Norwegian School of Economics

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Private Equity-Backed Firms' Performance Post IPO

An empirical study of private equity- and venture capital funds' ability to facilitate abnormal returns at the Norwegian stock market

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Major: Financial Economics

NORWEGIAN SCHOOL OF ECONOMICS

1. Abstract

We assess whether underpricing and long-long performance of Norwegian IPOs differs across private equity-backed and non-backed firms. Our sample consists of 67 backed firms and 298 non-backed firms, floated in the period from 1996 to 2010. We observe marginally lower underpricing of both smaller and larger backed IPOs, though statistically insignificant. We find that riskier issues exhibit higher underpricing, independent of firm size and private equity involvement. IPOs backed by private equity does not exhibit better long-run performance. On the contrary, both larger and smaller IPOs underperforms both relative to the OSEBX index and other IPOs, where especially larger IPOs exhibit severe underperformance in the five years following the public offering. While our full-sample regressions return insignificant negative excess alphas for backed relative to non-backed IPOs, time-varying rolling regressions display significant underperformance of private equity backed IPOs during both financial crises covered by our sample.

Preface

Our master thesis represents the end of a long and rewarding period of exciting research, and an end to a five-year study of economics.

We initiated our work by listing potential subjects of interest that both of us wanted to engage in. We quickly decided that corporate finance would represent the theoretical foundation, as both of us chose the major of financial economics. We both find Private Equity interesting, so we decided to pursue an empirical assessment of the long-run performance of Norwegian Private Equity- and Venture Capital-backed firms' post-IPO performance. Long-run underperformance of IPOs in general is a widely acknowledged and recurring phenomenon, while various studies claims Private Equity-backed IPOs have displayed significantly better aftermarket performance. Given Private Equity's growing magnitude and importance as an asset class, we considered the task as important and interesting, especially since the existing literature provided us with ambiguous results. Throughout the process, we have attained valuable knowledge about the industry, and important aspects of empirical research. Both of us enrolled in an econometrics course at NHH, to develop our understanding of varying techniques applied in the academic literature. Writing our thesis has been demanding, challenging, time-consuming and of course entertaining.

During the process of writing our master thesis, we have received valuable advice and assistance from numerous people. We appreciate the straightforward and precise feedback from our supervisor, Associate Professor Aksel Mjøs. In addition, we would like to thank Associate Professor Carsten Bienz for providing us with data on Norwegian Private Equity deals, and Nils Algaard for structuring and filtering the data series. Professor Thore Johnsen and Assistant Professor Francisco Santos have also contributed with important inputs concerning our methodological approaches and results, and for that, we are grateful.

Bergen, 19.12.2013

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Contents

2. Private Equity

Private Equity (PE) is a collective term for an asset class consisting of equity and debt, pooled in funds, and reinvested in privately traded companies. PE-funds often have a long-term perspective and usually apply an active ownership-structure to the invested firm. The main objective is to enhance firm value, usually through financial, operational, organizational and strategic improvements, prior to realizing the profits through various exits. PE usually sorts into two main categories depending on their position in the life cycle and future needs.

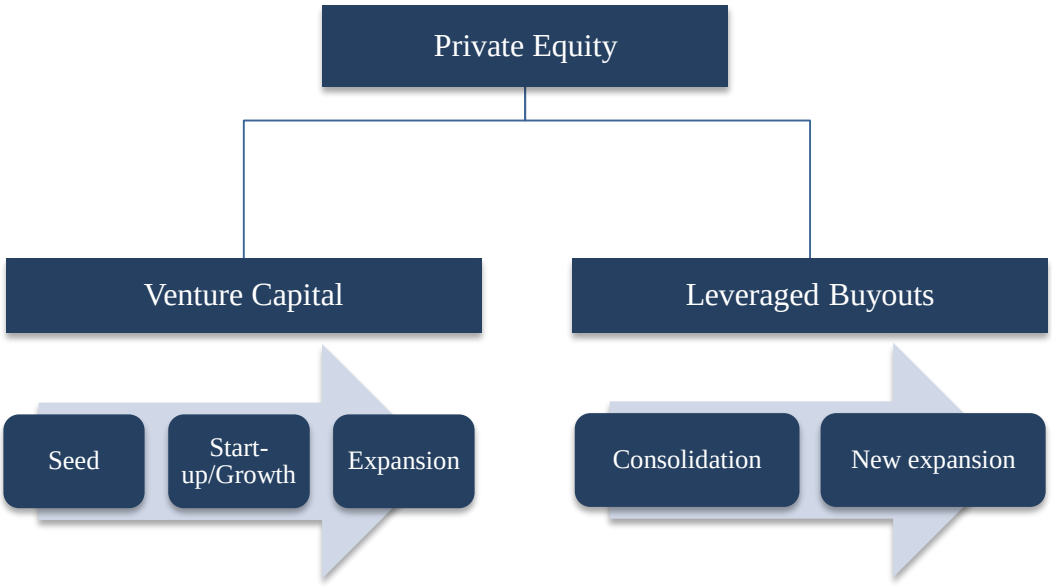

Figure 1.1) Categories of Private-Equity

ECON Analysis (2004)

Venture Capital [VC]

VC-funds invests in companies operating in the start-up or growth phase. In the former case, VCs supply capital and competence related to the development of business concepts and prototypes, while the latter case involves financing of further product/service development and introductory marketing. Newly established companies often have difficulties accessing the capital markets to obtain financing, due to lacking a financial history, marked relations, management- and organizational skills, tangible assets and earnings. This may deter the banking industry and other financial institutions, due to substantial uncertainty surrounding future earnings estimates. Private equity functions as an alternative way of accessing the

capital market, while simultaneously offering highly skilled and specialized human capital. This is often conditional on the fund obtaining a controlling share.

VCs aid further development and expansion, often undertaking a significant risk concerning market entry and expansion of new and/or existing markets. Companies in these stages often require expertise, enabling them to commercialize technology and distribute products/services to markets on a national or international scale. Further, VCs often specialize in selected sets of industries, which in turn determines the composition of their portfolios. International studies claim that VCs add value through; key-employee recruitment, identification of suppliers, development of customer relations and assistance in production. We elaborate on these results further ahead. Representatives from the VC-funds often serve at the company´s board of directors, reflecting their hands on approach, active ownership and management.

Leveraged Buyouts [LBOs]

LBOs occurs in the later stages of a firm's life cycle, often among companies that have had historically strong earnings, but due to market conditions or poor management, have experienced a recent- or prolonged downturn. LBO management teams often aim at development and restructuring to improve the strategy and operations of their portfolio firms. LBOs often leads to concentrated ownership, and the application of leverage is common, to overcome the free-rider problem, mitigate agency conflicts and align incentives, as proposed by Grossman and Hart (1980) and further developed by Müller and Panunzi (2004). In effect, financial structures often deviates from the market's norm levels. The application of leverage is not as pronounced among ventures, where contractual relationships with entrepreneurs are of higher-order importance.

In general, LBO- and VC-funds mainly operate outside the public capital market, which effectively limits disclosure requirements surrounding financial- and earnings statements. The funds usually acquires a controlling interest of the targeted company, and actively manage operations, while collecting a management fee and carried interest[1] for their services.

[1] Carried interest accumulates in addition to management fees, and usually amounts to 20 % of the fund's annual profit, subsequent to providing investors with an initially agreed upon rate of return. Management fees covers the costs of operating the fund, while the carried interest serves as the primary source of income for the fund's manager.

Concentration of ownership combined with carried interest reduces informational asymmetries and aligns incentives between management and owners/investors.

The roles of managers (General Partners [GPs]) and investors (Limited Partners [LPs]) separates in the following way; LPs provides capital, while GPs control daily operations. In contrast to public corporate structures, some claim that GPs are likely to manage their portfolio companies relatively more efficiently, due to incentives alignment and reduced agency conflicts.

In the following, we address LBOs as "PE", seed/ventures as "VC" and non-backed IPOs as "NB". "Private equity" refers to the cohort of seed, ventures and leveraged buyouts, applied when we do not distinguish between PE and VC.

2.1 Private Equity Funds' Structure and Organization

Below, we have illustrated how private equity actors typically organize their funds.

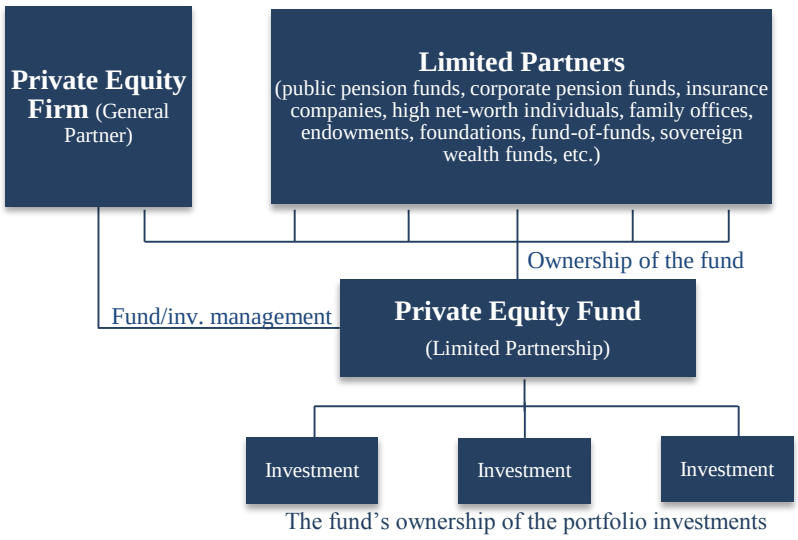

Figure 1.2) *Private Equity Structure and Organization*

Demaria (2010)

GPs and LPs fulfil distinct and separate roles. GPs are responsible for identifying attractive targets and maintaining everyday management. LPs do not influence daily operations as it might jeopardize their limited liability status, effectively inflicting responsibility beyond their

committed capital. Before and during the funds' lifetime, investors commit capital for several years, and might be subject to capital-calls[2] depending on the contractual relationship. Funds' maturities are determined in the contract regulating the relationship between GPs and LPs, and usually range from 8 to 12 years [Cendrowki et.al, (2008)]. The fund undergoes various stages, demonstrated by the figure below:

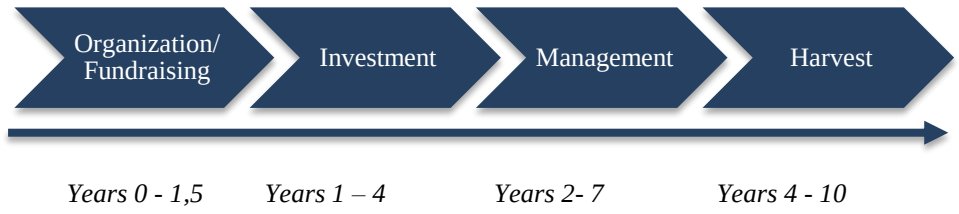

Figure 1.3) *Private Equity Funds' Stages*

Cendrowski et al (2008)

Organization/Fundraising: PE/VC-funds rarely trades on public stock exchanges, with the exception of a limited few. Hence, fund promoters have to pool money from investors by pitching their strategy and investment focus, which in turn determines their marketplace for investments. This includes industry, stage (PE or VC) and geographical focus[3]. These focus areas are held constant and rarely changes through the fund's lifetime without any collaboration with the LPs. Regulatory restrictions often limits PE/VC-funds' from marketing their fund raising, inducing "word-of-mouth" among LP-networks as the primary source of promotion.

Investments: GPs scout for firms, with the objective of finding suitable and potentially profitable investments, coinciding with their focus areas and strategies. Careful considerations of the potential for adding value is important. Often, PE/VC-actors' portfolios consists of few firms (fewer among PEs relative to VCs), due to limited input factors, such as human capital

[2] When LPs commit a certain amount of capital to a fund, the act of transferring the funds rarely occurs ex ante. Capital calls occurs when GPs require the LPs' committed capital, usually while awaiting favorable market conditions to provide attractive targets, in the intermediate period.

[3] E.g., Hitecvision, a Norwegian PE-actor, has chosen to focus their investments in the international oil and gas industry, primarily within small and medium capitalized firms in the oilfield services- and technology sector

and time, which in turn increases idiosyncratic risk. Syndication among VCs is common, as it mitigates this form of risk exposure. Usually, *one* VC-actor will initiate the lead and hold a controlling interest. Barry et.al (1990) finds that leading VCs on average obtain 19% ownership while the aggregated ownership by the syndicate is approximately 34%.

Management: After completing the investment stage, the management in charge of the targeted firm often experience replacements by professionals from the PE/VC-firm. Barry et. al (1990) presents results from the U.S. where, on average, one third of the board of directors is replaced by VCs. The authors also finds that VCs, on average, actively manages the established firm half of the lifetime before going public, and serves on the board of directors for an average of 35 months.

Harvest (divestments): Harvesting involves realizing investments by exiting positions within the portfolio firms. The most common exit strategies are; sales to strategic buyers, initial public offerings (IPOs) and repurchases by founders (buy-backs). In this stage, the LPs receives a return on their committed capital. We describe the exit strategies in detail in section 1.5.

2.2 History

The initiation of private equity dates back to 1946 with the formation of American Research and Development Corporation (ARD), a publicly traded, closed-end investment company. ARD was founded due to concerns of absent long-term financing for new enterprises, and the inadequate rate of new start-ups, stemming from the depression in the 1930s and the world war of the 40s. Financial institutions accumulated capital instead of reallocating among investors and entrepreneurs who had historically played a major role in funding- and starting small businesses. Additionally, ARD aimed at providing capital to new businesses with sufficient managerial expertise. The founders believed that management skills and expertise was equally important to new businesses as capital, in determining success or failure.

Private equity experienced a troubling start in the 50s and 60s, as rates of return declined due to centralized competition, originating from the U.S. governments' Small Business Investment Act of 1958. However, VC investments initiated during the 60s delivered abnormal positive

returns when exited through the "hot-issue" IPO-market during 1968-1969. The markets dried up in the 70s, resulting in acquisitions of large conglomerates for restructuring- and spin-off purposes. PE (LBOs) became a popular form of investment vehicle for facilitating takeovers. In addition, Limited Partnerships (LPs) was introduced as a new way of organizing investments (Fenn, Liang, and Prowse, 1995).

The 80s and the 90s, considered the first boom-years for private equity (in terms of fund-raising activity), followed favourable changes in regulatory frameworks and tax regimes by the US government. Capital flows surged to new heights, approaching $17.8 billion by the end of the 90s. PE grew rapidly, financed by high-yield debt, effectively driving the boom in PE-financing, while ending abruptly during 1989 – 1990. A new boom spurred with VC and the dot.com-bubble in the period of 1995 to 2000, primarily driven by speculation of institutional investors and easily available capital, causing rapidly rising stock prices. The bubble collapsed between 2000 and 2001. The period between 2003 and 2007 experienced a resurge of LBO deals, mainly due to decreasing interest rates, regulatory changes and loosening credit standards. This period saw 13 of the 15 largest LBOs ever performed, but it abruptly ended with the financial crisis of 2007 – 2008. Whether or not these deals created value remains an open question.

2.3 Adding Value Beyond Financal Capital?

How do private equity add value beyond being financial intermediates? This varies, and the literature focus on three main groups of activities: (1) Pre-investment screening (2) Monitoring and governance activities during the holding period, and (3) exiting activities.

2.3.1 Private Equity (PE)

Reduced Agency-Costs / New-Incentives Hypothesis

In Jensen (1989), the author argues that PE provides new management incentives, as demanding debt repayment schedules tightens operations, and reduces leeway for wasteful

spending and negative NPV[4] investments. Concentrated ownership further facilitate more effective monitoring than dispersed ownership.

Employee Wealth-Transfer Hypothesis

The theory hypothesizes that the value created from LBOs is at the expense of employees and suppliers in the form of layoffs, wage reductions and "squeezing". Shleifer and Summers (1988) coin it "transfer of wealth" when a PE-fund accrues value by acquiring firms and redistributing the wealth at the employees and suppliers expense.

Information Advantage / Underpricing-Hypothesis

Through superior knowledge and expertise, attained through detailed analysis, the buyout specialists may have attained more information about the company than other bidders have been able to. Because they have superior information, they can buy the shares for less than they would have had if the information were freely available.

Liquidity Premium

PE investments trades among privately held funds, hence they are often illiquied. The liquidity factor expresses risk associated with the speed at which investors may realize their investments to prevent/realize a loss/profit. Pástor and Stambaug (2003) seeks to find if the liquidity variable is important in explaining asset returns. In their paper, expected stock returns exhibit sensitivity to fluctuations in market-wide liquidity-measures. They provide evidence that the liquidity factor relates to expected excess returns unexplained by assets' sensitivities to the market-, growth- and value-factors. Illiquid assets display significantly higher returns and the spreads indicates that investors demand a higher risk-premium for holding less liquid assets. Pástor and Stambaug (2003) find that smaller firms, on average, exhibit less liquidity, while also having the highest sensitivity to aggregate market liquidity. Næs, Skjeltrop and Ødegaard (2011) provide insights from both Norway and the U.S. showing that liquidity provides information about the current and future state of an economy. They argue that trading of small capitalization firms decline during market downturns, as investors tilt towards larger firms, so called "flight-to-quality".

[4] Net Present Value: Measure of the present value of a projected cash flow less initial investments.

2.3.2 Venture Capital (VC)

Sapienza (1992) seeks to find if VC-backing adds value, beyond observing post IPO stock returns. In the article, it is argued that performance positively correlates with VCs involvement; those who maintain frequent and open communication while minimizing conflict are the most effective VCs. Neither CEO experience nor ventures' stage proved to inflict any impact on the value added, on any statistically significant level. When contributing with expertise, experience and knowledge the VCs adds more than capital.

Hellman and Puri (2002) explore how VCs assists their portfolio firms in achieving a more professional approach to business, providing evidence from Silicon Valley start-ups. When analysing the sample they find several recurring actions that they claim adds value:

- Adding a marketing VP to the firm
- Implementing human resource policies
- Adding stock options plans
- Replacing inefficient managers

They also stress the fact that competent VCs are highly skilled in screening firms and are able to identify and separate firms that are innovating from those who are imitating. Having a VC present also aids the portfolio company in distributing its products/services to relevant markets in an efficient and profitable manner.

	VC	**PE**
Target Companies	High risk, start-ups	Underperforming, undervalued
Sectors	Mainly information technology, biotech., and clean-tech.	Across all industries
Share of Ownership	Aquire a minority stake, less than 50%	Aquire 100% of the company
Aquistion Structure	Equity	Combination of Equity and Debt
Life-Cycle Stage	Early-stage companies	Mature, public companies
Size	<$10 million	>$100 million
Horizon	7-10 years	4-10 years
Claimed Contributions	Human relations, network of connections, managment expertise	Operational improvements, management expertise
Portfolios	Multiple firms	Few firms

Table 1.1) *Key Differences Between VC (seed/start-ups) and PE (LBOs)*

2.4 Private Equity in The Nordic Countries

Unbiased information related to private equity in the Nordic region is not easily attainable, as the PE/VC- and related sectors themselves disclose the lion's share of available information. Where possible, we have made an effort in displaying neutral data and information. In this section, we will describe how the Nordic region differs from the U.S. region, while also elaborating on the state of the Norwegian market and its neighbours. The Nordic countries here include Norway, Denmark, Sweden and Finland.

2.4.1 How Nordic Private Equity Differs from U.S. Private Equity

Spliid´s (2013) article study differences between the Nordic countries and the U.S. Existing literature on private equity mainly centres on U.S conditions, theory and data. Suman, Sharan, and Sachan (2012) examine the state of private equity research for the past seven years by studying 284 papers published in the period of 2005 to 2011. The bulk of the data originates from the U.S and the United Kingdom[5].

Investment Environment

- The size of the Nordic M&A market, relative to GDP, is one third lower than in the U.S.
- The stock market is smaller in both size and depth, expressed by market capitalization and trading volume, relative to GDP.
- The judicial systems in the Nordic region is based on civil law, while the U.S system is based on common law.
- Less connection between productivity and pay, wage determination is more inflexible.

Fundraising

- Domestic investors represents the main source of funds for the U.S private equity market. Nordic countries needs to attract international investors to obtain sufficient funds.

[5] 48.2% originates from North America and 31.7% from Europe.

2.4.2 History of Norwegian Private Equity

Norwegian private equity is a relatively new asset class compared to the status of private equity on the international arena. We saw the first signs of a PE-market in Norway during the early 80s. An extensive state ownership structure and a relatively small stock exchange, contributed towards limiting the private equity market prior to this period. Additionally, deregulation of the credit market occurred quite late in Norway, compared to the rest of the western world. Prior to deregulation, the government restricted available credit to the overall market, while simultaneously allocating cheap credit, high-risk loans, subsidies and guarantees freely to a few selected industries. Combined with an overall highly levered traditional industry, the leeway for a well-functioning private equity market narrowed. These practices lasted until the early 80s. Further, with the exception of the most pronounced industries, energy, fish and shipping, there were few sectors large enough to support specialized asset management groups, effectively deterring foreign private equity-actors in obtaining a foothold.

