OMX Nordic	Nasdaq OMX
BO	Chr. Hansen	DK	03.06.2010	90.00	95.00	5.56 %	Nasdaqomx nordic.com	Bloomberg
VC	Badger Explorer	NO	25.05.2007	32.00	33.90	5.94 %	Oslobors.no	Truls Evensen. Oslo Stock Exch

BO	Sanitec	SE	10.12.2013	61.00	65.00	6.15 %	(Sanitec, 2013)	Bloomberg
BO	Bufab	SE	21.02.2014	46.00	49.00	6.52 %	(Bufab, 2014)	Bloomberg
BO	XXL	NO	01.10.2014	58.00	62.00	6.90 %	Oslobors.no	Nasdaq OMX
VC	Veloxis Pharmacon (PN: LifeCycle Pharma)	DK	13.11.2006	44.00	47.10	7.05 %	Nasdaqomx nordic.com	Bloomberg
BO	Zalaris	NO	01.06.2014	23.00	25.00	8.70 %	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	QT Software (PN: Trolltech)	NO	05.07.2006	16.00	17.50	9.38 %	Oslobors.no	Bloomberg
BO	Nederman Holding	SE	16.05.2007	87.00	96.00	9.77 %	Ulf Persson. Nasdaq OMX Nordic	Bloomberg
BO	Thule	SE	26.11.2014	70.00	78.00	11.43 %	(Nordic Capital, 2014)	Nasdaq OMX
BO	Swedish Orphan Biovitrum	SE	15.09.2006	100	112.0	11.50 %	Ulf Persson. Nasdaq OMX Nordic	Bloomberg
VC	Exiqon	DK	29.05.2007	40.00	45.00	12.50 %	Nasdaqomx nordic.com	Nasdaq OMX
VC	Dibs Payment Services	SE	18.06.2007	36.00	41.00	13.61 %	Ulf Persson. Nasdaq OMX Nordic	Bloomberg
BO	ISS	DK	13.03.2014	160.0	182.7	14.19 %	Nasdaqomx nordic.com	Bloomberg
VC	Advanced Production and Loading	NO	18.03.2005	49.00	57.00	16.33%	Oslobors.no	Truls Evensen. Oslo Stock Exch
VC	Topotarget	DK	10.06.2005	22.50	26.30	16.89 %	Nasdaqomx nordic.com	Bloomberg
BO	Scandi Standard	SE	27.06.2014	40.00	47.00	17.50 %	(Scandi Standard, 2014)	Bloomberg
BO	OW Bunker	DK	28.03.2014	145.0	175.0	20.69 %	Nasdaqomx nordic.com	Bloomberg
VC	Renewable Energy Corp. (REC)	NO	09.05.2006	95.00	117.0	23.16 %	Oslobors.no	Truls Evensen. Oslo Stock Exch

10.2 Distribution characteristics

10.2.1 Untrimmed samples

Table 10-3: Distribution characteristics of raw initial returns

The table summarises key characteristics related to the distribution of raw initial returns. Skewness measures whether the initial returns are symmetrically distributed to the left and right of the mean. Kurtosis measures the thickness of the tails of the distribution. The kurtosis of the normal distribution is 3.

	Obs.	Mean	Median	Min	Max	Std.	Skewness	Kurtosis
PE-backed	60	2.847%	2.199%	-23.00%	23.160%	8.218%	-0.1305	1.4591
Non-PE-backed (matched-control)	60	10.603%	2.99%	-19.17%	119.31%	24.861%	3.000	12.559
Non-PE-backed (total-control)	155	7.789%	2.593%	-19.17%	119.310%	18.776%	3.455	15.437

The graphs below depict the density distribution of untrimmed samples together with the normal distribution. Shapiro -Wilks tests confirm the normality of the PE sample (A), and our suspicion of non-normality for the control samples (B, C).