Surrounding 1990, the Norwegian government intensified its focus on strengthening the capital markets, due to concerns of low equity ratios in the industrial sector. Consequently, it founded "Norsk Venture AS" [(*Norwegian Venture AS*), later Norsk Vekst AS (*Norwegian Growth AS*)], in 1989 with a 49 percent state ownership. The government aimed at raising equity to the Norwegian business sector by combining state-, private- , and commercial bank capital with expertise. The governments' involvement with private equity further expanded with the founding of SIVA, which provided high-risk financing to start-ups in the Norwegian sector. Argentum AS was established in 2001, a fund-of-funds enterprise, investing indirectly through other private equity-funds. Additionally, industrial conglomerates such as Orkla, has historically contributed towards increasing the frequency of M&As with the purpose of active ownership and brand management, similar to private equity.

2.4.3 Private Equity Actors

Management companies located in Norway		
Seed	**Venture**	**Buyout**
Atech Management AS	Alliance Venture	Altaria/Foinco
Bølgen	Convexa	Borea
Campus Kjeller	Energy Future Invest	Credo Partners AS
Fjord Invest	Energy Ventures	FSN Capital Partners
KapNord	Ferd Capital	Herkules Capital
LEN/Såkorninvest Midt-Norge	ICON Capital Group	HitecVision
Midvestor Management	Incitia Ventures	Marin Forvaltning
Norinnova Forvaltning	Kistefos Venture	NorgesInvestor
Procom Venture	Kverva	Norvestor Equity
Pronord	Mallin Venture AS	Progressus Management
ProVenture Management	Maturo Kapital	Reiten & Co
Sarsia Seed Management	Neomed Management	**Number of companies: 11**
Sinvent / SINTEF	Northzone Ventures	
Spring Management	Sarsia Management	**Foreign Funds with office in Norway**
Sydvestor AS	Skagerak Venture Capital	Altor Equity Partners
	Teknoinvest	CapMan Norway
	TeleVenture Management	EQT Partners
	Verdane Capital	Nordic Capital/NC Partners AS
	Viking Venture	Ratos AB
Number of companies: 15	**Number of companies: 20**	**Number of companies: 5**

Table 1.2) *Overview of Private Equity Companies Located in Norway 2011*

NVCA (2011)

NVCA defines a Norwegian PE firm as; "…a fund (GP) with headquarters located in Norway." (NVCA, 2011). As of March 2011, there were a total of 46 Norwegian- and 5 foreign PE firms located in Norway. We display fundraising according to investor type during 2012, in Figure 1.5.

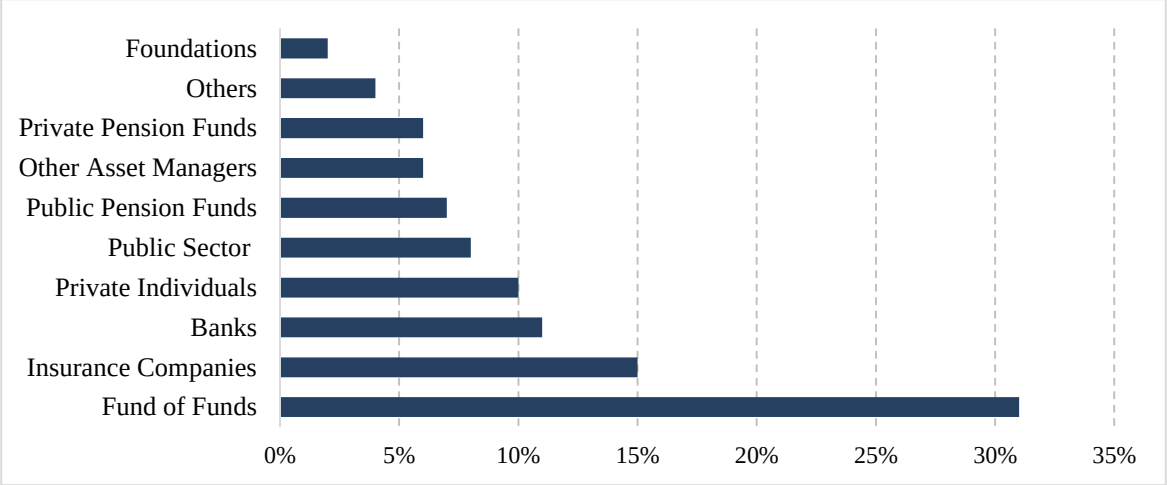

Figure 1.5) *Fundraising According to Investor Type in Norway (2012)*

NVCA (2012)

Fund of funds represent the largest fund contributors, with over 30% of the investments in private equity, followed by insurance companies and banks. Foreign investments allocated to Norwegian private equity-funds typically originates from fund of funds' investments. We have not been able to obtain data on ownership dispersion for fund of funds.

2.4.4 Market Characteristics

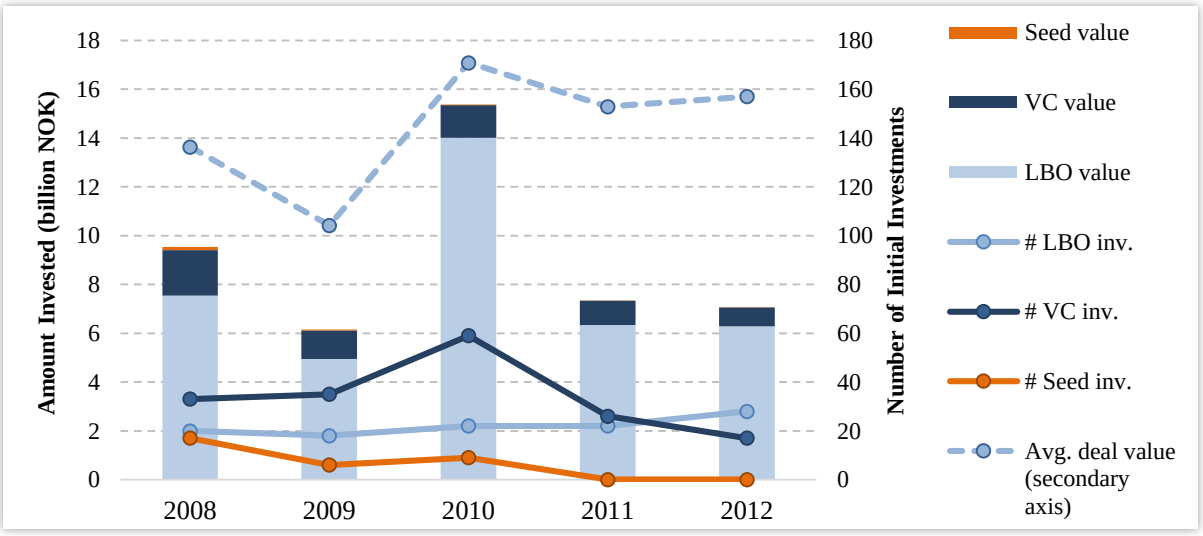

Figure 1.6) *The Norwegian Market's Characteristics*

Total value amount of investments, by phase (Norwegian and foreign Private Equity firms), in Norwegian enterprises. Number of initial investments and aggregated average deal value across all phases at the right axis. (NVCA, 2012)

Figure 1.6 displays the total value amount invested in Norwegian enterprises, reflecting a heavily represented buyout segment. Seed investments are almost non-existent, both in terms of allocated capital and number of investments, at least during 2011 and 2012. Considering the takeover dynamics of mature companies through LBOs (PE), especially regarding capital requirements, the emerging picture seems logical. The lines with markers indicates the number of initial investments, which makes the contrasts in terms of capital intensity even more pronounced. Ventures are most numerous in almost all years, but converges towards LBOs, which surpasses ventures by 2012. Seed investments have experienced an almost continuous decline during the last five years, exhibiting none during the two last years. Below, we have segmented each measure of average deal value[6]. It seems, during the last years, that increased capital allocation to LBOs has expanded average deal size quite heavily, while keeping the number of transactions constant, as displayed in Figure 1.6.

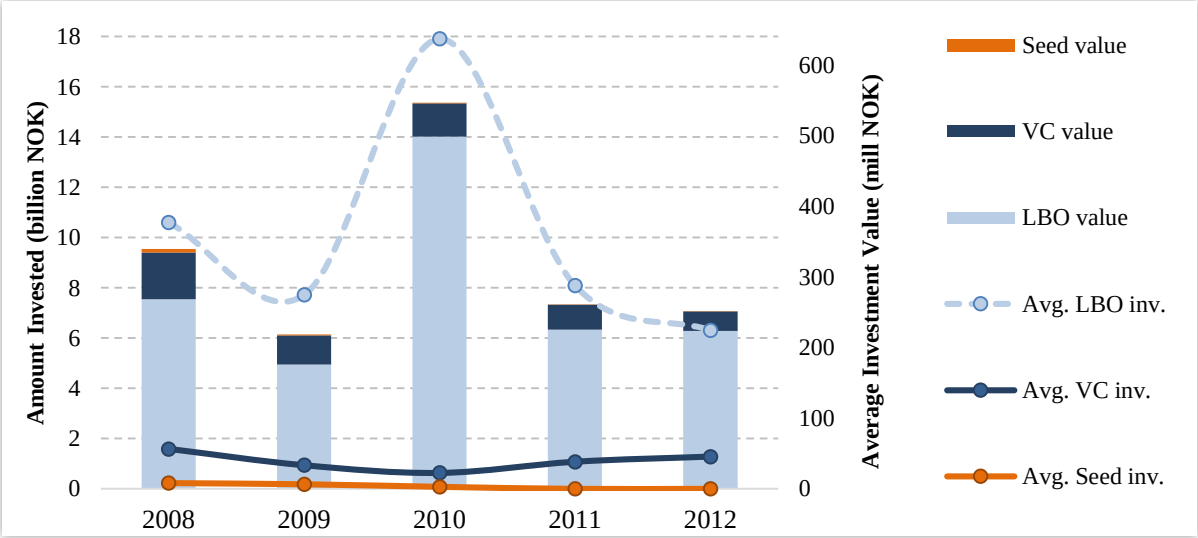

Figure 1.7) *Capital Allocations by Phase and Average Investment Value*

Total amount of investments by phase, both Norwegian and foreign PE-firms, and average value of initial investments, by phase. NVCA (2012)

VC deals exhibit a different pattern; variation in aggregated investment value seems to precede/follow an increase in the number of deals, while reducing the average deal value, and

[6] NB: The topmost line indicate average deal value across all segments, in million NOK, but has its reference point from the secondary y-axis, for convenience purposes.

in effect more evenly allocating capital among investments. For seeds, all these measures positively relates to each other.

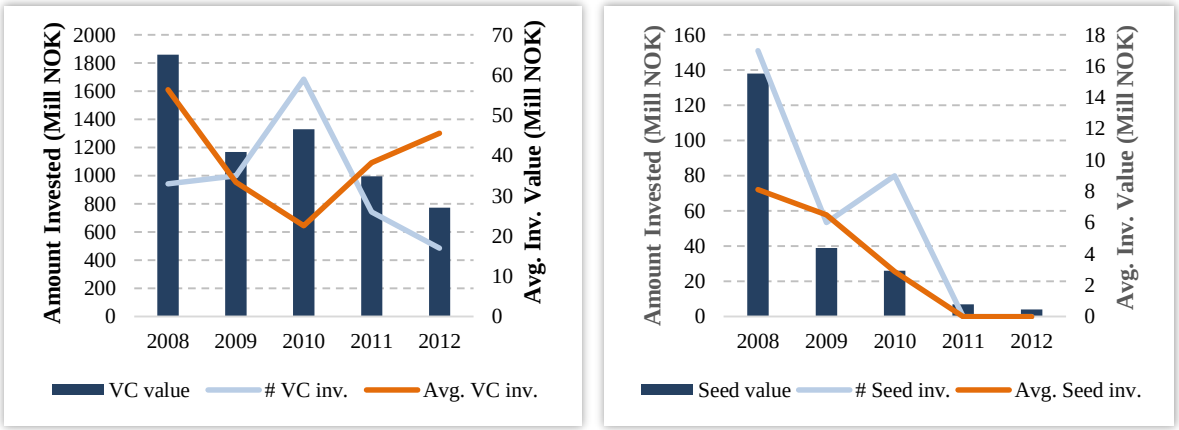

Figure 1.8) *Differences in Capital Allocation Between VC- and Seed Investments*

Total amount of investments by phase, both Norwegian and Foreign PE-firms, and average value of initial investments, by phase. (NVCA, 2012)

The axes have the same interpretation as in Figure 1.7. The Norwegian private equity sector depends on international funding, supported by NVCA's market survey in 2012, indicating that more than half of Norwegian private equity-funds' capital accrues from investors abroad. The trend in foreign to domestic capital-ratio is steadily increasing, except from the recent abrupt decline during 2012.

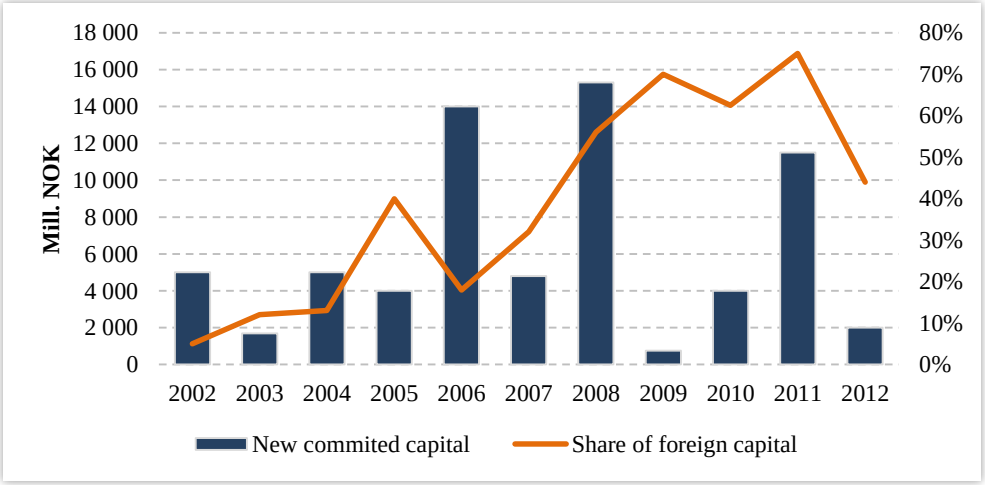

Figure 1.9) *Foreign Capital´s Share of New Committed Capital 2002-2012.*

(Source, NVCA 2012)

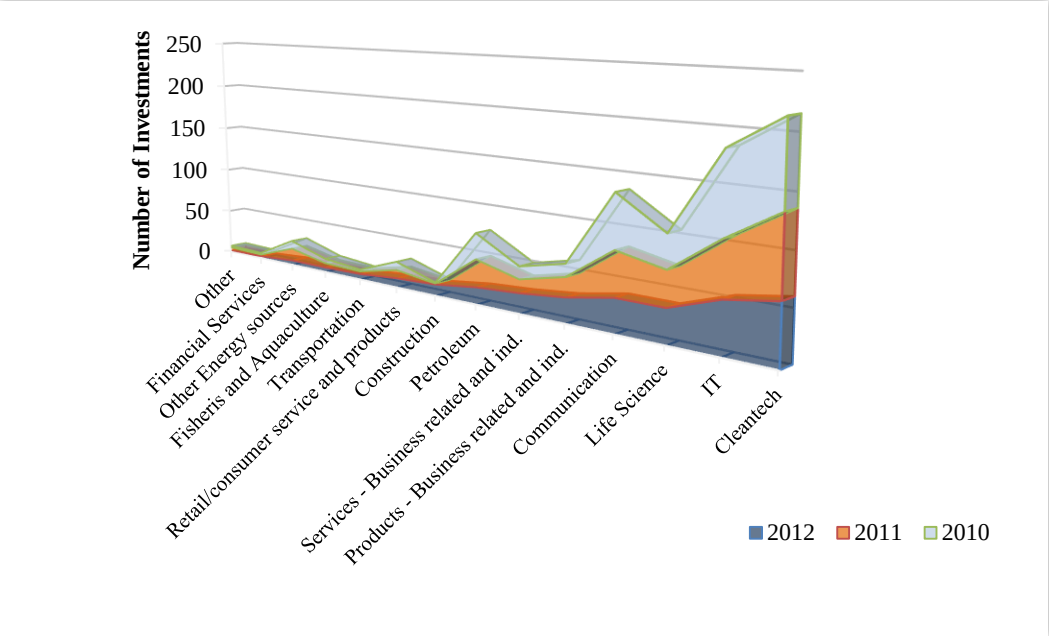

Figure 1.10) *Number of Private Equity Investments by Sector*

(Source: NVCA,2010, 2011, 2012, modified)

National and international private equity funds invests most frequently in the information technology- (IT) and cleantech sectors, followed by life sciences and communications, as demonstrated by Figure 1.10[7]. The pronounced involvement of PE/VC-funds within these sectors differ somewhat from the international arena, as the dominant positions of petroleum and cleantech (renewable energy/ environmental technology) reflects Norway's exposure to natural resources. The extensive focus on IT is commonplace, also internationally, as a combination of low capital requirements, no physical barriers, potential of relatively high returns and growth tend to attract investors. Clearly, this also promotes intense competition.

Das, Jagannatha and Sarin (2003) study 23 208 unique firms from the US market and identifies the top five industries characterized by heavy PE/VC involvement. IT, life science, and biotechnology account for over 60% of the total number of investments, which is similar to the Norwegian distribution, except for the heavy tilt towards cleantech.

[7] The numbers are corrected for companies where funds have co-invested; each observation represents a unique company.

2.4.5 Recent Development and Forecasted Trends

The Nordic private equity market's assets has grown substantially the last decade. In 2011, approximately EUR 79 billion was under the Nordic countries' asset management, measured as capital allocated from investors to funds. Compared to 2003 the assets amounted to approximately EUR 32 billion. (Argentum, 2013)

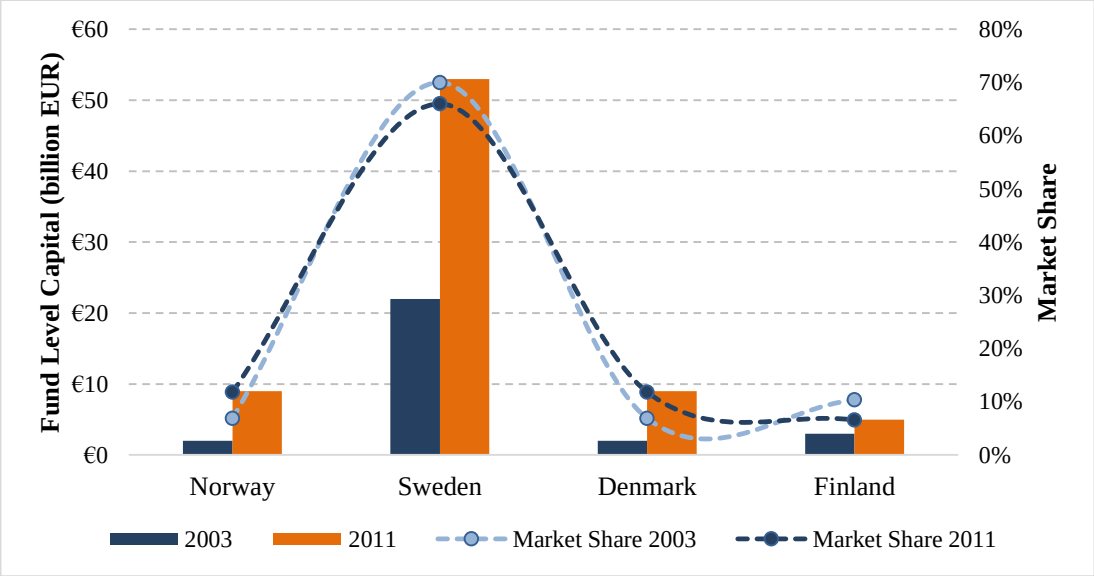

Figure 1.11) *Assets Under Management, Nordic Private Equity-funds, 2003 vs. 2011, and Relative Market Share Within The Nordic Market*

Argentum (2013)

Sweden has a dominant position among the Nordic Countries, here defined as Norway, Sweden, Denmark and Finland. However, by 2011 the Swedish market share of the total PE-market in the Nordics fell slightly to approximately 66 percent from a share of 70 percent in 2003. Denmark and Norway experienced the highest growth to approximately EUR 9 billion assets under management in 2011 (Argentum, 2013).

2.5 Private Equity Exits (Divestments)

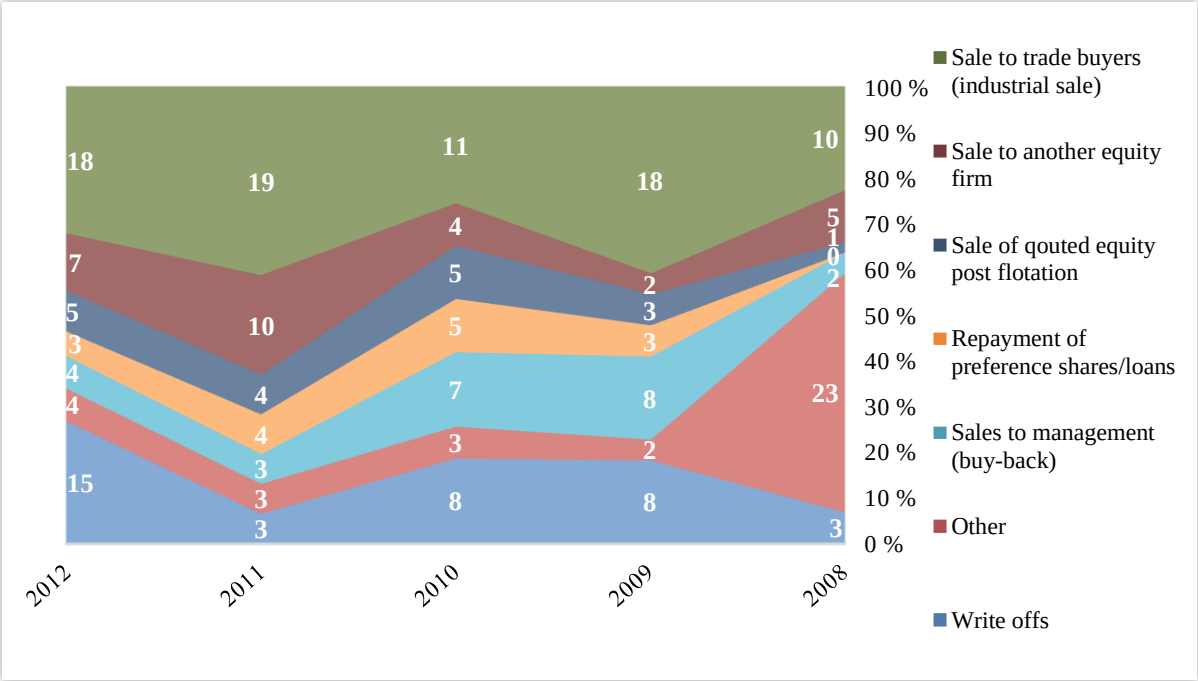

Figure 1.12) *Overview of Divestments[8] (IPOs included in "Other")*

Source (NVCA, 2008 – 2012)

Divestments involves the process of realizing investments, fully or partially, through a wide variety of possible exit routes. The execution of exits determines the success of the funds' involvement, and the method, timing and investor-approach requires careful planning in order to maximize shareholder value. Several considerations have to be taken into account; current market conditions, equity- and debt-markets conditions, deal flows, industry sales multiples and P/E ratios are some examples of qualitative and quantitative measures often applied to determine the attractiveness of a potential exit. For detailed overview of IPO-exits, confer Table 4.1.

[8] Each category's color, from top to bottom, correspond to the list aligned at the right, in ascending/descending order.

2.5.1 Secondary Sales

Secondary sales involves keeping the portfolio company privately held, either through allocating to another private equity fund or through a trade sale, often performed in cooperation with large industrial actors pursuing attractive targets that are able to provide synergies.

To Another Active Fund

These transactions involves sales to other private equity-funds with the goal of further development. The empirical evidence on the relationship between private equity-fund sponsorship and market sentiment exploitation is ambiguous. However, as a general trend, these transactions occur most frequently during market downturns, as public equities often exhibit poor performance.

To Financial Institutions

Sales to financial institutions, other than private equity-firms, most often pension funds, endowments, foundations, banks, insurance companies and various professional asset managers.

To Industrial Establishments (Trade Sales)

The most common exit in both the U.S. and in Europe, entailing a process of share transfers, most often to strategic buyers pursuing inorganic[9] growth strategies and synergies with existing operations. Trade sales represent the most frequently applied exit route also in Norway, as illustrated in Figure 1.12.

2.5.2 Liquidation

Liquidation, or write-offs, is the worst-case scenario, involving a full or partial deterioration of the initial investment. Write-offs experienced a heavy increase in 2012, coinciding with the abrupt decrease in allocation of capital to the fund level, displayed in Figure 1.9.

[9] Inorganic growth originates from mergers and acquisitions, take-overs, foreign exchange movements etc., as opposed to organic growth, which involves business expansion by increasing the overall customer base, output per customer or sales applying assets already in place.

2.5.3 Repurchase by Founders (Buy-Backs)

Private equity-funds may sell their equity stake back to the founders of the company, dependent on their ability to attain sufficient financial support from external financial intermediaries. This process is almost identical to a regular management buyout (MBO), besides that management now has received external business plan revisions prior to the take-over, potentially improving operations in the future. The founders are able to facilitate transfer of ownership using an investment vehicle consisting of their initial stake and a shell company with a liability attached to it, ultimately secured by the target company's assets. This way, they are still able to mitigate agency conflicts through concentrated ownership and aligned incentives, in the same manner as through PE/VC-involvement. This form of exit has occurred relatively frequently in Norway during recent years. It might represent a feasible exit route during poor equity market conditions, where IPOs offer poor returns for both the management fund and the entrepreneurs, and where alternative buyers are scarce. The market has experienced two crises during our sample period, which helps explain the rising popularity of this particular exit.

2.5.4 Share Sales (IPOs)

Share sales through IPOs often, in general, coincide with favorable market conditions, demonstrated by most studies previously engaged with the subject of "hot issue" markets[10]. Whether or not PE-funds exploit market sentiment to the same extent as non-sponsored IPOs remains an open question, as the existing evidence leaves an ambiguous impression. We will look into this subject ahead.

Commonly sighted motivations for IPOs are; increased liquidity, diversification, M&A-currency[11] and more easily accessible capital. Still, there are several disadvantages of going public, like dispersion of ownership, poorer management monitoring, misalignment of incentives between management and shareholders, high costs (both directly and indirectly),

[10] "Hot issue" markets refers to observations of a positive relationship between IPO volume and favorable market conditions in the form of high valuation multiples and overvalues equities.

[11] Obtaining a noted stock price enables the company to pay with/exchange shares when performing mergers and/or acquisitions.

and also increased transparency (unattractive from a competitive point of view) and costly regulatory requirements, rendering the motivation behind the decision of going public somewhat unclear. These issues, which we discuss in depth in section 2.2, gives rise to several IPO puzzles, which we elaborate on in section 2.3. The next section thoroughly explains the IPO process, IPO puzzles and the mutual relationship between the involved parties.

3. Initial Public Offerings (IPOs)

"The process of selling stock to the public for the very first time is called an initial public offering (IPO)".

Berk and DeMarzo (2011)

This statement neatly defines IPOs, but in order to obtain an understanding of factors driving the decision to go public, and also the processes surrounding the preliminary workings and post IPO precedures, we have to widen our theoretical framework. Below, we have cited a timeline created by Deloitte, illustrating the typical progress of a Norwegian IPO, pre offering.

3.1 The Mechanics of IPOs in a Norwegian Perspective

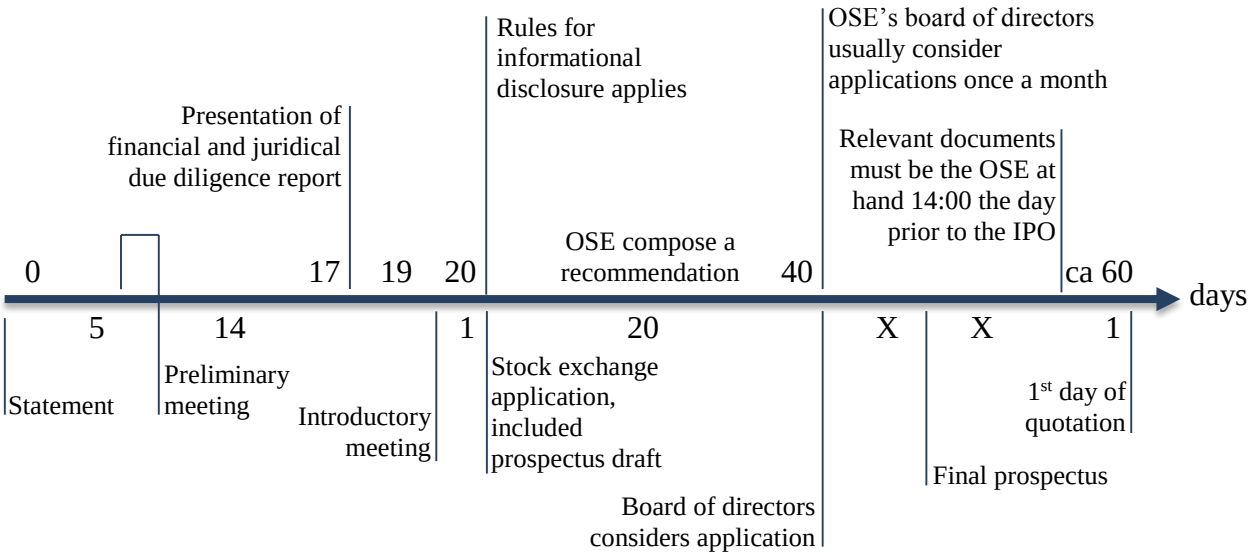

Figure 2.1) *Application Process*

Deloitte, "IPOs – The road towards the stock exchange and company requirements post flotation"

Through this section, we will focus on information relevant for the Norwegian IPO market, supplemented with input from international studies. Our review closely follows that of Deloitte's comprehensive examination of the Norwegian IPO process. We elaborate on Figure 2.1 under section 2.1.3, but prior to this, some information on the differences between the two largest authorized Norwegian market places follows, as the requirements for listing differs.

3.1.1 Authorized Norwegian Market Places

Oslo Stock Exchange (OSE), founded in 1819 in Christiania, historically focused on commodities and foreign exchange before entering securities trading during the latter part of the 19th century. Today, the exchange splits into OSE, Oslo ABM and Oslo Axess. We dismiss Oslo ABM, as it is a market for bonds and certificates, while we describe OSE and Oslo Axess below. Both are subject to an overrepresentation of companies engaged in energy, shipping and seafood.

Oslo Stock Exchange (OSE)

OSE (2013) states that the energy sector constitute around half of the market values listed, the market for shipping stocks is the largest in Europe (2nd in the world) and the seafood sector is also world leading. There are 167 companies listed on OSE, and the aggregated market capitalization of all companies were NOK 1392 billion by the end of 2012. Around 80 percent were distributed among the top 10 companies, illustrated in the graph below. Statoil, Yara International, Norsk Hydro, Orkla, Aker Solutions, Marine Harvest and Aker comprises 50 % of the total market value of all companies listed on OSE, reflecting the high concentration of energy and commodities.

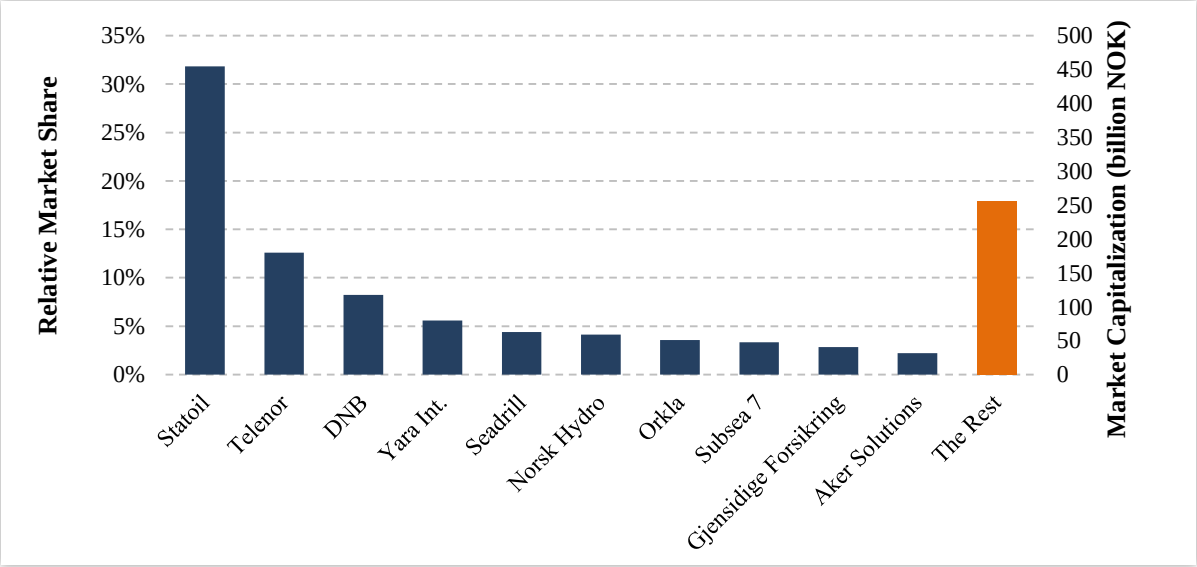

Figure 2.2) *Distribution of Market Capitalization on OSE (31.12.12)*

Oslo Stock Exchange

Concerning the distribution of IPOs across sectors, both on the OSE and Oslo Axess, Figure 2.3 illustrates a composition tilted towards energy, traditional industry and IT/telecom. Additionally, IT/Telecom and shipping displays display fewer, while larger IPOs, than many of the remaining sectors.

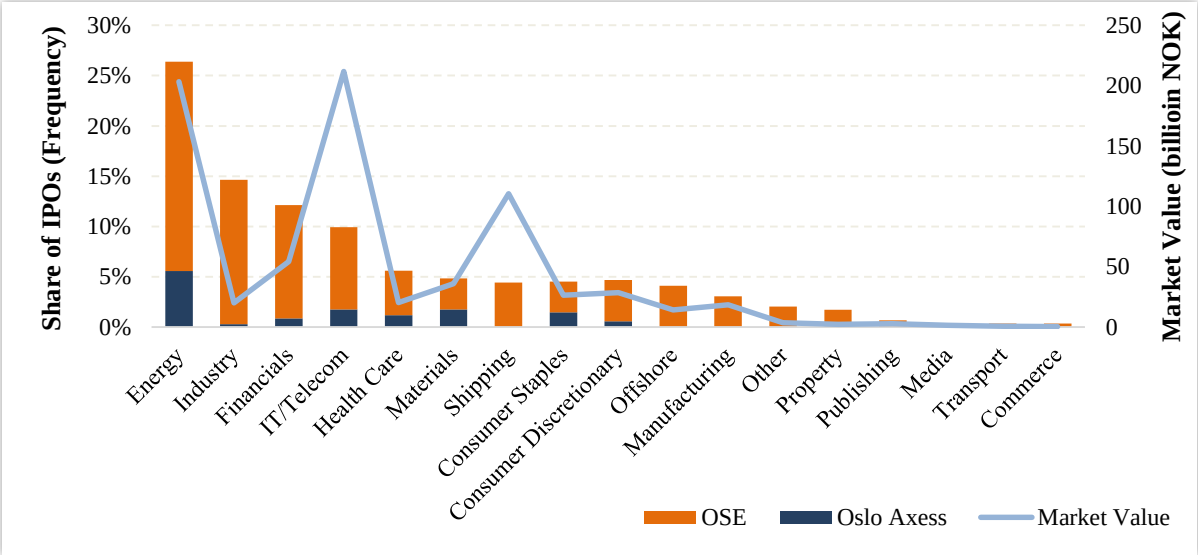

Figure 2.3) *IPOs; Sector Composition (1996-2010)*

Oslo Stock Exchange

Oslo Axess

OSE fully complies with EU-regulations, while Oslo Axess is a less stringent market place, accessible for companies of a smaller size and shorter history. Oslo Axess was initiated in 2007. We have listed *Terms for Quotation* found at OSE's home pages below.

	OSE	Oslo Axess
- Dispersion (Share of public equity dispersed amongst public stakeholders)	25 %	25 %
- Number of stock holders that each must own over NOK 10.000 of stock	500	100
- Minimum market value (mill NOK)	300	8
- Positive EBITDA the last three years?	No	No
- History and operations	Three active years Exemptible	One yearly- or interim report, operations plan
- Pre commercial companies	Cannot list Exemptible	Suitability evaluation
- Price floor per stock	NOK 10	NOK 1

The accumulated market capitalization's ratio of the top ten firms listed on Oslo Axess is approximately the same as on OSE, 79 %, but more evenly distributed, as Statoil ASA weighs heavily on OSE. There are 33 companies listed on Oslo Axess by December 2013.

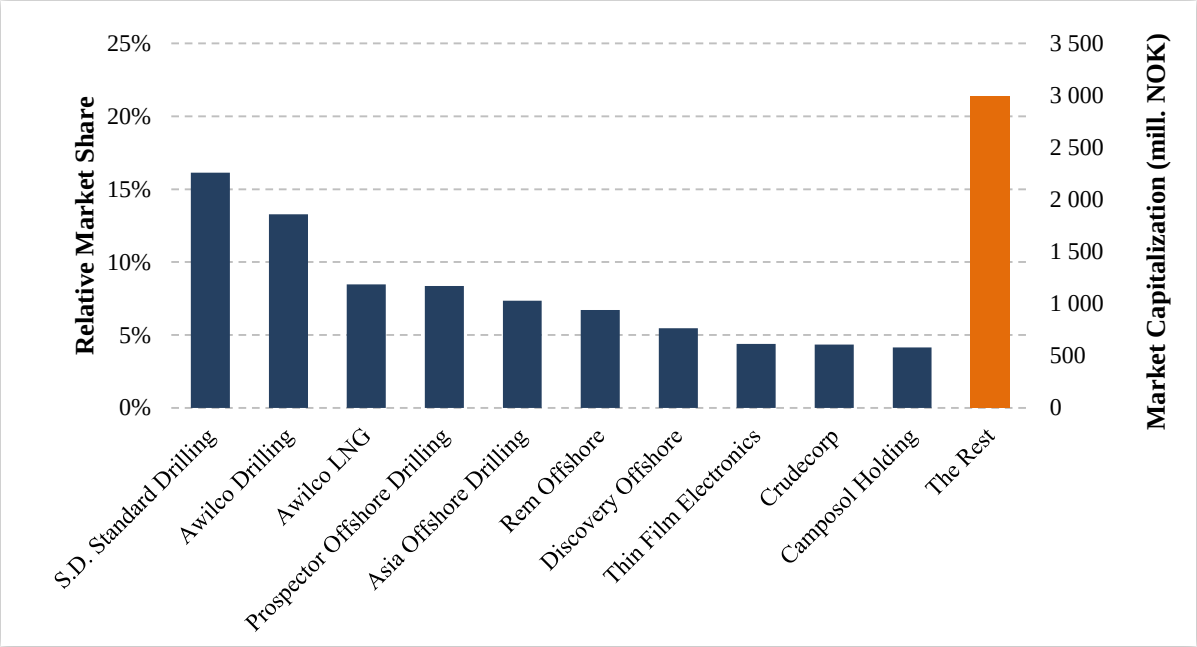

Figure 2.4) *Distribution of Market Capitalization on Oslo Axess (31.12.12)*

Oslo Stock Exchange

3.1.2 Evaluations Prior to an IPO

Through an IPO, companies achieve liquidity, diversification and access to capital through seasoned issues. Even so, there are several disadvantages of an IPO, elaborated under section 2.2.4-2.2.6. Firms need to evaluate market timing, company maturity, growth prospects, regulatory requirements, reporting standards, needs for capacity and internal expertise. Usually, companies start the preliminary work one or two years prior to the offering.

3.1.3 Application Process

The section refers to Figure 2.1, which indicate the extent and order of preliminary workings prior to the offering. The stylized timeframe is purely for illustrative purposes, as some IPOs are substantially more time-consuming.

Statement and OSE Meeting Before Application Processing

Prior to delivering an application, the firm's management and the board of directors of OSE hold a preliminary meeting, clarifying the following conditions:

1) Business concept and planned operations
2) Management and administrative board
3) The firm's economic situation
4) Accounts and accounting principles, and also competence within financial reporting
5) Available resources for handling reporting- and informational requirements post IPO
6) If possible, any capital increases and distribution sales expected to be completed
7) Potentially planned stabilization and needs for admission requirements exemptions
8) Information and stock holder policies
9) If an alternative application for notation at Oslo Axess is of interest

No later than five days prior to the meeting, OSE demand a written statement of whether or how the conditions for admission are/will be fulfilled.

Preliminary Meeting, Application and Processing

The management precede the IPO application by attending an introductory meeting arranged by the OSE, where the firm's management is informed about the obligations that follows a public listing. The company must use a standard form of application, supplied by the OSE, and signed by the firm's board of directors.

Prospectus

The main purpose of the prospectus is to describe the relevant aspects of the issuer company, to enable current and future investors in making informed assessments of their demand. The regulatory framework surrounding IPO prospects are meant to enhance capital market efficiency through increased confidence and greater harmonization with the EU.

Fast Track-Listing

For companies that want a faster and/or more custom listing process than described above, the OSE introduced with effect from first of July 2012 a compressed process, "fast track-listing". In optimal situations, this means that the processing time can be reduced down to four weeks, at an introductory fee equal to three times the normal fee.

Quotation

The company is admitted to listing after the OSE Board's decision is published and all conditions are met. The President and CEO then makes decisions about which day the stock will be listed.