Exhibit A: PE sample **Exhibit B: Matched-control sample** **Exhibit C: Total-control sample**

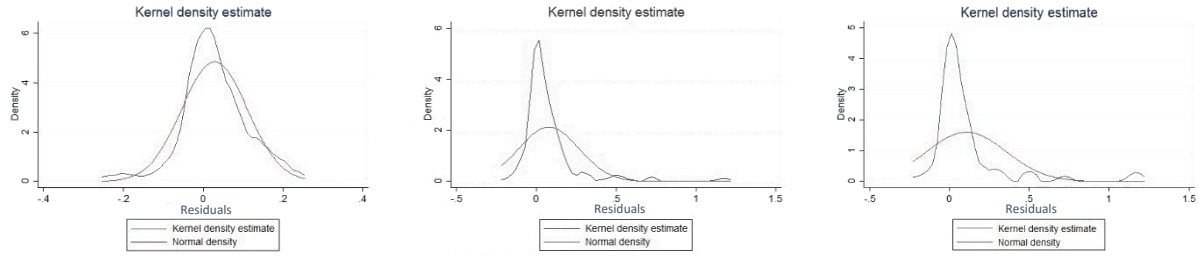

Figure 10-1: The Kernel density distribution of the initial returns (untrimmed samples) together with the normal density distribution

10.2.2 VW (mean) initial return for untrimmed- and trimmed samples

Table 10-4: PE-backed and NB IPOs

	Obs.	Mean (untrimmed)	Obs.	Mean (trimmed)
PE-backed	60	6.197%	58	2.216%
• VC-backed	25	12.989%	24	1.670%
• BO-backed	35	4.654%	35	2.289%
NB (matched-control)	60	5.010%	58	4.853%
NB (total-control)	155	3,915%	151	3.891%

Trimming the PE sample involves excluding of REC (VC firm) and ISS (BO firm) as abnormally large weights (10% and 12% respectively) and initial returns (23.6% and 14.2% respectively) distorted the sample means considerably.

10.2.3 EW- and VW initial returns (trimmed samples)

Table 10-5: NB IPOs

The table summarises distribution characteristics related to raw, EW and VW initial returns for the (trimmed) total-control sample (i.e. 151 NB IPOs).

	Raw IR	EW IR	VW IR
Mean	6.664 %	0.044 %	0.0258 %
Median	2.593 %	0.017 %	0.0016 %
Min	-13.333 %	-0.088 %	-0.2527 %
Max	72.727 %	0.482 %	1.0082 %
Std.	13.916 %	0.092 %	0.1129 %
Skewness	2.499	2.499	5.875
Kurtosis	7.831	7.831	46.574

Table 10-6: PE-backed IPOs

The table summarises distribution characteristics related to raw, EW and VW initial returns for the (trimmed) PE sample (i.e. 58 PE-backed IPOs). EW returns are calculated based on 1/n as weights (n=total sample size). VW returns are calculated using inflation-adjusted offer sizes as weights.

	Raw IR (EW trim)	EW IR	VW IR
Mean	2.9420 %	0.0507 %	0.0382 %
Median	2.1190 %	0.0365 %	0.0057 %
Min	-17.1050 %	-0.2949 %	-1.1033 %
Max	20.6900 %	0.3567 %	0.7406 %
Std.	7.1370 %	0.1231 %	0.2022 %
Skewness	0.196	0.196	-2.406
Kurtosis	0.378	0.624	19.735

Exhibit A: Raw IR **Exhibit B: EW IR** **Exhibit C: VW IR**

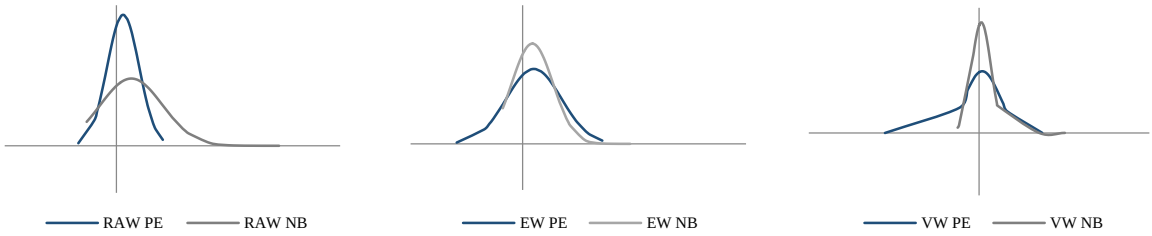

Figure 10-2: The distribution of the Raw, EW and VW initial returns

10.3 Scoring procedure: "Prestigious" underwriters and PE-sponsors

10.3.1 "Prestigious" underwriters

To determine whether an underwriter is considered "prestigious" or not, we developed a scoring procedure based on:

i) The Nordic underwriter ranking by TNS Sifo
ii) The international underwriter ranking by Dealogic & WSJ[88] Investment Banking Scorecard

The Nordic ranking was further separated into country specific rankings as different underwriters topped the ranking lists for Norway, Sweden, Denmark and Finland. We organised the Nordic ranking by country and year, and the international ranking by year. We deemed an underwriter as "prestigious" if it in the relevant IPO year and market was:

i) Ranked as number 1 on the Nordic ranking, or
ii) Ranked among top 10 on the international ranking

To illustrate, an IPO listed in Norway in 2007 used a "prestigious" underwriter, if the underwriter was ranked as number 1 in Norway in 2007 or was among top ten on the international ranking in 2007.