3.1.4 Financial Reporting

Listed companies are normally required to prepare consolidated financial statements and interim financial statements in accordance with IFRS, as adopted by the EU. In addition, the Norwegian Accounting Act sets some specific requirements beyond IFRS requirements, typically information on executive compensation, options and the like.

The effects and extent of the restatement to IFRS will depend on the industry and the complexity of the individual company. In addition to the direct effects of the external reporting, the transition to IFRS could also affect the internal procedures and processes, such as budgeting and internal reporting and monitoring. It is also a requirement that listed companies must submit interim reports for each quarter during the year, specified and presented in accordance with the requirements of IFRS.

3.1.5 Disclosure Requirements

Listed companies are placed under the Securities Trading Act, adopted by the OSE, and subject to a number of requirements, particularly in relation to transparency and information. The requirements are essentially the same whether the listing takes place on OSE or Oslo Axess, and involves the following issues:

1) *Transparency*, ensuring that all participants have access to information simultaneously.
2) *Insider Information* regulations ensures that no one are able to profit from publicly undisclosed information.
3) *Profit Warnings* is to be published when there is reason to expect a result that is significantly different from what has previously been announced.
4) *Changes in Capital, Dividends, Mergers and Demergers* are all transactions that shall immediately be made public by the firm.

5) *Agreements with closely related parties,* like companies in the same concern, are required to be disclosed immediately.
6) *Agreements involving larger acquirements or disposals* are subject to expanded disclosure requirements, when exceeding certain thresholds.
7) *Changes to the Board and of auditor* should be published immediately.
8) *General Meetings* are required announced 21 days prior to date the meeting takes place, both by mail and through at least one national newspaper.

3.1.6 Underwriters

Underwriters of an IPO aids the companies that hire them in marketing the issue, performing valuations, filing necessary reports and allocating shares. Often, this process calls for a syndicate of underwriters, where the lead underwriter offers the lion's share of advice and others assist with marketing and sales related issues.

Underwriters' services provided during an IPO also includes a market-making role, guaranteeing that the stock remains liquid during the initial stages of the offering. Often, the underwriters also guarantees for the whole issue at a given price, and hence; acts as an insurer, a service often referred to as "the underwriters put". Greenshoe provisions (over-allotments) limits the underwriters downside potential, while simultaneously facilitate an immediate liquid market for the issuing companies' stock. The Greenshoe provision enables the underwriter to issue additional stock at the original offer price, limited to a fixed share of the initial issue, often 15 %. Both the initial issue plus the Greenshoe provision are put up for sale, enabling the underwriters to cover their short position if the issue is successful, or turn around and support the stock price through supporting purchases, if the issue fails.

Valuation

There are primarily two ways of performing a valuation of a non-listed company; 1) discounted cash flow-analysis (DCF) or 2) using comparable industry peers or recent representative IPOs. Often, underwriters employ both methods to arrive at a reasonable price range, in close collaboration with the issuing firm. Both methods are flawed, and none of them account for generally overpriced industries. Especially the DCF method is sensitive to overly optimistic estimates of industry growth rates, as this will have a large impact on the terminal

value for the last forecasted year. When the initial price range is set, the underwriter prepares a road show and a book building process, detailed below.

Book Building

Prior to the book building process, the underwriters often performs a road trip in cooperation with senior management, to create publicity, pending the informal bidding process taking place afterwards. Subsequent to the road trip, underwriters receive share allotment orders and allocate according to each respective part's willingness to pay, which in turn incentivize their largest investors to state their real price. Other mechanisms include auctions and fixed price issues, but book building is by far the most widespread method.

Risk Management

Auctions have yet to become widespread for IPOs, so the underwriter often enters into an agreement of a *firm commitment*, meaning that the underwriter purchase all the outstanding stock, adjusted for their fee, and resell it in the secondary market. This entails an exposure to declining stock prices, which obviously creates an ex ante incentive to underestimate the true value of the issuing company's stock. This is yet another cost carried by the issuing company's owners, further emphasizing the puzzles surrounding why companies willingly incur them.

For the vast majority of IPOs, the stock price increase during the first day of trading, reducing the risk carried by the underwriter. Loughran and Ritter (2004) find that, between 1990 and 1998, only 9 % of U.S. IPOs experienced a negative stock price development, 16 % ended at the same price, while the rest experienced positive first-day returns. These ranged from an average of 7 % in the 80s, 15 % in the 90s to 65 % during the dot.com-bubble years following the millennial change, while reverting to 12 % during 2002-2003.

3.2 Pros and cons of performing an IPO

Going public involves both advantages and disadvantages, some of which Berk and DeMarzo (2011) briefly mentions and which we will elaborate on. Textbooks within the field of Corporate Finance often touches on the subject, but rarely supply in-depth and nuanced explanations of observed practice.

3.2.1 Liquidity and Diversification

Going public enables the owners to liquidate their stake and diversify their holdings, an attribute often perceived as a major advantage. In addition, management funds depend on well-functioning markets that enables them to realize their investments within a set timeframe. Pagano, Panetta and Zingales (1998) mentions liquidity as a motivation for going public, due to diminishing trading costs and a widening scope for diversification.

3.2.2 Access to capital

One of the main reasons for performing an IPO is to gain easy access to capital in addition to obtaining a market price for the company's shares. The usual textbook doctrine postulates that an IPO represents a natural stage in a firm's life cycle, often necessary to pursue further growth options. Pagano, Panetta and Zingales (1998) on the other hand observe substantial deviations that are difficult to interpret in the light of this limited insight. They observe that large corporations in advanced capital markets – like UPS and Bechtel in the US – are being privately held. On the other hand, in Italy, companies are most commonly publicly traded. Using Italian companies as a benchmark, they claim the results are applicable to all of continental Europe due to similar ratios of equity markets to GPD and in terms of IPOs per capita, across countries. They find, somewhat surprisingly, that companies do *not* go public to finance growth, but rather to rebalance their accounts after periods of high investment and growth. Rebalancing involves bringing a portfolio that has deviated away from its target asset-allocation back into line, by either investing in underweighted securities or realizing overweighed ones. This result applies for several other European economies, but contrasts with American data.

On the other hand, debt financing seemed to be more readily available after the companies went public, as stricter disclosure requirements causes scrutiny and transparency. This will, in return, ensure increased competition amongst external lenders and reduce the cost of debt, increase supply of capital, or both, mentioned in Rajan (1992).

3.2.3 Dispersion of Ownership

Greater liquidity and diversification also causes some issues concerning incentives on behalf of management, often distorted and misaligned by the following dispersion of ownership among thousands of arbitrary stockholders. As Draho (2004) points out, efficient corporate governance is often of second-order importance in an IPO decision, while the need for external capital often provides the initial impetus.

Nonetheless, acknowledged articles debating over the issue of whether PE/VC contribute with added value, compared to non-backed (NB) companies, argues that concentrated ownership by PE/VC-funds post IPO drives observed abnormal returns. Megginson and Weiss (1991) highlights this from a VC perspective, while Cao and Lerner (2009) exert a similar view for LBO-exits, an operation most often performed by PE-funds. They find that both mean and median retained shares amounted to 40 percent immediately subsequent to the flotation, among 526 LBO-exits between 1981 and 2003.

The fact that PE- and VC-funds also employ top-tier national investment- and commercial bankers on the board of directors of the issuing company might alleviate informational asymmetries and provide access to capital, as highlighted in Brav and Gompers (1997). Representatives from the funds also hold board positions subsequent to the IPO, exerting active management. Barry et al. (1990) find for American data, that VC funds hold on average 34 % of the board seats post IPO, and this share remains stable one year forward.

3.2.4 Stock Market Monitoring vs. Private Monitoring

With dispersed ownership, there is a trade of private monitoring for public monitoring. This is an apparent disadvantage, as shareholders incentives rarely align with those of management, giving rise to agency conflicts. Active management funds engage in active ownership post IPO, and often gear up the company, effectively tightening the operational leeway for corporate perquisites and negative NPV projects. In addition, PE-funds often combine equity with debt to provide an additional layer of monitoring. The method is hypothesized and proven effective, as shown in the two-periodic model of Axelson, Strömberg and Weisback (2009).

3.2.5 Transparency and Regulatory Requirements

Under section 2.1.4 and 2.1.5, we listed some of the most pronounced regulatory requirements surrounding companies' activities post IPO, both of informational and financial character. These requirements are often costly, while simultaneously imposing a competitive disadvantage on listed firms. When being forced to disclose any important information that might alter the future prospects of the firms' value, discretion surrounding major impact decisions, is difficult to obtain.

3.3 IPO Puzzles

When academics address IPO puzzles, the underwriters'- and issuing companies' incentives often lies at the core of the debate. Underpricing, long-run underperformance and cyclicality of IPOs are all subject to some anomalies that we will address in detail. These puzzles are interrelated and often studied in connection with one another. We have made an effort at illustrating these connections in a coherent manner.

Figure 2.5) *Interrelations Between IPO Puzzles*

Oslo Stock Exchange

The interrelation between underpricing, cyclicality (of both initial returns and IPO volume) and long-run underperformance is hypothesized in Ibbotson, Sindelar and Ritter (1994) in the

following sense: periodic over-optimism on the part of investors leads to “windows of opportunity”; periods where firms and investors collectively approach the public market place in pursuit of abnormal returns. When the companies fail to fulfil these expectations, usually after revised earnings estimates, the resulting long-run performance often disappoints. This connects cyclicality and long-run performance. Underpricing often associates with asymmetric information between the issuing company, the underwriter (e.g. investments banks) and investors. If the underwriter price the offering too high, investors will shun future issues, while issuers will approach competitors if the price is set too low. We pursue several hypotheses explaining why market participants allow this market anomaly to persist, in the following subsections. With a brief description of each puzzle and their interrelations in mind, we approach an in-depth description of each one below.

3.3.1 Empirical Results on Underpricing

Underpricing refers to the incident of high initial returns on the first days of public trading, and is often measured as the difference between the offering price set by the underwriter and the price at the end of the first day of trading. Underpricing of new equity issues is a well-known phenomenon, generally occurring across firms of different characteristics, across industries and countries. Below, we have reproduced two tables illustrating the results of international and national studies investigating the phenomenon of underpricing.

Country	Source	Sample Size	Time Period	Avg, Initial Return
Argentina	Eijgenhuijsen & van der Valk	20	1991-1994	4,4 %
Australia	Lee, Taylor & Walter; Woo; Pham; Ritter	1,103	1976-2006	19,8 %
Austria	Aussenegg	96	1971-2006	6,5 %
Belgium	Rogiers, Manigart & Ooghe; Manigart, DuMortier; Ritter	114	1984-2006	13,5 %
Brazil	Aggarwal, Leal & Hernandez; Saito	180	1979-2006	48,7 %
Bulgaria	Nikolov	9	2004-2007	36,5 %
Canada	Jog & Riding; Jog & Srivastava; Kryzanowski, Lazrak & Rakita; Ritter	635	1971-2006	7,1 %
Chile	Aggarwal, Leal & Hernandez; Celis & Maturana; Ritter	65	1982-2006	8,4 %
China	Chen, Choi, and Jiang (A shares)	1,394	1990-2005	164,5 %
Cyprus	Gounopoulos, Nounis, and Stylianides	51	1999-2002	23,7 %
Denmark	Jakobsen & Sorensen; Ritter	145	1984-2006	8,1 %
Finland	Keloharju	162	1971-2006	17,2 %
France	Husson & Jacquillat; Leleux & Muzyka; Paliard & Belletante; Derrien & Womack; Chahine; Ritter	686	1983-2006	10,7 %
Germany	Ljungqvist; Rocholl: Ritter	652	1978-2006	26,9 %

Greece	Nounis, Kazantzis & Thomas	363	1976-2005	25,1 %
Hong Kong	McGuinness; Zhao & Wu; Ljungqvist & Yu; Fung, Gul, and Radhakrishnan; Ritter	1008	1980-2006	15,9 %
India	Marisetty and Subrahmanyam	2811	1990-2007	92,7 %
Indonesia	Hanafi; Ljungqvist & Yu; Danny; Suherman	321	1989-2007	21,1 %
Iran	Bagherzadeh	279	1991-2004	22,4 %
Ireland	Ritter	31	1999-2006	23,7 %
Israel	Kandel, Sarig & Wohl; Amihud & Hauser; Ritter	348	1990-2006	13,8 %
Italy	Arosio, Giudici & Paleari; Cassia, Paleari & Redondi; Vismara	233	1985-2006	18,2 %
Japan	Fukuda; Dawson & Hiraki; Hebner & Hiraki; Pettway & Kaneko; Hamao, Packer, & Ritter; Kaneko & Pettway; Ritter; TokyoIPO,com	2579	1970-2007	40,5 %
Korea	Dhatt, Kim & Lim; Ihm; Choi & Heo; Ng; Cho; Ritter	1417	1980-2007	57,4 %
Malaysia	Isa; Isa & Yong; Yong	350	1980-2006	69,6 %
Mexico	Aggarwal, Leal & Hernandez; Eijgenhuijsen & van der	88	1987-1994	15,9 %
Netherlands	Wessels; Eijgenhuijsen & Buijs; Jenkinson, Ljungqvist, & Wilhelm; Ritter	181	1982-2006	10,2 %
New Zealand	Vos & Cheung; Camp & Munro; Ritter	214	1979-2006	20,3 %
Nigeria	Ikoku; Achua	114	1989-2006	12,7 %
Norway	Emilsen, Pedersen & Saettem; Liden; Ritter	153	1984-2006	9,6 %
Philippines	Sullivan & Unite; Ritter	123	1987-2006	21,2 %
Poland	Jelic & Briston; Ritter	224	1991-2006	22,9 %
Portugal	Almeida & Duque; Ritter	28	1992-2006	11,6 %
Russia	Ritter	40	1999-2006	4,2 %
Singapore	Lee, Taylor & Walter; Dawson; Ritter	441	1973-2006	28,3 %
South Africa	Page & Reyneke	118	1980-1991	32,7 %
Spain	Ansotegui & Fabregat; Alvarez Otera	128	1986-2006	10,9 %
Sri Lanka	Samarakoon	115	1987-2007	48,9 %
Sweden	Rydqvist; Schuster; Simonov; Ritter	406	1980-2006	27,3 %
Switzerland	Kunz,Drobetz, Kammermann & Walchli; Ritter	147	1983-2006	29,3 %
Taiwan	Chen	1,312	1980-2006	37,2 %
Thailand	Wethyavivorn & Koo-smith; Lonkani & Tirapat; Ekkayokkaya and Pengniti	459	1987-2007	36,6 %
Turkey	Kiymaz; Durukan; Ince	282	1990-2004	10,8 %
United Kingdom	Dimson; Levis	3,986	1959-2006	16,8 %
United States	Ibbotson, Sindelar & Ritter; Ritter	12,007	1960-2007	16,9 %

Table 2.1) *International Studies on Underpricing: Equally Weighted Average Initial Returns for 45 Countries*

Loughran, Ritter and Rydqvist (2008)

International studies report underpricing-levels ranging from 4.2% (Russia) to 164.5% (China) for overlapping periods. Although underpricing is highly cyclical, we can report that the average underpricing across countries and periods is 27.1% with a standard deviation of approximately similar magnitude, 27.4%, in other words, quite high.

Author	Period	Method	Initial Return
Ruud and Ullevoldsæter (1987)	1982 - 1986	CAPM, market adjusted	14,80 %
		Market adjusted model, without beta	14,60 %
		Market adjusted model, with beta	18,20 %
Nærland (1994)	1984 - 1994	CAR	12,03 %
Håland (1994)	1982 - 1994	CAPM	19,30 %
		Market adjusted model	18,20 %
Sættern (1996)	1982 - 1996	Market adjusted model	13,46 %
Emilsen and Pedersen (1996)	1982 - 1996	CAPM	17,40 %
		Market adjusted model	12,74 %
Gabrielsen et.al (2001)	1982 - 1999	Market adjusted model	16,70 %
Ardø (2001)	1990 - 2003	CAR	12,90 %
Emilsen and Enger (2003)	1982 - 2002	Market adjusted model	18,50 %
	1999 - 2000	Market adjusted model	50,80 %
Edvardsen (2004)	1997 - 2004	Unadjusted returns	11,25 %
Kyllo and Skaar (2006)	1985 - 2005	Market adjusted model	13,44 %
Samuelsen and Tveter (2006)	2004 - 2005	Market adjusted model	2,21 %
Kalstad (2007)	*2003 - 2006*	*Unadjusted returns*	*3,35 %*
Hjesdal (2007)	*2004 - 2006*	*Unadjusted returns*	*3,15 %*
Grønberg (2011)	*2004 - 2005*	*Unadjusted returns*	*-1,11 %*
Ellingsen (2012)	*2006 - 2011*	*Market adjusted model*	*2,41 %*
Moen and Hewage (2012)	*2000 - 2011*	*Market adjusted model*	*1,55 %*

*CAR: Cumulative Abnormal Return

Table 2.2) *National Studies on Underpricing*

Moe (2007)

NB) We have extended Moe's table with additional studies, displayed in italics.

The average level for national (Norwegian) studies, including the one covering the short and abnormal period of the dot.com-bubble, amounts to 13.14% with a standard deviation of 10.83%. The median value of the national sample resembles the mean (13.44%), while the median value of the international sample (20.3%) indicate more extreme values. Almost all studies find positive levels of underpricing, demonstrated by the widespread and recurring presence of abnormal initial returns following shortly after the IPO. However, nationally documented underpricing seems to have declined somewhat in recent times, from double- to single digit returns.

This evidence of recurring underpricing is inconsistent with market efficiency, which is the main reason why it has been the topic of several reputable articles from leading academics.

Levels of underpricing are unevenly distributed across firms. Ibbotson, Sindelar and Ritter (1994) find that smaller issues, on average, are underpriced by more than larger issues. The authors then represent several explanations for why underpricing is widespread across countries and persists through time:

1) *The Winner's Curse*: Due to informational asymmetry, some investors will be worse off than others. Those with superior knowledge only demand shares in underpriced issues of good quality, while those without this knowledge will demand shares in every issue, while only receiving a fraction of the good issues but *all* of the bad issues. Faced with this adverse selection problem, the uninformed investors will demand a sufficient level of underpricing to compensate them for the selection bias imposed on them.

2) *Dynamic Information Acquisition*: In an attempt from investments bankers in revealing information during the pre-selling period, they subsidize those willing to help them price the issue, in the form of underpricing.

3) *Information Cascades*: Investors do not only act according to their own private information, but also manage to observe others' information, and revise their behaviour accordingly. This effect runs both ways, causing the underwriter to underprice the issue initially to attract *some* investors, which will induce others to follow.

4) *Reducing Legal Liabilities*: Underpricing might occur as a precautionary action, as underwriters want to avoid legal actions from investors following the IPO. The evidence is mixed, and the authors suggests that legal liability considerations are at most a minor reason for the underpricing of IPOs.

5) *Enhancing Banker Relations with Investors*: This hypothesis is one of the most widely acknowledged, but consists of several nuanced theories. One of the most recognized states that investment bankers take advantage of the informational asymmetry between themselves and the issuing firm, regarding market dynamics, securing future business with their investors on the buy-side.

6) *Regulatory Constraints*: Some countries practice regulatory requirements based on firms' book values. This is mentioned also in the next section related to Korea's high post IPO

performance, due to price adjustments of the issue. This effect is most pronounced for small growth firms, with low book values, which may ultimately lead to excessive underpricing.

3.3.2 Empirical Results on Long-Run Performance

Poor long-run performance of IPOs is another market anomaly of IPOs and a natural extension of underpricing. Jay R. Ritter and Tim Loughran have conducted, by far, the most comprehensive studies on the subject, in their seminal papers: Ritter (1991), Loughran (1993), Loughran and Ritter (1995).

In Ritter (1991), a sample of 1,526 IPOs going public in the U.S. in the 1975-84 period, significantly underperform comparable firms matched by size and industry, three years subsequent to the offering. Ritter states the data patterns are consistent with an IPO market in which investors are periodically overoptimistic about the earnings potential of young growth firms and the simultaneous exploitation of sentiment by these firms. The pattern of underperformance concentrates among relatively young growth companies, in particular those going public in high-volume years.

Loughran (1993), building on Ritter's (1991) results, also document a long-run underperformance when applying a sample of 3,656 IPOs in the 1967-1987 period, using a six-calendar-year aftermarket period, measured relative to an equally-weighted NASDAQ index. Loughran finds an average six-year holding period return (HPR) of 17.29% for IPOs, compared with a similar HPR of 76.23% for the NASDAQ index, effectively measuring a wealth relative[12] of 0.666, which is smaller than Ritter's reported wealth relative of 0.831. Both authors later write a joint paper on the same subject in Loughran and Ritter (1995), including the performance of SEOs, which is the main contribution from their previous work. Using a sample of 4,753 companies going public in the U.S. during 1970 to 1990, the authors find poor long-run returns for both investment types, arguing that investors would have had to invest 44 percent more in the issuing firms than in the non-issuing firms to achieve the same

[12] The "wealth relative" is calculated as: $\Sigma (1 + R_{i,T}) / \Sigma (1 + R_{bench,T})$, where $R_{i,T}$ is the buy and hold return on IPO *i* for period *T* and $R_{bench,T}$ is the buy and hold return on the benchmark portfolio over the same period.

wealth effect five years after the offering. The table reproduced below illustrates partially consistent results across international studies.