10.3.2 "Prestigious" PE-sponsors

When determining whether a PE-sponsor is considered "prestigious" or not, we developed a scoring-procedure inspired by the one applied by Schöber (2008). The scoring system is based on an overall assessment of four variables that represent proxies for the quality of the PE-sponsor:

i) Age of the PE-sponsor. If a firm was dissolved during the relevant period, only the active years were taken into account.
ii) The number of IPOs associated with each PE-sponsor. We assume our sample is representative as a proxy for the relative frequency of participation in IPOs by the PE-sponsors.
iii) The average (inflation-adjusted) offer size associated with the IPOs
iv) Average equity stake held by the PE-sponsors prior to the IPO

[88] Wall Street Journal (WSJ).

Each PE-sponsor were given a score of 1 or 0 on each criteria, based on its relative performance. A PE-sponsor obtained a score of 1 if its value was equal to- or greater than the 70^{th} percentile value of all sponsors (and zero otherwise). The overall ranking of each sponsor was determined by the sum of the individual scores. A PE-sponsor was considered "prestigious" if it achieved a score of 3 or 4. Finally, a PE-backed IPO was considered backed by a "prestigious" sponsor as long as it was *associated with* a sponsor (i.e. not required to be the lead sponsor) with 3 or 4 points.

10.4 Assumptions multivariate regression

10.4.1 OLS regression: Assumptions about the error term (Hopland, 2015)

The ordinary least square (OLS) method provides unbiased (and consistent) estimators $(\hat{\beta})$when A1-A4 are satisfied. An estimator is unbiased if its expected value equals the true parameter value, i.e. $E(\hat{\beta}|X) = \beta$. If in addition A5 is satisfied, then the OLS estimator will be BLUE[89], implying it is the most efficient (i.e. with lowest variance) linear estimator.

Assumption 1: The regression equation (1) is linear in its parameters:

$$(1)\ \ y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

y represents the dependent variable, X_1 and X_2 represent the independent variables and ε is the error variable.

Assumption 2: The error terms (ε_i) are pairwise independent (i.e. independent samples):

$$(2)\ cov(\varepsilon_i, \varepsilon_j|X) = 0\ \ \in i \neq j$$

Assumption 3: The error term (ε) is uncorrelated with all independent variables (X_1, X_2, … X_n), implying the conditional mean of the error term must equal zero:

$$(3)\ E(\varepsilon_i|X) = 0$$

(follows from $E(\varepsilon) = 0\ and\ cov\ (\varepsilon_i, x_{ij}) = 0, where\ j = 1,2, \dots, k$ when we have k independent variables)

Assumption 4: Not-perfect multicollinearity, implying none of the independent variables can be written as an exact linear combination of other independent variables. E.g. we cannot have $X_2 = a + b_1 X_1$, where $b_1 = \pm 1$.

Assumption 5: The variance of the error term is constant (i.e. homoscedasticity), regardless of the value of all independent variables:

$$(4)\ var\ (\varepsilon_i|X) = \sigma_\varepsilon^2$$

Assumption 6: The error terms (ε) are normally distributed around the mean

[89] Best Linear Unbiased Estimator (BLUE).

10.4.2 Diagnostics: Evaluating homoscedasticity of residuals

Figure 10-3 depicts the residuals plotted against the predicted values of y. The variance of the error term (ε) appears to increase with the predicted y-variables, indicating violation of assumption 5 (homoscedasticity). White's - and Breuch-Pagan's test confirms the residuals suffer from heteroscedasticity (HES). The consequences of HES involve: i) OLS is no longer BLUE (i.e. there are other linear estimators with lower variance (more efficient) than the OLS estimator). However, the OLS-estimator will still be unbiased. ii) The normal test procedures are invalid. Fortunately, OLS represents a valid test-procedure, when asking STATA to estimate standard errors that are roust to HES (Hopland, 2015).