Country	Author	Period	# Companies	# Years	Return
Australia	Lee et al. (1996)	1976-1989	266	3	-51,0 %
Brasil	Aggarw al et al. (1993)	1980-1990	62	3	-47,0 %
Canada	Shaw (1971)	1956-1963	105	5	-32,3 %
Chile	Aggarw al et al. (1993)	1982-1990	28	3	-23,7 %
Finland	Keloharju (1993)	1984-1989	79	3	-21,1 %
Hong Kong	McGuinness (1993)	1980-1990	72	2	-18,3 %
Italia	Giudici & Paleari (1999)	1985-1995	84	3	-2,6 %
Japan	Cai & Wei (1997)	1971-1992	180	5	-26,0 %
Korea	Kim et al. (1995)	1985-1988	99	3	91,6 %
Malaysia	Paudyal et al. (1998)	1984-1994	62	3	9,0 %
New Zealand	Firth (1997)	1979-1987	143	5	-17,9 %
Singapore	Lee et al. (1996)	1973-1992	132	3	0,8 %
Storbritannia	Levis (1993)	1980-1988	712	3	-8,1 %
Sverige	Loughran et al. (1994)	1980-1990	162	3	1,2 %
Sveits	Kunz & Aggarw al (1994)	1983-1989	34	3	-6,1 %
Tyrkia	Kiymaz (1998)	1990-1995	138	3	44,1 %
Tyskland	Sclag & Wodrich (2000)	1884-1914	163	5	-7,8 %
Tyskland	Ljungqvist (1997)	1970-1990	145	3	-12,1 %
USA	Stigler (1964)	1923-1928	70	5	-37,7 %
USA	Simon (1989)	1926-1933	35	5	-39,0 %
USA	Simon (1989)	1934-1940	20	5	6,2 %
USA	Stigler (1964)	1949-1955	46	5	-25,1 %
USA	Cusatis et al. (1993)	1965-1988	146	3	33,6 %
USA	Loughran (1993)	1967-1987	3656	6	-33,3 %
USA	Loughran & Ritter (1995)	1970-1990	4753	5	-30,0 %
USA	Ritter (1991)	1975-1984	1526	3	-29,1 %

Table 2.3[13]) *International Studies on Long-Run Performance*

Jenkinson and Ljungqvist (2001)

The authors hypothesize several reasons for the persistence of long-run underperformance, where investor over-optimism and overvalued firms exploiting "windows of opportunities" are central.

[13] Returns are calculated annually, with the exception of McGuinness (1993), Stigler (1964) and Keloharju (1993) who states accumulated returns. Returns are benchmark adjusted, but not risk adjusted; assuming all betas equal 1. Initial returns are not included and the methodological approach to calculating return varies (Broks og Båtstrand, 2008)

On the other hand, as depicted in the table above, six studies find positive long-run returns, ranging from 0.8% to 91.6%. The upper bound concerns Korea, and Jenkinson and Ljungqvist (2001) argue that some of the abnormal return can be attributed regulatory requirements, above all; price adjustments of issues.

Nonetheless, this is consistent with Brav and Gompers (1997), where underperformance of IPOs is apparent on an equal-weighted basis, but almost disappears when value weighting the returns. They argue that underperformance is not an IPO effect, as similar size and book-to-market firms that have not issued equity perform as poorly as IPOs. Their hypotheses explains why this anomaly persists, and closely resemble those asserted in Ritter and Loughran's papers. Ibbotson, Sindelar and Ritter (1994) suggest the following reasons:

1) *Excessive Optimism*: Optimistic investors will, on average, receive the highest allocation of shares, as their valuations will be over-optimistic and their bid priced accordingly. Subsequent to the offering, they will revise their earnings estimates until their expectations narrows towards the pessimistic estimates, and eventually align with realistic ones. This causes the market price to drop, gradually approaching the fundamental value of the firm.

2) *Impresarios:* The investment bank underwriting the issue fulfils a role as an advocate for the company, intentionally underpricing it to create the appearance of excess demand. This in turn induces long-run underperformance among the IPOs with the highest initial returns.

Author	Period	# Companies	# Years	Return
Håland (1994)	1982 - 1991	59	3	-17,80 %
Nærland (1994)	1984 - 1994	131	3	-25,20 %
Emilsen and Pedersen (1996)	1984 - 1996	58	3	-15,20 %
Sættern (1996)	1984 - 1996	99	3	11,50 %
	1982 - 1996	49	3	-20,30 %
Blystad and Lorentzen	1988 - 1997	151	3	0,80 %
Gabrielsen et.al (2010)	1983 - 1999	207	3	-20,20 %
	1983 - 1999	81	3	-14,20 %
	1983 - 1999	207	3	-14,50 %
Emilsen and Enger (2003)	1983 - 2000	169	3	15,40 %
Edvardsen (2004)	1997 - 2004	46	3	9,20 %
Ingebritsen (2004)	1996 - 2000	109	3	-4,60 %
	1996 - 2000	87	3	-9,00 %
Moen and Hewage (2012)	*2000 - 2008*	*99*	*3*	*-21,70 %*

Table 2.4[14]) *National Studies on Long-Run Performance*

Kyllo and Skar (2006)

NB) We have extended Kyllo and Skaar's (2006) table with an additional study, displayed in italics.

National (Norwegian) studies on long-run performance document a narrower range than international studies. 10 out of 14 find negative benchmark-adjusted returns, with an average of -9,0 % (median -14,4 %) and a standard deviation of 13,3 %. Varying sample periods, sample sizes and methodologies impairs generalization, and assuming full market exposure ($\beta = 1$) might return misleading risk-adjusted returns.

3.3.3 Empirical Results on Cyclicality and "Hot Issue" Markets

The phenomenon of IPO cyclicality has also been the topic of intense research, where the existing evidence points towards a mutual connection between initial returns, mentioned in 2.3.1 and cyclicality of IPO volume. Both factors show a tendency to correlate positively with the overall market conditions, as illustrated in Ibbotson, Sindelar and Ritter (1994). "Hot issue" markets refers to incidents when initial returns surge above the public offer price shortly after the listing. Reasons for these phenomena usually centres around three hypotheses:

[14] Returns are calculated annually and accumulated. Returns are benchmark adjusted, but not risk adjusted; assuming all betas equal 1. Initial returns are not included and the methodological approach to calculating return varies (Broks og Båtstrand, 2008)

1) *Changes in Firm Risk*: there are some evidence of risker issues being more heavily underpriced than less risky issues, implying that risk explain periods of fluctuating initial returns. High initial returns also positively correlates with IPO volume, implying that differing risk characteristics drive both swings in IPO volume and hot issues. While the evidence explains some of the volume- and returns cyclicality, there remains a substantial part still unaccounted for by differences in issuers' risk characteristics.

2) *Positive Feedback or "Momentum" Strategies*: Investors following a "positive feedback" strategy that might cause positive autocorrelation in IPO returns, leading prices to drift upwards, and setting in motion a self-fulfilling prophecy. Lowry and Schwert (2002) also find that both IPO volume and average initial returns are highly autocorrelated. They lend support to Ibbotson, Sindelar and Ritter by claiming that both the cycles in returns and the lead-lag relation between initial returns and IPO volume are driven by information learned through the registration period. In other words, more positive information results in higher initial returns and more firms subsequently filing for registration soon after.

3) *Windows of Opportunity*: There are periods when IPOs sell at abnormally high multiples, price to earnings, market to book value, or other measures of value, that often coincide with high IPO volume. This pattern is apparent in Figure 2.6 below, illustrating the development of IPO volume and market capitalization of new and existing listings for the Norwegian market over the period 1996 – 2012. In Ibbotson, Sindelar and Ritter (1994), the authors argues that this might induce underwriters and issuers to accept higher underpricing, illustrating the mutual connection between the variables illustrated in Figure 2.5. If firms are timing market sentiment, they are taking advantage of the asymmetrical information between themselves and investors, what the authors has coined "exploiting windows of opportunity".

Below, we have graphed the cyclicality of Norwegian IPOs, where the number of IPOs is represented by the orange line, while we illustrate the total market capitalization and the market capitalization of new listings (in billion NOK) by dark and light blue bars, respectively.

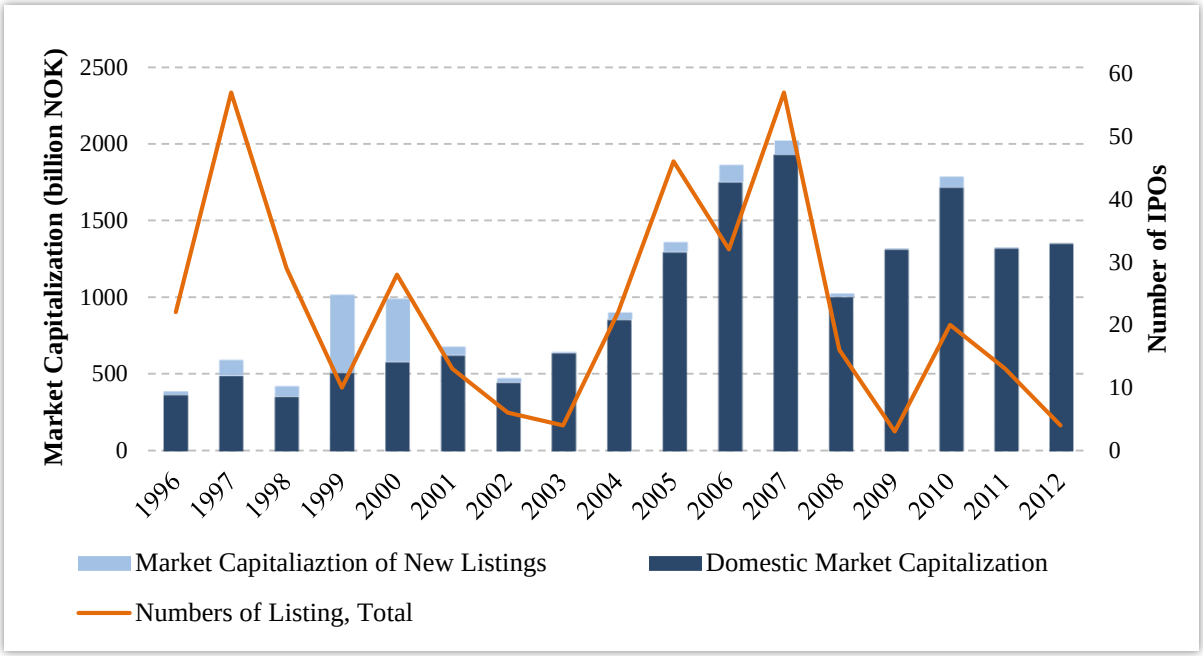

Figure 2.6) Cyclicality of Norwegian IPOs

World Federation of Exchanges and Oslo Stock Exchange

The data exhibits several properties consistent with the theories. IPO volume declines heavily from 1997 to 1999, but quickly doubles during 2000. Subsequent to the dot.com-bubble crash of 2000/2001, IPO volume declined dramatically. Even though the volume declines dramatically from 1997 to 1999, the market capitalization of new listing increases by a factor of 7.3, supporting the theory of market sentiment, recognized in the aftermath of the bust.

International studies document similar results; Aggarwal and Rivoli (1990) report that IPOs issued in the high-volume years of 1985 and 1986 supplied negative market adjusted-returns, using a NASDAQ index as the benchmark, during their first year of trading. Ritter (1991) hypothesize a form of over-optimism on the part of investors of the prospects of young growth firms, which in turn induces the same firms to take advantage of these "windows of opportunity" also referred to as "hot issue market" phenomenon, documented in Ibbotson and Jaffe and Ibbotson (1975), Ritter (1984) and Ibbotson, Sindelar and Ritter (1988). Lerner (1994) tracks financing of the biotechnology industry in the U.S. during the 1978-1992 period, finding that IPO activity is highly related to the inflation-adjusted price paid for the issue, which implies that issues are taking advantage of "windows of opportunity". Loughran, Ritter, and Rydqvist (1994) document a positive correlation between the annual volume of IPOs and stock market levels, in 14 of 15 countries, during the last 20 to 30 years prior to their studies.

3.4 Comparing IPOs: PE/VC-IPOs versus NB-IPOs

The theory outlined above, have so far been quite general, in the sense that we have made few direct comparisons between PE, VC and NB companies going public. In the following, we will confront the differences perceived as most pronounced by international studies, further narrow our focus, and then use the framework to formulate formal tests that we will apply to the Norwegian market. The structure outlined from 2.4.2 – 2.4.4 lays the foundation for statistical hypotheses testing and is reproduced under the sections further ahead in order to create a coherent and logical transition.

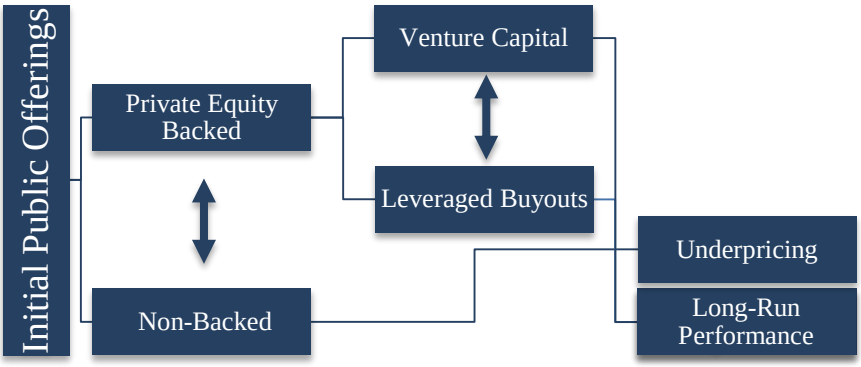

Figure 2.7) *IPO Comparisons*

3.4.1 Differences Between PE and VC

In the following, we continue to address LBOs (and RLBOs[15]) as "PE" investments (and exits), seed/ventures as "VC" and non-backed as "NB", which also includes demergers and divestments from industrial conglomerates. "Private equity" refers to the cohort of seed, ventures and leveraged buyouts, applied when we do not distinguish between PE and VC.

Studies comparing aftermarket performance differences between PE- and VC-backed firms, often find distinguishing features. Jones and Rhodes-Kropf (2003) find betas amounting to 1.80 for VC-funds and 0.66 for PE-funds during their sample period. We address the issue of risk in section 2.4.4.

[15] Reversed Leveraged Buyouts; refers to the exit of LBO investments.

Levis (2011) document contrasting IPO performance. PE-backed IPOs achieve positive and significant cumulative abnormal returns and operating performance during the 36 months following the offering, both equally- and value-weighted. VC-backed and other NB IPOs on the other hand, underperforms the market. Levis' sample contains 1,595 IPOs issued on the LSE[16] during the period of 1992 to 2005.

We are aware of the differences between PE and VC-funds aftermarket performance. However, we do not distinguish our sample data between these two categories, since PE and VC funds often operate in a similar manner, meaning they perform both LBOs and ventures. Additionally, is would severely limit our data and restrict our inferential abilities. In the following, we mention PE and VC-studies interchangeably, highlighting both similarities and disparities, while simultaneously trying to generalize across the private equity asset class.

3.4.2 Differences Between PE/VC and NB IPOs

With the distinction of PE and VC in mind, this section aims at shedding light on the drivers behind the differing performance patterns between PE/VC and NB firms going public. The existing literature document widely differing results of PE/VC-backing on both underpricing, long-run performance and the underlying drivers of these differences. We summarize their results together with their theoretical constructs and assumptions. Based on these, we conduct formal statistical testing, attempting to obtain evidence for further inference. We elaborate briefly on some issues beyond our scope of empirical testing, in order to provide a broad theoretical framework for further interpretation. We refrain from extensive details on subjects outside the scope of this thesis.

Below, we have constructed a figure illustrating which factors the literature highlights as important in driving differences in underpricing and long run-performance between PE/VC-backed and NB IPOs. The model simultaneously reflect the structure of this section, while also indicating which variables we aim at measuring explicitly, characterized by an orange coloured square.

[16] LSE: London Stock Exchange

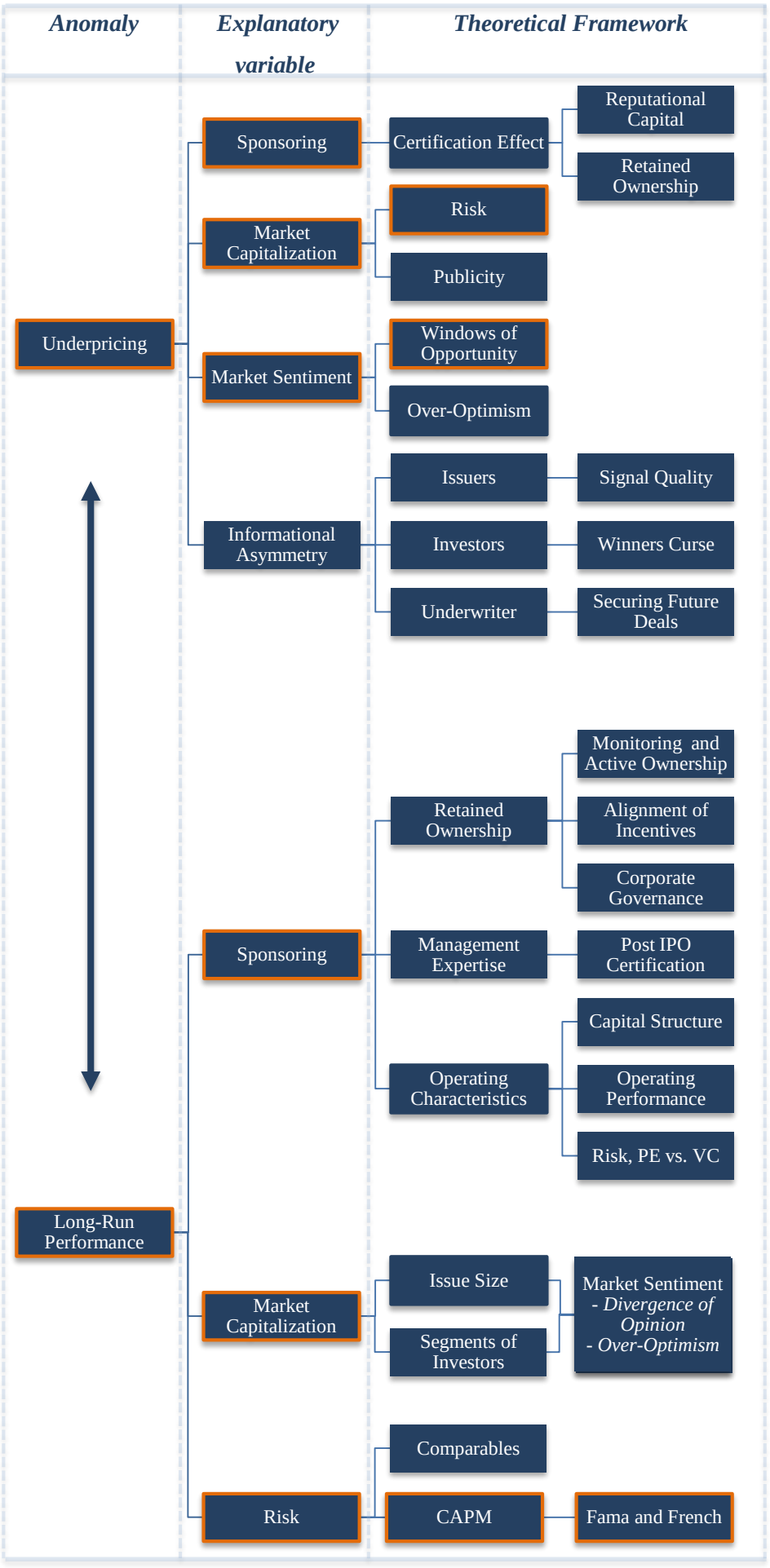

Figure 2.9) Factors Affecting Underpricing and Long-Run Performance

3.4.3 Underpricing

Figure 2.9 indicates that there is a relationship between the level of underpricing and long-run performance, which *ceteris paribus* seems evident, as one would think that higher degrees of underpricing should facilitate relatively higher long-run returns, as it incorporates a discount. On the other hand, studies document that underpricing relates to poor long-run performance, which means that an issue can be underpriced and overvalued at the same time, as documented in Purnanandam and Swaminathan (2004). The interpretation mainly aligns with theories postulating that firms exploit market sentiment. Underpricing in general is a multifaceted feature, affected by continuous, cyclical and iterative processes. Below, we elaborate on these processes, distinguish our expectations based on PE/VC-backing, and formulate our hypotheses accordingly.

Sponsoring

"Sponsoring" refers to whether or not the firm has been assisted by a PE or VC fund, and in effect has received the operational, strategic and financial expertise available[17]. The theory of the winner's curse stipulate that investors, on average, demand that IPOs must be underpriced so that the less informed ones will overcome their problem of adverse selection.

The certification effect refers to the PE/VC-funds' ability to reduce underpricing, as they ensure investors that the offered firm is of high quality. The results are mixed; Megginson and Weiss (1991), Barry et al. (1990) and Hopkins and Ross (2013) find significant reduced underpricing from PE involvement prior to the IPO, while Bergström, Nilsson, and Wahlberg (2006) argues that the certification effect is open for discussion. Franzke (2004) finds no support for the certification role of VC firms or prestigious underwriters when examining 160 NB-, 70 VC- and 61 bridge-financed firms on the German Neuer Markt between 1997 and 2002. The evidence points in the other direction, that VCs underprice issues more heavily.

[17] We have not set any threshold level for preliminary ownership prior to the IPO, as we were unable to find these levels for more than 20 companies. However, given the operational structure of PE/VC funds and the purpose of their presence, in obtaining board positions and performing active ownership, we believe any biases to be limited.

There are reasons for expecting both a positive and negative relationship. The former depends in large on the retained equity share in the IPO process, as gains from reducing underpricing is positively related to retention rate. Since PE/VC funds often retain a significant share, their incentives to reduce underpricing might not align with the issuers' incentives. The latter is more flocculent, aiming at PE/V-funds' ability to create long-term value by implementing management structures, operational strategies, improved monitoring and networks of suppliers and customers[18]. Bergström, Nilsson, and Wahlberg (2006) also mentions that PE/VC-funds reputation is at stake during an IPO exit, as they experience more publicity and scrutiny.

A larger empirical body documents lower underpricing with PE/VC involvement, so we expect a reduction in underpricing. We will make this hypothesis subject to empirical testing. Our null hypothesis states the conservative outcome:

H_1: PE/VC IPOs do not exhibit lower underpricing than NB IPOs.

Market Capitalization and Risk

Higher market capitalization is associated with lower underpricing and better long-term performance, partly due to issues of risk and publicity. Levis (2011) distinguish between PE and VC IPOs, where the former displays less underpricing than the latter, and NB IPOs. The author attributes this to the size and maturity of these issues, where he especially emphasize risk-characteristics of larger issues as a mitigating factor of underpricing. Megginson and Weiss (1991) on the other hand, find that VCs reduce underpricing, unrelated to market capitalization. We assume market capitalization has no effect on underpricing in our sample, but aim at testing formally. We also aim at measuring the risk surrounding PE/VC-backed issues, primarily for calculating risk-adjusted returns, but also for underpricing comparisons.

H_2: Risk does not affect the level of underpricing

H_3: Market capitalization does not explain differences in levels of underpricing

[18] In Levis (2011), the author argues that improved efficiency and operational organization attributes value beyond the finite period of active ownership, performed by a PE/VC fund. We comment on this further ahead, under section 2.4.4 (Sponsoring).

Market Sentiment

Market sentiment addresses the issuers' inclination for taking advantage of overoptimistic investors, often measured by the degree of underpricing, as it reflect the excess demand and implicitly positive expectations inherent in the initial returns.

PE/VC-funds operate with a fixed investment maturity, leaving less flexibility for timing IPOs, than NB companies. In addition, Bergström, Nilsson, and Wahlberg (2006) find that backed firms are not taken public during "hot issue" markets to the same extent as NB firms, suggesting they do not exploit retail investors' sentiment as extensively. They also mention that institutional investors are more numerous than retail investors in PE/VC-backed IPOs. This mitigates herd behaviour, as institutional investors are less inclined to act irrationally, rather depending on information of the fundamental long-run value of companies than the short-term run-ups. We will supply descriptive statistics, illustrating whether or not PE/VC-firms exhibit higher underpricing, and observe whether their issues coincides with overall "hot issue" markets.

Informational Asymmetry

Bergström, Nilsson, and Wahlberg (2006) argue that the level of informational asymmetry and distribution of valuable information, influence levels of underpricing. They distinguish between issuer, underwriter and investors. If the issuer has obtained most information, it might use underpricing as a signal of quality to distinguish itself from low quality firms. They argue that PE firms are of high quality, inducing them to underprice as a means of securing future seasoned issues, as their reputation is at stake when exiting through an IPO. If investors hold more information, the winner's curses issue arises. If underwriters possesses most information, they will trade off lost future earnings from underwriting for lost future business with investors in deciding the level of underpricing. If the underwriter underprice too heavily, issuers will shy away, while investors will be reluctant to participate in future offerings if they experience declining initial returns.

When distinguishing between PEs and VCs, one might expect that PEs initiating RLBOs reduce informational asymmetries, as they are on average larger and receive more media attention. VC deals are smaller in terms of size, making assumptions about the effect of the

relationship difficult. On average though, we would expect VCs to reduce underpricing due to relatively more homogenous dispersion of information among investors. We will not make this issue subject to testing.

3.4.4 Long-Run Performance

IPO long-run performance also depends on several factors, as displayed in Figure 2.9. Our main hypothesis attempts to identify significant and consistent differences in the long-run performance, dependent on whether or not the firms have received PE/VC-backing. We will provide a theoretical framework beyond our scope of formal testing, in an attempt to guide subsequent interpretation. The literature provide somewhat heterogeneous results with respect to the effect of backing on long-run performance. In addition, differing sample sizes, time horizons, markets, methodology and risk adjustments are all factors impairing generalization. We elaborate on the most frequently cited and widely recognized reasons for observed differences.

Sponsoring

Brav and Gompers (1997) apply a sample of 934 VC-backed IPOs from 1972 to 1992 and 3407 NB firms from 1975 to 1992, finding that VC-backed IPOs outperform NB IPOs using equal-weighted returns. However, when value-weighting returns, the underperformance of NB IPOs decrease substantially, and the authors claim underperformance is not an IPO effect, arguing that long-run underperformance generally apply for small firms, regardless of equity issuances. Bergström, Nilsson and Wahlberg (2006) finds that PE IPOs outperform NB IPOs across all time horizons and weighting methods (6 months, 3 years and 5 years). Levis (2011) presents evidence from analyzing PE and VC versus NB IPOs, which is consistent with abnormal performance of the former. His findings aligns with those of Bergström, Nilsson and Wahlberg (2006) in supporting the abnormal performance of PE IPOs, while finding no such support for VC IPOs. In general, improved operational efficiencies, closer monitoring, availability of management expertise and higher level of debt represents the main value drivers underlying the PE (LBO) model, as promoted by Jensen (1986, 1989). Levis (2011) argue that, even though these efficiencies seem to accrue during the period in which the firm is under PE control, it is also reasonable to assume that management and financial practices implemented during this period, continues for some time after going public. In addition, lock-up agreements

and retained shares in the company facilitates continued engagement, incentives alignment, closer monitoring, while also reducing agency conflicts and informational asymmetries.

The studies mentioned so far have provided us with rather ambiguous results regarding performance differences between sponsored and non-sponsored firms. The concentration of ownership pre IPO has been attributed wide academic coverage, as active ownership is recognized as a fundamental reason for documented abnormal performance of private equity. Megginson and Weiss (1991) also measures the post IPO holdings of VCs in an attempt to unveil a lasting certification role subsequent to the offering. Their evidence indicates that VCs do not apply IPOs to cash out immediately; instead, they actively contribute post IPO in the same manner as mentioned above, ultimately realizing their investment stepwise. Bergström, Nilsson and Wahlberg (2006) in turn argues that this gradual reduction in ownership might induce shortsightedness, characterized by high initial returns, while rapidly deteriorating in the long run.

Results for VC-backed firms concerning long-run performance are mixed. Those that incorporate both VCs and PEs find that the latter outperforms, while the former does not. Studies that focus solely on VCs exhibit polarized results, one documenting abnormal outperformance (Brav and Gompers, 1997) and others the opposite (Rindermann [2003], Levis [2011], and Da Silva Rosa, Velayuthen, and Walter [2003]).

H_4: PE/VC IPOs do not exhibit better long-run performance than NB IPOs.

Risk

Most studies either assume that the risk exposure for PE/VC portfolios equals that of the aggregate market (CAPM $\beta = 1$), use industry peers, and/or various benchmark adjustments. Some, on the other hand, try to adjust both segments for differences in systematic risk, for size and for value effects of the Fama and French 3-factor asset-pricing model. Those studies accounting for systematic risk exposures, all find market betas significantly different from one, although with widely differing values. When taking into account the operational structure of VC/PE funds, it seems logical that they display market betas higher than one on fund level, as time consuming focus on few investments leads to high levels of idiosyncratic risk. On a portfolio level, this is not necessarily the case as aggregated fund returns incorporates diversification, supported by literary results finding time varying betas both above and below

one. Cao & Lerner (2009) conducts risk adjustments with respect to CAPM and the Fama-French model for PE-backed firms. They find significant betas ranging from 1.25 to 1.30 when applying the CAPM, equally weighted and value weighted, respectively. The range changes to 1.23 to 1.25 when applying Fama-French. Korteweg and Sorensen (2010) report betas of 0.74 for seed investments, 2.7 for early-stage investments and 2.6 for late-stage investments. Jones and Rhodes-Kropf (2003) find "long-run" betas of 1.24 for VC-funds and 0.72 for PE-funds in their study of the relationship between idiosyncratic risk and returns. The authors discuss the effect of total risk on VC funds returns, and find that their model predicts higher alphas, even net of fees, for funds with higher realized total risk. Fan, Fleming & Warren (2013) on the other hand, estimate that PE-backed firms display betas ranging from 0.85 to 0.90 using data from the U.S. market, while VC-backed firms exhibit a beta close to 0.75. They emphasize that betas are inconsistent through time and display substantial variation. In the period of 2000 to 2008, betas of PE-backed firms exceed 2, while VC-backed firms' betas exceed 1.2. Before and after this period, beta measures consistently yield values below one for both segments, which indicate clear cyclicality of systematic risk exposure.

The reliability and validity of long-run performance estimates will depend on correct adjustment of differences in total risk. We aim at measuring betas and alphas for our aggregate portfolios of PE/VC and NB firms, by applying both the Fama and French 3 factor model, while also applying liquidity and momentum, and the Capital Asset Pricing Model (CAPM).

H_5: Risk-adjusted returns does not differ across PE/VC- and NB IPO portfolios.

Market Capitalization

Higher levels of market capitalization (size) has been shown to significantly reduce underperformance for both PE/VC and NB firms, in Bergström, Nilsson, and Wahlberg (2006), Cao and Lerner (2009) and Levis (2011). The former article find that value weighting returns renders the larger LBOs more profitable than the smaller ones, but does not explicitly take account of differing risk characteristics. They also hypothesize that issue size affect long-run performance due to market sentiment. Over-optimistic investors that start reassessing their expectations post IPO, are more numerous in the retail segment. These investors primarily buys into smaller IPOs, while institutional investors focus on larger IPOs. Therefore, PE-backing might mitigate the effect of sentiment on post IPO prices. Cao and Lerner take account

of differing risk characteristics, while also documenting relatively better performance when value weighting returns. Brav and Gompers (1997) find that underperformance in the NB sample is driven primarily by small issuers, i.e. those with market capitalizations less than USD 50 mill. They also find that VC-backed IPOs outperform NB IPOs when returns are equally weighted, while this effect disappears when returns are value weighted, signalling that smaller companies supply relatively lower returns.

H_6: *Market capitalization has no effect on long-run performance.*

4. Data and methodology

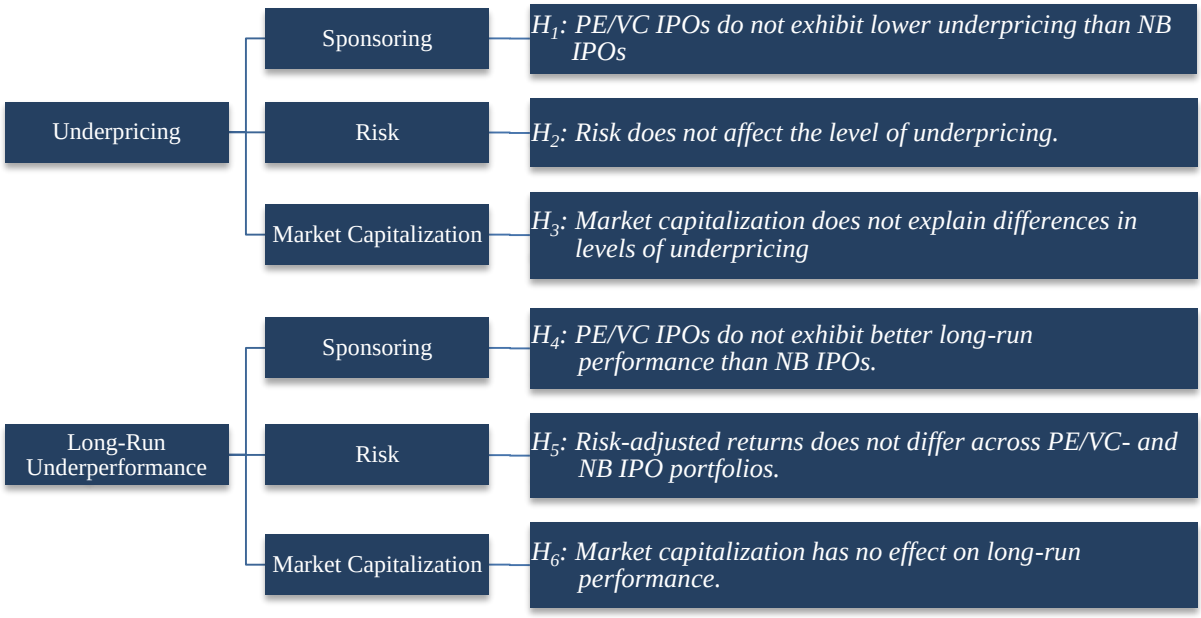

Figure 3.1) *Hypotheses*

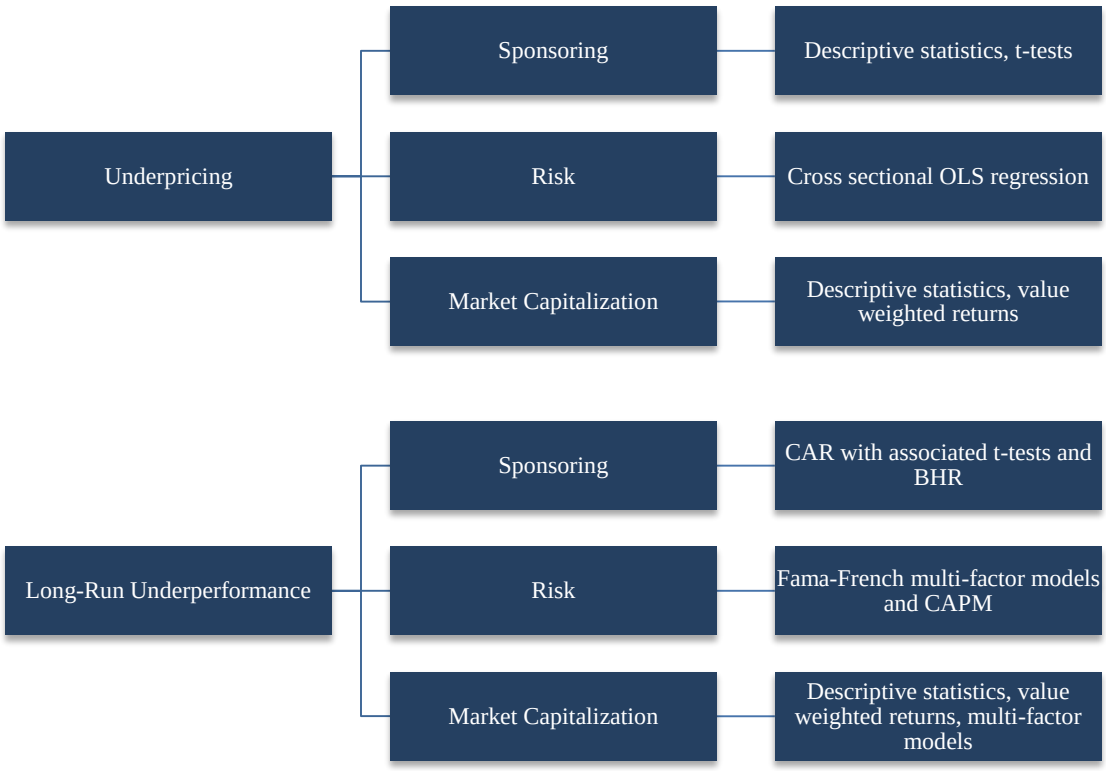

Figure: 3.2) *Methodology Related to Hypotheses*

4.1.1 Underpricing

Sponsoring

We define underpricing during the initial return period similarly as in Ritter (1991) and Bergström, Nilsson, and Wahlberg (2006); as the period between the offering date and the first day demonstrating a closing price that differ from the offering price[19]. The initial raw return of IPO_i equals:

$$r_i = ln\left(\frac{P_{i,1}}{P_{i,0}}\right)$$

Where $P_{i,0}$ is the offering price, while $P_{i,1}$ is the first registered price differing from the offering price. We then adjust the raw return for market movements by subtracting the return of a benchmark index, the OSEBX. This abnormal benchmark adjusted return for stock *i* is defined as:

$$ar_i = r_i - r_{BM}$$

where ar_i is the abnormal return, r_i is the raw initial return and r_{BM} is the benchmark return. In this process, we separate VC/PE IPOs from NB IPOs, calculate the abnormal initial returns, and then aggregate the results on a portfolio basis, both equally- and value weighted, in event time and calendar time. We assign weights to IPO stock returns in event time in proportion to their relative market capitalization, after applying a time-varying GDP deflator, to account for the effect of inflation on market capitalization weights.

$$AR_p^{EW} = \frac{1}{n_p}\sum_{i=1}^{n_p} ar_i$$

AR_p^{EW} is the equally weighted abnormal return for portfolio *p*,

[19] Bergström, Nilsson and Wahlberg (2006) mention that some equities experience a lack of demand shortly following the IPO, which is especially pronounced among smaller, illiquid stocks, and for stocks registered in countries with inferior trading systems. The former is more relevant for the Norwegian market, and we report initial returns based on the first price differing from the offering price in cases where there are not registered any intermediate trades.

$$AR_p^{VW} = \sum_{i=1}^{n_p} w_i \times ar_i$$

and AR_p^{VW} is the value weighted abnormal return for portfolio *p*.

Market Capitalization and Risk

We calculate equity betas for companies with at least three years of activity post IPO and run a cross sectional multiple regression with deflated market capitalization, equity betas and a PE/VC-dummy as independent variables, and raw firm level, simple, benchmark adjusted initial returns (underpricing) as the dependent variable:

$$BM\ adj.\ Initial\ Return = \beta_0 + \beta_1(Market\ Cap.) + \beta_2(Beta) + \beta_3(PE/VC) + u_t$$

We include maximum five years of returns post IPO for the beta calculations, to capture the market sensitivity originating from a limited period following the IPO event. We have to consider the assumptions underlying the OLS model when running a multiple regression. We list these in Appendix 6.1 and comment on relevant aspects of each assumption in the analysis, under section 4.2.3. In addition to the regression model, we account for the effect of size by value-weighting the benchmark-adjusted initial returns by GDP-deflated market capitalization values and aggregate on a portfolio levels. Deflating accounts for inflation by adjusting the relative weights of each firms' market capitalization and aligns it with the base year of 2010, while value-weighting initial returns emphasize the effect of large capitalization firms.

4.1.2 Long-Run Performance

Sponsoring

We collect returns from the firms' total return indexes, supplied by Datastream, which shows a theoretical growth in the value of a share, assuming re-invested of dividends. The total return index accounts for capital operations, like stock splits or reversed stock splits.

$$RI_t = RI_{t-1} \times \frac{PI_t}{PI_{t-1}} \times \left(1 + \frac{DY_t}{100} \times \frac{1}{N}\right)$$

Where RI_t equals the return index level at the 1st day of month *t*, RI_{t-1} equals the return index level in the previous month, PI_t equals the price index level in month *t*, PI_{t-1} equals the price

index level in the previous month, DY_t = dividend yield percentage in month *t* and N = number of working days in the year (taken to be 260). The raw[20] return of stock *i* is then calculated as:

$$r_{i,t} = ln\left(\frac{RI_t}{RI_{t-1}}\right)$$

While we calculate the simple[21] returns as:

$$r_{i,t} = \left(\frac{RI_t - RI_{t-1}}{RI_{t-1}}\right)$$

We distinguish between simple/logarithmic returns, and raw/weighted returns explicitly, as we highlight the differing distribution properties in the analysis. Logarithmic returns attain algorithmic properties incorporating the effect of compounding and enables us to aggregate on portfolio level by simply summing up the values. In addition, logarithmic returns also attains normality properties. However, they emphasize the effect of returns deviating from zero, effectively distorting the distribution properties relative to simple returns, which serves better in displaying differences between sample values on firm level.