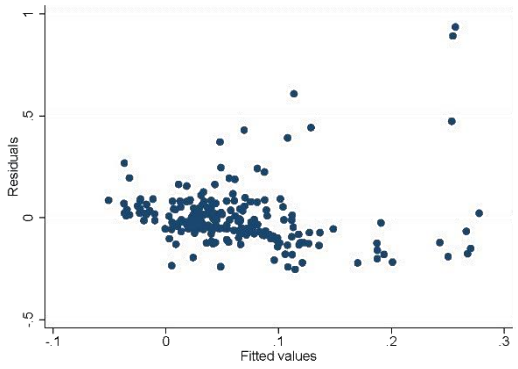

Figure 10-3: Residuals plotted against fitted values

10.4.3 Diagnostics: Evaluating the normality of residuals

The figure below depicts the (Kernel) density estimates of the initial returns together with the normal distribution. The returns appear to be non-normally distributed (confirmed by a Shapiro-Wilk test). The consequence of non-normality is less accurate inference. However, the OLS method will still provide unbiased estimators.

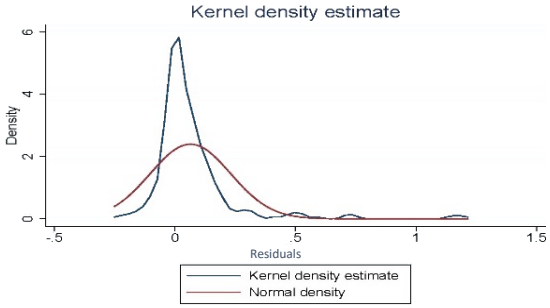

Figure 10-4: The Kernel density distribution of all initial returns (i.e. 215) together with the normal density distribution

10.5 Mathematical explanation: Consequences of OVB

Assume the true model is given by; (1)$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + u$, but that we wrongfully estimate (2) $y = \beta_0 + \beta_1 x_1 + w$.

Estimation of the underspecified model yields:

$$(3)\ \widehat{\beta_1^{Simple}} = \frac{\frac{1}{n}\sum_{i=1}^{n}[(y_i - \bar{y})(x_{1i} - \overline{x_1})]}{\frac{1}{n}\sum_{i=1}^{n}(x_{1i} - \overline{x_1})^2}$$

From the true model (2), we know that:

$$(4)\ y_i - \bar{y} = \beta_1(x_{i1} - \bar{x}_1) + \beta_2(x_{i2} - \bar{x}_2) + u_i - \bar{u}$$

Replace $(y_i - \bar{y})$ in (3) with (4):

$$\widehat{\beta_1^{Simple}} = \frac{\frac{1}{n}\sum_{i=1}^{n}\left[\beta_1(x_{i1} - \bar{x}_1) + \beta_2(x_{i2} - \bar{x}_2) + u_i - \bar{u})(x_{1i} - \overline{x_1})\right]}{\frac{1}{n}\sum_{i=1}^{n}(x_{1i} - \overline{x_1})^2}$$

$$(5)\widehat{\beta_1^{Simple}} = \beta_1 + \beta_2 \frac{\frac{1}{n}\sum_{i=1}^{n}[(x_{i2} - \bar{x}_2)(x_{1i} - \overline{x_1})]}{\frac{1}{n}\sum_{i=1}^{n}(x_{1i} - \overline{x_1})^2} + \frac{\frac{1}{n}\sum_{i=1}^{n}[(u_i - \bar{u})(x_{1i} - \overline{x_1})]}{\frac{1}{n}\sum_{i=1}^{n}(x_{1i} - \overline{x_1})^2}$$

By taking the probability limit (plim) of (5), we get:

$$(6)\ \widehat{\beta_1^{Simple}} = \beta_1 + \beta_2 \frac{cov(x_1, x_2)}{var(x_1)} = \boldsymbol{\beta_1 + \beta_2 * \delta}$$

(since $cov(x_1, u) = 0$ following assumption 3 in section 10.4.1)

$\widehat{\beta_1^{Simple}}$ becomes (asymptotically) biased since it does not converge (in probability) towards the true parameter value β_1 Hence, the bias of $\widehat{\beta_1^{Simple}}$ is given by $\boldsymbol{\beta_2 * \delta}$**.** The bias arises due to the estimator $\widehat{\beta_1^{Simple}}$capturing parts of the effect of the omitted variable (x_2) in regression 1. From (6) we see that the bias *increases* with the correlation between x_1 and x_2 and the magnitude of β_2 and decreases with the variances of x_1. If x_1 and x_2 are negatively correlated ($\delta<0$) and β_2 is positive (and significant), then the estimator $\widehat{\beta_1^{Simple}}$ in (1) will *underestimate* the effect of x_1 on y since the term $\beta_2 * \delta<0$.