We measure long-run performance over six months, one-, three- and five years, excluding initial returns. The reasons for excluding the initial return is that not all investors are able to participate in the offering during the periods of high initial returns, and that these returns also might incorporate effects irrelevant for the long-run fundamental value of the offering firm[22]. Measuring returns over shorter time spans than the traditional three to five year period, enables us to investigate whether it is profitable to hold IPOs over shorter periods. When a stock is delisted, we distribute the value amount across the remaining firms in the portfolio, both

[20] $Raw\ return = \left[\frac{(RI_t - RI_{t-1})}{RI_{t-1}}\right] \leftrightarrow ln\left[\frac{RI_t}{RI_{t-1}}\right]$, as opposed to $weighted\ returns = \left\{\left(ln\left[\frac{RI_t}{RI_{t-1}}\right]\right) \times w_i\ or\ \frac{1}{n_P}\right\} \leftrightarrow \left\{\left(\left[\frac{(RI_t - RI_{t-1})}{RI_{t-1}}\right]\right) \times w_i\ or\ \frac{1}{n_P}\right\}$

[21] $Simple\ return = \left[\frac{(RI_t - RI_{t-1})}{RI_{t-1}}\right]$, as opposed to $logarithmic\ return = ln\left[\frac{RI_t}{RI_{t-1}}\right]$

[22] In Bergström, Nilsson, and Wahlberg (2006), the authors argue that underwriters allocate the lion's share of new issues to institutional investors, as these are less likely to realize their investments in pursuit of short-term gains. If not so, anyone would be able to buy into new IPOs, realize the investment and obtain the often-observed double-digit initial returns during a time-span of a few hours/days. Unarguably, this situation would not be sustainable, as released pressure on the sell-side would cause declining prices and diminishing returns. Underwriters aim at supporting the share price subsequent to the IPO, and are unlikely to allocate shares to parties that trigger sales, indicating that preferential share allocation sustain high initial returns. The argument supports the notion that initial returns and long-term fundamental value are unrelated, which is why we choose to replicate their approach.

equally-weighted and in proportion to their relative weight. We further apply two measures of long-run performance applied in Ritter (1991) and Bergström, Nilsson, and Wahlberg (2006), CAR and BHR:

(1) Cumulative abnormal returns (CAR) calculated with monthly rebalancing and the OSEBX as benchmark, for both PE/VC- and NB firms, equally- and value-weighted in event time. Equally weighted returns captures the effect of differing management quality, while keeping the effect of size restricted to value weighted returns. This might in turn be more relevant from an investor's perspective, as no investor is likely to hold an equal amount of each stock in any portfolio. In addition, the latter will highlight the effect of size. CARs have the drawback of potentially returning cumulative returns more than 100% negative, but serves well as a comparative measure of different groups of IPOs across time. We calculate the benchmark adjusted abnormal return as:

$$ar_{i,t} = r_{i,t} - r_{BM,t}$$

where $ar_{i,t}$ is the monthly abnormal return of IPO i, $r_{i,t}$ is the monthly raw[23] initial return for IPO i and $r_{BM,t}$ is the monthly benchmark return. We separate PE/VC-backed from non-backed firms, calculate the abnormal returns, and then aggregate the results on a portfolio basis. We calculate the equal weighted portfolio of abnormal returns by adding the abnormal returns of n IPOs during month t.

$$AR_{p,t}^{EW} = \frac{1}{n_p} \sum_{i=1}^{n_p} ar_{i,t}$$

where $AR_{p,t}^{EW}$ is the equally weighted abnormal return of portfolio p in month t. The value-weighted portfolio return formula is defined as:

$$AR_{p,t}^{VW} = \sum_{i=1}^{n_p} w_{i,t} \times ar_{i,t}$$

[23] Prior to weighting returns, either by value or number of firms.

Where $w_{i,t}$ is the weight of the stock *i* in relation to the total size of portfolio *p* in month *t*, and $AR_{p,t}^{VW}$ is the value weighted abnormal return for portfolio *p* in month *t*. Market capitalization weights are aligned to the base year of 2010 using a time-varying GDP deflator. We accumulate both measures separately in event time, regardless of issue date, to obtain a CAR for each weighting method:

$$CAR_{t-T} = \sum_{t=1}^{T} AR_t$$

After calculating the CARs, we replicate the methodology in Ritter (1991) when applying t-tests on the differences between portfolios, across time. The t-statistics for the equally/value-weighted abnormal portfolio return for month *t* is computed for each month as:

$$AR_{t-statistic}^{EW/VW} = AR_{t}^{EW/VW} \times \frac{\sqrt{n_t}}{sd_t}$$

where AR_t is the equally/value-weighted abnormal return for month *t*, n_t is the number of observations in month *t*, and sd_t is the cross-sectional standard deviation of the adjusted returns for month *t*. The t-statistic for the cumulative abnormal return in month *t*, $CAR_{1,t}$, is computed as:

$$CAR_{t-statistic}^{EW/VW} = CAR_{1,t}^{EW/VW} \times \frac{\sqrt{n_t}}{csd_t}$$

where n_t is the number of firms trading in each month, and csd_t is computed as: $\left\{csd_t = [t * var + 2(t-1) * cov]^{\frac{1}{2}}\right\}$, where t is the event month, var is the average (over 60 months) cross-sectional variance, and cov is the first-order autocovariance of the AR_t series.

Subsequent to finding CARs in event time, we calculate value-weighted buy-and-hold returns (BHR) in calendar time.

(2) We measure six months, one-, three- and five-year buy-and-hold returns (BHR) in calendar time for both PE/VC and NB IPOs. Calendar time BHRs account for the periods of high and low market valuations, in other words it captures the effect of "hot market" issues. We calculate BHRs in the following way:

$$R_{p,T} = \prod_{t=1}^{T} (1 + r_{p,t})$$

where $R_{p,T}$ is the portfolio's BHR measured without the initial returns, from the first month subsequent to the year of the offering, over time *T*, and $r_{p,t}$ is the sum of the portfolio firms' returns in month *t*. We invest a value-weighted share in each IPO at the first trading day subsequent to the year of flotation and redistribute the value amount according to each IPOs relative weight, when a firm delists, while rebalancing monthly. We then divide the BHRs of the IPO portfolios by the BHRs of the OSEBX, accumulated through the same period in time, in order to compute Wealth Relatives (WR):

$$WR_{p,T} = \frac{R_{p,T}}{R_{BM,T}}$$

where $R_{BM,T}$ is the BHR of the OSEBX. A WR < 1 indicate that portfolio *p* underperformed the market, while a WR > 1 indicate that portfolio *p* outperformed the market.

An issue that arises from both methods is the implicit risk considerations applied. Both methods adjust returns by some benchmark, usually a broad aggregate one, reflecting the market. This implies a beta equal to one, which may not be the case.

Risk

We address risk both using CAPM and the multifactor model of Fama and French (1992), while also adding liquidity and momentum factors, separately, to the model. Carhart (1997) proposes the momentum factor as an extension to the Fama and French three-factor model, while the liquidity factor originates from Pástor and Stambaugh (2003). Assistant Professor, Francisco Santos at NHH, recommended these additional factors to us, as they may explain risk exposures well due to the limited size and pronounced illiquidity of numerous stocks traded on the OSE.

When running ordinary least squares (OLS) regressions on time series data, we have to account for numerous assumptions, listed in Appendix 6.4. We form monthly portfolios in calendar time by including the returns in month *t* of all available issues that were listed in the five years previous to the month of the observation, as we are primarily interested in the risk of newly listed companies. Subsequent to various adjustments, described in the analysis, we run the following regressions on a portfolio level:

$$r_{p,t}{}^{EW} - r_{f,t} = \alpha + \beta_p \left(r_{M,t} - r_{f,t}\right) + u_t$$

where $r_{p,t}{}^{EW} - r_{f,t}$ is the aggregated, equally weighted portfolio return in month *t*, less the Norwegian three month treasury bill rate $r_{f,t}$, α is the regressions intercept, interpreted as the potential risk-adjusted abnormal return, β is the slope of the regression line between IPO portfolio *p* and the OSEBX returns less the treasury bill rate $\left(r_{M,t} - r_{f,t}\right)$, and u_t is the error term. The OSEBX index is defined as a value-weighted index[24]. The same analogy applies for value-weighted returns.

$$r_{p,t}{}^{VW} - r_{f,t} = \alpha + \beta_p \left(r_{M,t} - r_{f,t}\right) + u_t$$

We use the equity-, rather than asset betas from the CAPM regressions above, and the multi factor regressions below. It is argued in Fama and French (1992) that the combination of the size- and value-factors absorbs the apparent roles of leverage in average stock returns. However, our CAPM alphas and betas incorporates the effect of leverage when risk-adjusting the returns of the different IPO groups. Further, we regress on the differences in portfolio returns, equally- and value-weighted, to identify points of distinctions for the explanatory variables and the risk-adjusted returns between the two groups of IPOs:

$$(r_{PE,t}{}^{EW/VW} - r_{f,t}) - (r_{NB,t}{}^{EW/VW} - r_{f,t}) = \alpha + \beta_p \left(r_{M,t} - r_{f,t}\right) + u_t$$

[24] We are aware that this might bias the estimates when regressed on equally weighted returns. However, we observe that none of the international studies distinguishes between these properties of the index when performing their analyses across samples (EW/VW). In other words, we use the value-weighted OSEBX index also for equally weighted portfolios.

Additionally, we run multiple regressions including the risk factors of SMB[25] and HML[26] separately, before isolating the incremental effect of the liquidity- (LIQ)[27] and momentum-factors (UMD)[28]:

$$r_{p,t}{}^{EW/VW} - r_{f,t} = \alpha + \beta_p \left(r_{M,t} - r_{f,t}\right) + s(SMB_t) + h(HML_t) + u_t$$

$$r_{p,t}{}^{EW} - r_{f,t} = \alpha + \beta_p\left(r_{M,t} - r_{f,t}\right) + s(SMB_t) + h(HML_t) + [\, l(LIQ_t) + m(UMD_t)] + u_t$$

where s, h, l and m are the factor loadings on (SMB_t), (HML_t), (LIQ_t) and (UMD_t), respectively. Similar to the CAPM calculations, we run the regressions on returns in calendar time, by including the returns in month *t* of all available issues that were listed in the five years previous to the month of the observation, equally and value weighted, and on the estimated portfolios' differences in returns.

In addition to running regressions covering the full sample period of 01.01.1996 to 31.12.2012, we run rolling regressions with a moving and overlapping window, covering 24 months for each monthly observation. This involves an overlap of 23 months for each estimated coefficient and intercept. We apply the extended Fama-French model including liquidity and momentum for these calculations. Applying rolling regressions enables us to evaluate the time-varying properties of both the alpha-estimates, and the factor-loadings of all the portfolios.

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[25] Small Minus Big, i.e., the return of a portfolio of small-capitalization stocks in excess of the return on a portfolio of large-capitalization stocks.

$$\left[SMB = \frac{1}{3}(Small\ Value + Small\ Neutral + Small\ Growth) - \frac{1}{3}(Big\ Value + Big\ Neutral + Big\ Growth)\right]$$

[26] High Minus Low, i.e., the return of a portfolio of stocks with a high book-to-market ratio in excess of the return on a portfolio of stocks with a low book-to-market ratio.

$$\left[HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth)\right]$$

[27] Liquidity, i.e., the return of a portfolio that is long in low-turnover stocks and short in high-turnover stocks. For details on how to create the portfolios, cf. Pástor and Stambaug (2003).

[28] Up Minus Down, i.e., the average return on the two high prior return portfolios minus the average return on the two low prior return portfolios.

$$\left[MOM = \frac{1}{2}(Small\ High + Big\ High) - \frac{1}{2}(Small\ Low + Big\ Low)\right]$$

Market Capitalization

The effect of firm size is indicated by the value-weighted returns applied in both the BHR and CAR estimates, and also factors in when calculating the risk-adjusted returns from the CAPM and multi-factor models.

4.2 Potential biases

4.2.1 Survivorship Bias

We believe we mitigate survivorship bias in applying CARs and BHRs, as they reveal performance differences across the IPO groups (PE/VC versus NB) well, and incorporates the effect of bankruptcy. Poor performers suffering bankruptcy inflicts negative returns leading up to the actual event, which accumulated through time, compounds and returns a terminal value reflecting the effect of firms disappearing from the sample. Likewise, we account for the premium that often originates from acquisitions by rebalancing subsequent to the purchase. We argue that we observe both winners and losers through the entire sample period, limiting this potential bias.

4.2.2 Omitted Variables Bias

Omitted variables occurs when a model incorrectly leaves out one or more important causal factors. We believe this problem to be most severe in the regression model attempting to explain levels of underpricing. The remaining models, explaining long-run performance, are based on acknowledged empirical results, which leaves less room for spurious results. One way to mitigate omitted variables bias, involves including additional explanatory variables to the model. Originally, we estimated our regression in section 4.2.3 using only market capitalization and a PE/VC-dummy. Subsequently, we added equity betas (proxy for risk, accounting for leverage), as the original regression yielded a negative adjusted R^2 and insignificant coefficients. In this way, we have accounted for every explanatory variable emphasized in the literature, except for the retained equity share at the flotation date. However, these data were unavailable to us.

4.2.3 New Listings Bias

This bias concerns the effect of differing life cycles of our sample firms and the firms comprising the index. Both the CAR and BHR calculations measures performance following the IPO, by subtracting the benchmark returns, prior to aggregating on portfolio levels. If the benchmark returns are unrepresentative of our portfolio firms' returns, it might bias our results. We have applied multifactor models for the risk-adjusted returns' calculations, where the additional factors proxy for explanatory variables beyond the simple CAPM model. This way, we allocate explanatory power to features like value, growth, liquidity and momentum, effectively reducing the bias inherent in using only the index.

4.2.4 Rebalancing Bias

This bias arises due to the different periodic rebalancing between the portfolios and the OSEBX-benchmark. The OSEBX is rebalanced every 6th month, while we rebalance our portfolios every month, rendering the benchmark and the portfolios less comparable.

4.2.5 Skewness Bias

Barber and Lyon (1997) argues that long-run CARs often display a positive skew, of returns and t-statistics. We account for this by trimming the upper and lower sample values in the CAR calculations to obtain reliable estimates. Additionally, all our trimmed CAR t-tests return highly significant *negative* t-statistics. If they were unbiased, they would be even more negative, limiting the practical implications of this bias.

4.2.6 Outliers

We account for outliers by trimming our sample values, removing 2,5 % of the most extreme values in each direction (two-sided). Bloch (1966) argues that trimmed/truncated means are robust estimators, as they are less sensitive to unlikely, extreme events than the full sample mean. Bloch argues that the trimmed mean provides a more reliable insight on the central tendency of a sample distribution. However, we have only trimmed our cross-sectional data of initial returns, while leaving our time-series portfolio returns' unadjusted. This could bias our estimates when applying CAPM and multi-factor models on portfolio returns, especially due to REC's combination of high market capitalization and volatile stock returns. However,

we include a maximum of 60 months' returns history to account for development related to the IPO event.

4.2.7 Sampling- and Methodological Errors

Our data originates from various sources, posing a potential problem of sampling error. The population of IPOs, obtained from OSE's "list-changes"-documents, representing a fairly reliable source. Manually having to adjust this information might distort some of our results, while posing no serious problems for our analysis. We have received information on PE/VC-deals from Carsten Bienz, Associate Professor of NHH's Argentum Centre for Private Equity. While the source seems reliable, the data originates from both media coverage and observations by Argentum. This might create biases, but we have tried to mitigate this problem by manually confirming the presence of PE/VC-funds prior to the IPO events by using information available online.

Concerning underpricing, we lack a sizable part of the full sample firms' initial returns, both for PE/VC and NB IPOs, mainly due to unavailable prospectuses. This might invalidate inference if the sample firms' characteristics deviated from those of the population. However, we believe it is improbable that companies unrepresentative of the population would be more likely to enter our subsample.

4.2.8 Measurement Error

Measurement error is the difference between the *measured* and *true* value of a variable. It is difficult to assess whether our estimated coefficients represent the population coefficients, but we have applied different econometric approaches to evaluate the potential for errors, and in turn carried out corrections and transformations where necessary. A frequent problem with time-series data, involves auto-correlation among the error terms, potentially invalidating inference based on the resulting standard errors. We observe no serious problems with autocorrelation, but still run regressions with Newey-West Heteroskedasticity and Autocorrelation robust standard errors. Additionally, we test for unit root using Dickey-Fuller tests, which returns test-statistics below the critical value for each data-series, indicating we do not have a problem with unit root.

5. Analysis

5.1 Data Collection

We were able to identify PE/VC backed IPOs in a stepwise process. We collected data from OSE of all IPOs from 01.01.96 to 31.12.2010, which we collocated with a list of PE/VC deals that we received from Associate Professor Carsten Bienz, director of NHH's Argentum Centre for Private Equity. After 2010, none of the floated firms were involved with PE/VC firms, except for Asetek, listed on March 20th by Northzone Ventures. We cross-referenced our observations with information available at the web pages of every PE/VC company, in order to certify that each company was involved with a fund prior to going public (Appendix 6.5). We have not set a lower limit on ownership when including a given company in our sample. However, given the operational structure of PE/VC funds, in obtaining board positions and performing active ownership, we believe any biases are limited.

Our sample covers IPOs originating from both OSE and Oslo Axess, while dropping Aker drilling, DNBNOR, Gjensidige NOR[29] and Tanker Navigation, as we were not able to find reliable return series. Further, we have included demergers among IPOs, as these operate as individual legal entities subsequent to the disinvestment from the concern, while simultaneously being listed as separate IPOs by the OSE. In total, 365 companies went public during our sample period, where 67 were actively managed by a PE/VC fund prior to their listing. The limited size of this sub-sample might confine our potential for statistical inference, and will leave some of our BHR calculations ambiguous, as several years experience slumps in PE/VC backed IPOs. Our sample period covers the dot.com-bubble of 2000/2001 and the recent subprime credit crisis of 2007/2008, which seemingly have affected the IPO volume distribution across years.

[29] Both DNB and Gjensidige NOR were listed at separate entities prior to our observed IPOs. However, subsequent to their merger in 2003, both companies continued as a combined firm; DNBNOR. We are unable to find reliable return series after the merger.

Table 4.1
IPO Volume Distribution Across Years

The tables displays the volume distribution of PE/VC and NB IPOs, respectively, going public on the OSE and Oslo Axess over the period of 1996 to 2010. Panel A displays the frequency of each group in absolute terms, Panel B; relative to the full sample across years and Panel C; relative between groups each year.

Panel A

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
PE/VC	2	6	4	2	6	2	2	1	8	15	7	8	1	0	3	67
NB	20	51	23	8	22	15	3	3	14	30	25	49	15	3	17	298
Total	22	57	27	10	28	17	5	4	22	45	32	57	16	3	20	365

Panel B

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
PE/VC	3 %	9 %	6 %	3 %	9 %	3 %	3 %	1 %	12 %	22 %	10 %	12 %	1 %	0 %	4 %	100 %
NB	7 %	17 %	8 %	3 %	7 %	5 %	1 %	1 %	5 %	10 %	8 %	16 %	5 %	1 %	6 %	100 %
Total	6 %	16 %	7 %	3 %	8 %	5 %	1 %	1 %	6 %	12 %	9 %	16 %	4 %	1 %	5 %	100 %

Panel C

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
PE/VC	9 %	11 %	15 %	20 %	21 %	12 %	40 %	25 %	36 %	33 %	22 %	14 %	6 %	0 %	15 %
NB	91 %	89 %	85 %	80 %	79 %	88 %	60 %	75 %	64 %	67 %	78 %	86 %	94 %	100 %	85 %
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

5.2 Underpricing

For our original sample of 298 NB IPOs and 67 PE/VC IPOs, we were able to identify offering prices for 160 NB IPOs and 59 PE/VC IPOs, from OSE's Newsweb. We supplemented missing data and crosschecked the data we found with the observations of two master theses from NHH; Hoxha and Glad (2010) and Broks and Båtstrand (2008). The first prices that differed from the offering prices were collected both from OSE's "list changes"-documents and Datastream, in order to calculate initial returns. We used Datastream to ensure that stocks experiencing a period of static prices after the IPO were not traded in the intermediate period between the offering date and the first day displaying a different price. We obtained the daily OSEBX total return index and IPO firms' first registered market capitalization from Datastream. In addition, we have deflated each companies' market capitalization with a time-varying GDP deflator, in order to assign weights to IPO returns in proportion to their relative size.

5.2.1 Descriptive Statistics

Table 4.2
Descriptive Statistics of Initial Returns- / Underpricing-Data

We define underpricing as the period between the offering date and the first day demonstrating a closing price that differ from the offering price, provided there is no intermediate trading; $[r_i = ln(P_{i,1}/P_{i,0})]$, and report the results on an aggregated portfolio level, adjusted for the OSEBX return over the same period. We also report the raw, benchmark-adjusted, simple, initial returns' distribution properties, at firm level. Our sample data covers initial returns for 160 NB IPOs and 59 PE/VC-backed IPOs, as the remaining ones lacked reliable offering prices. Each firms' market capitalization has been deflated using a time-varying GDP-deflator to correctly adjust value-weighted returns. We account for outliers by reporting symmetrically trimmed values in parenthesis, where we have removed extreme observations lying in the upper and lower 2,5 percentiles. For the raw initial returns sample, we remove absolute values, while we rearrange according to the product of market weights and returns for the VW $\{w_i \times ar_{i,t}\}$ sample and the fraction of return and number of firms $\left\{\frac{1}{n_p} ar_{i,t}\right\}$ for the EW sample, prior to trimming. Subsequently, we recalculate the remaining returns according to new weights/fractions. We calculate raw underpricing on firm level as simple, rather than logarithmic returns for two reasons; 1) both measures yield normalized values 2) simple returns yield intuitive results, while logarithmic returns will amplify/moderate negative/positive values and might return values lower than -100 %. On a portfolio level however, this is desirable, as logarithmic returns incorporate compounding while retaining its normality properties.