10.6 Correlation matrix

Table 10-7: Correlation matrix

*** p<0.01, ** p<0.05, * p<0.10

Variables	lnOS	STD
PE	0,2912	-0,182***
VC	0,0144	-0,0417
BO	0,3431	-0,1849***
PRESTUnd	0,4278	-0,1013
lnOS	1	-0,3427***
HIGHTECH	-0,1758***	0,2495***
STD	-0,3427***	1
DK	0,0545	0,1258
NO	-0,044	-0,0544
SE	0,008	-0,0037
2009	0,0129	0,1384
2010	0,065	-0,0205

10.7 Additional empirical results

10.7.1 One-sample T-tests, using untrimmed samples

Table 10-8: Initial returns of PE-backed and control IPOs

The table depicts the mean EW- and VW returns for PE-backed IPOs and the two control samples. One-sample t-tests were employed to tests if the mean returns differ significantly from zero. The standard deviation of the mean initial return was used when computing the t-statistics.

		Equally weighted			Value weighted	
	Obs.	**Mean**	**T-stat**	**Obs.**	**Mean**	**T-stat**
PE-backed	60	2.847%	2.6834***	60	6.197%	5.246***
• VC-backed	35	1.507%	0.7185	25	12.989%	5.251***
• BO-backed	25	3.804%	3.6824***	35	4.654%	3.665***
Non-PE-backed (matched -control)	60	10.603%	3.3036***	60	5.839%	3.863**
Non-PE-backed (total-control)	155	7.789%	5.1643***	155	3.915%	5.576***
All	215	6.410%	5.6441***	215	4.915%	7.045***

The rather extreme difference between EW and VW return of VC-backed IPOs can mainly be attributed to the presence of REC in the untrimmed sample. With a weight of 10% and initial return of 23%, including REC appeared to severely distort the VW mean of VC-backed IPOs. Related to VW returns of the untrimmed BO sample, we removed ISS as it had considerable effect on the sample mean (with weight and return equal to 12% and 14.3% respectively).

10.7.2 Two-sample T-tests, using untrimmed samples

Table 10-9: Comparison of initial returns between PE-backed- and control IPOs (untrimmed)

The table compares the EW- and VW returns of PE-backed IPOs to other IPOs, using both samples of control IPOs. The t-statistics result from t-tests with the H0: "Mean initial returns of PE-backed IPOs and control IPOs do not differ significantly".

		Equally weighted			Value weighted	
	Obs.	**Difference**	$\|T-stat\|$	**Obs.**	**Difference**	$\|T-stat\|$
PE minus matched-control	60/60	-7.756%	2.3347***	60/60	0.358%	0.1864
PE minus total-control	60/155	-4.942%	2.6799***	60/155	2.282	1.661

Table 10-10: Comparison of initial returns between VC- and BO-backed IPOs (untrimmed)

The table depicts the difference in EW and VW initial return between: i) The two PE types (VC and BO) and their matched-control IPOs, *separately* and ii) "diff in diff" between VC and BO (vs their matched-control IPOs).

		Equally weighted			Value weighted	
	Obs.	**Difference**	$\|T-stat\|$	**Obs.**	**Difference**	$\|T-stat\|$
VC minus matched-control	25/25	-16.885%	2.4541***	25/25	0.878%	0.2421
BO minus matched-control	35/35	-1.235%	0.5072	35/35	-0.203%	0.0890
Diff-in-Diff[90]	-	**15.650%**	**2.1444***	-	**1.081%**	**0.2577**

The rather extreme differences between VC-backed and matched-control IPOs when employing EW returns (16.89%) arise when the matching procedure is based on the *untrimmed* control pool. The distortion can mainly be attributed to Diadrom Holding AB and

[90] Difference-in-difference: We tested whether the difference of 15.65% was significantly different from 0 using the standard deviation of the differences from "VC vs. Matched" and "BO vs. Matched".

BIMobject (EW returns), which exhibited initial returns of 119.3% and 114.7% respectively. The two outliers serve as matching partners for the VC sample (when identifying matching partners from the untrimmed control pool), and consequently explain the extreme underpricing difference of 16.885%.

10.8 Multivariate regression incl. dummy for "prestigious" PE-sponsors

Table 10-11: Multivariate regression incl. dummy for "prestigious" PE-sponsors

The table below reports the coefficients and the corresponding standard error (in parenthesis) and (absolute) t-values from one regression. The regression was run with initial returns (IR) as the dependent variable, and variables assumed to affect initial returns as independent variables. The regressions are estimated with standard errors that are robust to heteroscedasticity.

$$(4) IR_i = \alpha_1 + \beta_1 PRESTspons + \beta_2 PRESTund + \beta_3 \ln OS + \beta_4 HIGHTECH + \beta_6 DK + \beta_7 NO + \beta_8 SE + \beta_9 09 + \beta_9 10 + \varepsilon$$

"PRESTspons - dummy variable equal to one if the PE-sponsor is "prestigious" and zero otherwise. "PRESTund" - dummy variable equal to one if the firm's underwriter is "prestigious". "lnOS" - the natural logarithm of (deflated) offer sizes. "HIGHTECH"- dummy variable equal to one if the firm belongs to the telecommunication or technology industry. "STD" - the standard deviation of daily returns over 19 days, beginning the day after the IPO date. "DK", "NO" and "FI" – country-specific dummy variables for Denmark, Norway and Finland respectively. Hence, Sweden represents the reference category. "2009" and "2010" – time specific dummy variables for 2009 and 2010.

	(4)
VARIABLES	IR
PRESTspons	-0.00001
	(0.01767)
	|t|: 0.00075
PRESTund	0.02368
	(0.01798)
	|t|: 1.31690
lnOS	-0.00322
	(0.00616)
	|t|: 0.52227
HIGHTECH	0.08496
	(0.06370)
	|t|: 1.33371
STD	2.67454***
	(1.06744)
	|t|: 2.50331
DK	0.00778
	(0.04318)
	|t|: 0.18006
NO	-0.04234*
	(0.02454)
	|t|: 1.72554
FI	-0.07357*
	(0.04068)
	|t|: 1.80847
2009	-0.20572***
	(0.07820)
	|t|: 2.63072
2010	-0.08291***
	(0.02412)
	|t|: 3.43711
Constant[91]	-0.00847
	(0.12418)
	|t|: 0.07193
F-value	F(10,202) = 2.63
	Prob>F = 0.0050
Observations	213
R-squared	0.27506

[91] An interpretation of the constant is not particularly informative as our sample does not include obs. with lnOS and STD equal to zero

10.9 Asymmetric information (informed- and uninformed investors): Winner's curse

The "winner's curse problem" represents a form of adverse selection explained by i) information asymmetry between different types of investors and ii) rationing of shares in IPOs (Berk & DeMarzo, 2011). Rock (1986), was the first to present an asymmetric information model attempting to explain underpricing as a direct result of a "winner's curse problem" (Berk & DeMarzo, 2011). His model, along with the winner's curse hypothesis, is empirically supported and discussed in academic research by Beatty and Ritter (1986), Levis (1990) and Ritter and Ibbotson (1995).

Rock's model assumes potential investors in the IPO market are either uninformed or (perfectly) informed. Informed investors are willing to incur costs to acquire information about the aftermarket performance of new issues. These investors will thereby only submit share orders in IPOs where the true stock value exceeds the offer price (i.e. underpriced offers). In contrast, uninformed investors are not prepared to incur such evaluation costs. Hence, they seemingly do not know which IPOs will deliver positive initial returns. Since a predetermined number of shares is assumed offered at a fixed price, uninformed investors will therefore receive lower (higher) share allocations when the share demand is high (low). This implies uninformed investors suffer from a "winner's curse problem"; they only receive all requested shares when the informed investors do not participate in the new issue (i.e. when the issue yields poor returns). Uninformed investors will therefore only participate in IPOs if, on average, new issues are (sufficiently) underpriced. In summary, informational frictions between different investor types may force issuing firms to underprice their IPOs to compensate uninformed investors for facing biased share allocation (Levis, 1990).