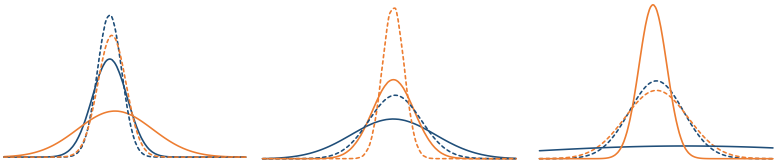
PE/VC

*Numbers in parenthesis are calculated applying symmetrically trimmed samples, cf. table info.	**Deflated Market Capitalization** Million NOK	**Raw Inital Returns Firm Level** Simple, Benchmark-adj.	**EW Initial Returns Portfolio Level** Logarithmic, Benchmark-adj.	**VW Initial Returns Portfolio Level** Logarithmic, Benchmark-adj.
Minimum	61 (106)	-59,36 % (-23,87 %)	-1,54 % (-0,46 %)	-0,33 % (-0,33 %)
Maximum	66 446 (11 914)	60,01 % (54,70 %)	0,79 % (0,74 %)	7,55 % (1,00 %)
Median	809 (809)	1,08 % (1,08 %)	0,02 % (0,01 %)	0,00 % (0,00 %)
Mean	2 950 (1 657)	3,64 % (3,48 %)	0,03 % (0,05 %)	0,23 % (0,04 %)
Standard Deviation	8 876 (2 155)	18,85 % (13,04 %)	0,33 % (0,21 %)	1,13 % (0,18 %)
Skewness		0,42 (1,17)	-1,51 (0,50)	5,75 (3,13)
Kurtosis		3,73 (3,68)	8,51 (2,08)	34,23 (15,80)

NB

	Deflated Market Capitalization Million NOK	**Raw Inital Returns Firm Level** Simple, Benchmark-adj.	**EW Initial Returns Portfolio Level** Logarithmic, Benchmark-adj.	**VW Initial Returns Portfolio Level** Logarithmic, Benchmark-adj.
Minimum	4 (75)	-78,28 % (-27,88 %)	-0,96 % (-0,20 %)	-0,24 % (-0,53 %)
Maximum	220 235 (19 789)	413,27 % (69,07 %)	1,01 % (0,33 %)	0,82 % (2,05 %)
Median	879 (879)	3,67 % (3,67 %)	0,02 % (0,02 %)	0,00 % (0,01 %)
Mean	4 207 (1 772)	9,35 % (6,04 %)	0,03 % (0,03 %)	0,02 % (0,04 %)
Standard Deviation	19 680 (2 648)	40,39 % (15,12 %)	0,16 % (0,09 %)	0,09 % (0,20 %)
Skewness		6,78 (1,17)	0,09 (0,52)	4,96 (6,35)
Kurtosis		64,18 (2,78)	16,80 (1,69)	41,70 (62,95)

Normal Distributions

Raw Inital Returns Firm Level Simple, Benchmark-adj.	**EW Initial Returns Portfolio Level** Logarithmic, Benchmark-adj.	**VW Initial Returns Portfolio Level** Logarithmic, Benchmark-adj.
		

At first glance, NB IPOs appears larger in terms of size, but after adjusting for outliers, we observe that the mean and standard deviation of both groups aligns. The minimum market capitalization of four million NOK for the NB sample results from deflating. The raw, firm level, benchmark-adjusted returns' sample also show extreme values, with a range varying from -59,36 % to 60,01 % for PE/VC and -78,28 % to 413,27 %[30] for NB IPOs. When we trim the returns, these ranges substantially narrows and nearly aligns, rendering the distributions quite similar. However, NB initial raw returns exhibit a median three times as high (3,67 % vs. 1,08 %) and a mean nearly twice the size (6,04 % vs. 3,48 %) relative to that of PE/VC initial raw returns, after adjusting for outliers.

On portfolio level, the equally-weighted returns are not comparable, as the sample sizes differ. In order to make the value-weighted returns more comparable, we adjust for outliers. Prior to trimming, it is worth mentioning that the combination of Renewable Energy Corporation's (REC) initial market capitalization weight of 38 % and underpricing of 19,79 % severely distorts the distribution properties. Trimmed returns reduces the mean and standard deviation by a factor of 6 for the PE/VC sample and renders these properties quite similar, while the skew and kurtosis of the NB sample still remains nearly twice and quadruple the size of the PE/VC sample (6,35/3,13 and 62,95/15,80). This indicates a positively skewed and highly leptokurtic distribution for the NB sample, resulting from infrequent extreme deviations from the mean, as opposed to frequent, modestly sized deviations. Observant readers might notice that the sample space between the minimum and maximum value for the NB VW sample actually widens for the trimmed sample. This might seems counter intuitive, but results from recalculations of weighted returns subsequent to removing the largest ones from the original sample. This also increases the distribution's kurtosis. We include combined frequency- and normal distributions in Appendix 6.6.

[30] The initial return of Camposol Holding.

5.2.2 Sponsoring

Table 4.3
Underpricing in Event Time

The table displays equally- and value-weighted average underpricing of PE/VC-backed and non-backed IPOs in event time. We define underpricing as the period between the offering date and the first day demonstrating a closing price that differ from the offering price. We calculate initial logarithmic raw returns as: $r_i = ln(P_{i,1}/P_{i,0})$, where $P_{i,0}$ is the offering price, while $P_{i,1}$ is the first closing price differing from the offering price. We adjust for benchmark returns using the OSEBX index during the same period in time, and aggregate the values into portfolios. Additionally, we report trimmed portfolio initial returns in parenthesis, adjusted for extreme values in the upper and lower 2,5 percentiles of the distributions. For a more thorough explanation, confer the previous table.

Portfolio Underpricing	**PE/VC**	**NB**
Equally Weighted	1,84 % (2,72%)	5,09 % (4,78%)
Value Weighted	13,42 % (3,85%)	3,03 % (4,81 %)

*numbers in parenthesis are calculated applying symmetrically trimmed samples, cf. Table info

The unadjusted equally-weighted portfolios indicate that small capitalization, NB IPOs underprice more heavily, while narrowing somewhat when applying trimming, to about two percent. The value weighted unadjusted portfolios on the other hand display marked underpricing of PE/VC IPOs, but as we have mentioned, RECs abnormally high market capitalization in combination with its substantial underpricing leaves the results ambiguous. When applying trimming to both samples, NB IPOs seems to underprice marginally higher, by about one percent on average. The VW unadjusted portfolio leaves the impression of higher underpricing amongst large PE/VC IPOs, while the opposite is true for NB IPOs. However, trimmed values show that larger issues experience marginally higher underpricing for both groups of IPOs, which contradicts conventional international results. In general, the adjusted samples yields results showing lower underpricing among PE/VC IPOs for both small and large issues. Our results are indicative of PE/VC actors being marginally better at pricing issues, leaving less money on the table for investors, even though tests fail to supply us with any significant t-statistics for differences in means for either equally or value weighted portfolios[31]. Our results show marginally lower underpricing of PE/VC IPOs, but our limited sample sizes restricts our inferential abilities.

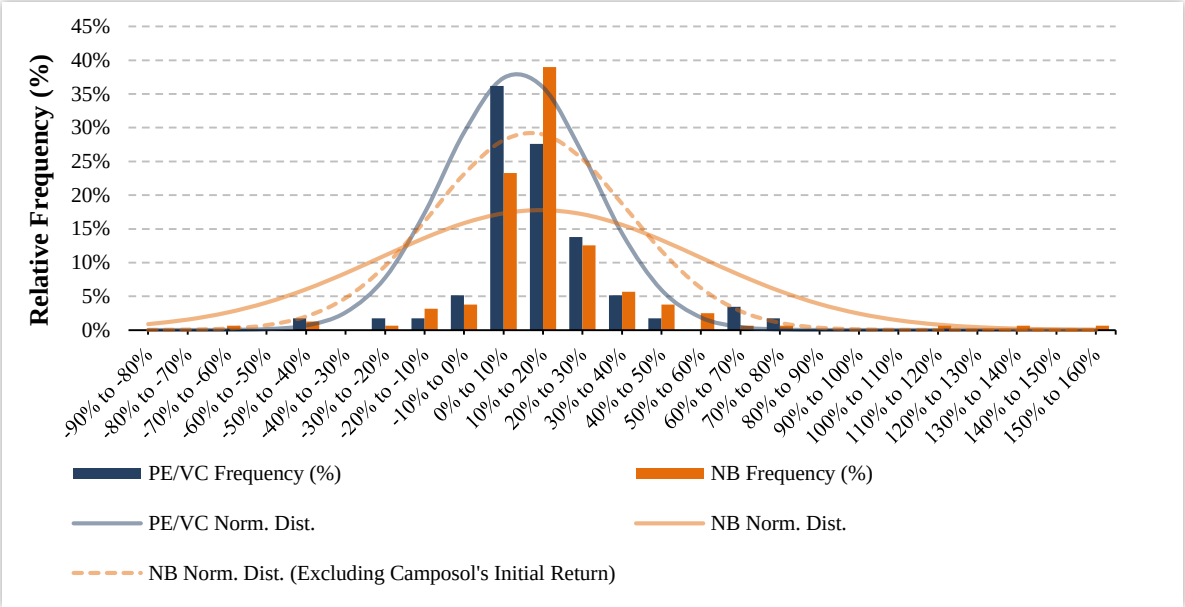
[31] We test for differences in means between sample groups, across equally- and value-weighted portfolios, using Welch's t-test for samples of unequal variance and size, as N = 160 for NB and N = 59 for PE/VC, and N=144 for NB and N=55 for PE/VC in the adjusted samples.

Unadjusted EW portfolios: p-value of 0,33
Adjusted EW portfolios: p-value of 0,27
Unadjusted VW portfolios: p-value of 0,16
Adjusted VW portfolios: p-value of 0,21

Figure 4.1

Initial Returns' Frequency- and Normal Distributions

Frequency distributions of raw, simple, benchmark-adjusted PE/VC- and NB returns with normal distributions. We use simple rather than logarithmic returns to illustrate the distribution of underpricing on firm level, as we only apply the initially calculated logarithmic returns when aggregating additively on a portfolio level. The dotted line illustrates the change in the NB normal distribution when excluding the extreme observation of Camposol (413,27 %). We illustrate relative frequency distributions due to differing sample sizes.



We are unable to find significant differences between the portfolios comprised of equally and value weighted logarithmic initial returns, but as the frequency distributions above illustrate, there are substantial differences in the raw, simple returns' data set. While assigning weights attribute towards distinguishing between large and small firms' contribution to the results, the distribution above is purely descriptive and ignores size. Additionally, returns are calculated as simple returns, rather than logarithmic, leaving a more realistic impression of the actual, firm level, initial returns distribution. NB IPOs display some pronounced extreme values, and the lion's share of the observations lies in the interval between 10 % and 20 %. The PE/VC IPO samples returns mainly lies in the interval between 0 % and 10 %, while also displaying fewer infrequent and extreme values, as the kurtosis clearly indicates (3,73 for PE/VC, 64,18 for NB). Even after adjusting for Camposol's initial return of 413,27 %, the NB sample still exhibit a higher standard deviation than the PE/VC sample. In other words, even though the

theoretically constructed portfolios display no significant differences, we observe marked differences in the raw initial returns' data set.

Table 4.4
Underpricing/Initial Returns in Calendar Time

Average equally-weighted underpricing of PE/VC and NB IPOs, respectively, in calendar time. Underpricing equals the initial return in the period between the IPO day and the first day demonstrating a closing price other than the opening list price, provided there is no intermediate trading. We adjust for the OSEBX return over the same period in time.

Year	PE/VC	N	NB	N	Diff. (PE/VC-NB)
1996	-	-	-	-	-
1997	12,62 %	6	14,61 %	33	-1,99 %
1998	-0,60 %	3	7,97 %	11	-8,57 %
1999	29,88 %	2	-23,50 %	5	53,37 %
2000	-4,32 %	6	-10,46 %	10	6,13 %
2001	-6,05 %	1	10,84 %	7	-16,89 %
2002	-43,45 %	2	-3,64 %	1	-39,81 %
2003	-9,79 %	1	3,27 %	1	-13,05 %
2004	0,83 %	6	4,19 %	6	-3,36 %
2005	6,86 %	14	5,29 %	21	1,57 %
2006	4,65 %	7	2,79 %	14	1,87 %
2007	0,97 %	8	2,97 %	27	-2,01 %
2008	-	-	15,77 %	10	-
2009	-	-	-2,30 %	2	-
2010	-12,60 %	3	-1,04 %	12	-11,56 %
Sum		**59**		**160**	

The PE/VC yearly cohorts suffers from small and highly varying sample sizes, leaving statistical testing for differences in means across and between years, impractical. In addition, due to the small size of the PE/VC sample for most cohorts, it is difficult to compare any given year's underpricing across the two groups. Despite these issues, we have listed the results above to illustrate differences and comment on distinctive values.

The largest deviation in underpricing between the two groups of IPOs originates from 1999, where PE/VC IPOs, on average supplied an initial return of 29,88 %, while NB IPOs was overpriced by 23,50 %. The only PE/VC-backed firms floated in 1999 were Infostream and Axis-Shield, where the former supplied investors with an initial return of 44 %, and the latter 16 %. Because NB IPOs on average were overpriced this year, the difference seems pronounced, while it in fact may have arisen purely by chance. Additionally, PE/VC-backed

IPOs seems to be highly overpriced relative to NB IPOs during the period of 2001-2003, while a closer look reveals that this period also suffers from few observations. The remaining cohorts display similar underpricing between the two groups of IPOs. It is worth mentioning that 24 % of the PE/VC sample- and 13 % of the NB sample goes public in 2005, a year where both groups supply quite similar initial returns. We observe that, on average, across all yearly cohorts, PE/VC IPOs display marginal *over*pricing (μ = -1,75 %, σ = 16 %), while NB IPOs are marginally *under*priced (μ = 1,91 %, σ = 10 %).

5.2.3 Market Capitalization and Risk

Table 4.5
Explanatory Factors of Underpricing

We run a multiple regression on raw firm level, simple, benchmark-adjusted initial returns for PE/VC- and NB IPOs with deflated market capitalization (using a time-varying GDP-deflator), equity betas and a dummy-variable indicating PE/VC-backing, as independent variables: $\{BM\ adj.initial\ return = \beta_0 + \beta_1(Market\ Cap.) + \beta_2(Beta) + \beta_3(PE/VC) + u_t\}$. We calculate betas for companies that remains active for at 36 months subsequent to the IPO, and include a maximum of 60 months for any given beta value, to capture the market sensitivity surrounding the IPO event. This leaves us with a sample consisting of 46 PE/VC IPOs and 102 NB IPOs, for a total of 148 IPOs.

	(1) **Robust OLS**
Market Capitalization	-0.000 (0.000) *t: -0,27 / P > | t |: 0,79*
Equity Beta	0.036 (0.044) *t: 0,81 / P > | t |: 0,42*
PE/VC dummy	-0.073 (0.050) *t: -1,45 / P > | t |: 0,15*
Constant	0.070 (0.072) *t: 0,98 / P > | t |: 0,33*
N	148.000
Adj. R^2	-0.0125

Standard errors in parentheses, t- and p-values below.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Our original results resemble those of Megginson and Weiss (1991), as the dummy coefficient indicate a negative effect of PE/VC involvement on underpricing, although insignificant, while simultaneously showing virtually no effect of size. We do not find any effect of risk affecting underpricing, as postulated by Levis (2011), for our original sample. The explained variance of underpricing by market capitalization, equity betas and the PE/VC-dummy is

below zero, displaying an adjusted R^2 of -1,25[32]. The F-test yields an F-value of 0,76 and we have to keep the null stating joint insignificance of our explanatory variables. We have accounted for the multiple regression model's assumptions in Appendix 6.1 in several ways; the most important one, the zero conditional mean, states that the error term should not simultaneously correlate with the dependent and independent variables, which might indicate, among other things, an omitted variables bias. Including additional explanatory variables might mitigate this problem. The F-test reveals that our explanatory variables are jointly insignificant, which indicate we might have an omitted variables bias. We also operate with a sub-sample of our full IPO-sample, but cannot find any logical reason for breaching assumption three, concerning random sampling. On the other hand, our sample period covers two financial crises, which may bias our full IPO-sample, relative to past and future IPOs.

Regarding the assumption of constant variance (homoskedasticity), the diagnostic plot in Appendix 6.2 show that the data probably do not suffer from heteroskedasticity. Despite a couple of outliers, the error terms display a shape indicative of constant variance. When assessing assumption 6 (normality of residuals), we notice that the extreme initial returns of Camposol (413,27 %) and Norwegian Applied Technology (145,92 %) leaves our inference invalid, as our density distributions are far from normally distributed (Appendix 6.3). We remove these observations, which leaves our residuals resembling approximately normally distributed, with the exception of higher density surrounding the mean. When we regress using the adjusted sample, we find that the estimated equity betas display a significant and positive coefficient[33], indicating that riskier issues display higher underpricing (initial returns).

The remaining explanatory variables' p-values now increase substantially, still leaving them jointly insignificant. The original p-value and the negative direction of the PE/VC-dummy coefficient (0,15) indicated that PEs/VCs mitigated underpricing to some extent. However, subsequent to the adjustment, the p-value increases to 0,47. It seems our adjusted data supports

[32] The adjusted R^2 accounts for an increasing number of explanatory variables, as the ordinary R^2 always increase when adding variables to the model. $Adj.R^2 = 1 - \frac{SS_{err}/\,df_e}{SS_{tot/df_t}}$, where SS_{err} is the sum of squared error terms, SS_{tot} is the total sum of squares, df_t is the degrees of freedom $n-1$ of the population variance, and df_e is the degrees of freedom $n-p-1$ of the estimate of the underlying population error variance.

[33] $\beta_{(Equity\ Beta)} = 0{,}069$, with a p-value of 0,02. (t-statistic: 2,36)

the notion of risk being the primary factor influencing underpricing, which is consistent with the results of Levis (2011).

5.3 Long-Run Performance

We use total return index (RI) values from Datastream when calculating the returns of individual firms and the OSEBX index, as the RI accounts for capital operations and dividends, by assuming reinvestment in each respective equity. The first RI value for each company originates from the 1st of the month subsequent to the offering, as we wish to calculate long-run performance excluding initial returns, which we highlighted separately in section 4.2. We have supplemented the tables below with additional information, where appropriate.

5.3.1 Descriptive Statistics

Table 4.6
Descriptive Statistics of Monthly Abnormal Returns

We measure monthly, simple[34], benchmark-adjusted returns as; $\left[r_{i,t} = (RI_t - RI_{t-1})/RI_{t-1}\right]$, where RI_t equals the total return index level in month *t* and RI_{t-1} is the total return index level the previous month. The index values accounts for capital operations (e.g. stock splits) and assumes reinvestment of dividends. We report individual (firm level) stock's raw[35] returns independent of life span (i.e. including all returns for all months *t*), and additionally on an aggregated portfolio level, equally- and value-weighted, dependent on life span (i.e. between a minimum of one and a maximum of 60 monthly returns), to capture the "IPO-effect". These portfolios are comprised of returns originating from companies that went public during the five years prior to each respective months aggregated return, effectively excluding companies of longer maturities. In the event of delistings prior to month t_{60}, we rebalance the portfolios. Our sample data cover return series for 298 NB IPOs and 67 PE/VC-backed IPOs. We have included the OSEBX returns' distribution and its normal distribution for the equally- and value-weighted portfolios to highlight differences.

PE/VC

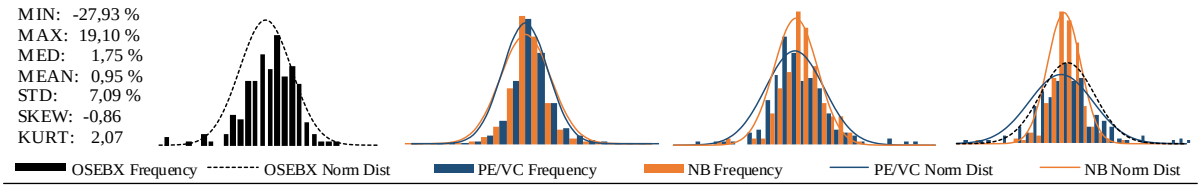
	Raw IPO Returns Firm Level Monthly Simple BM-adj. Returns	EW IPO Returns Portfolio Level Monthly Simple BM-adj. Returns	VW IPO Returns Portfolio Level Monthly Simple BM-adj. Returns
Minimum	-95,96 %	-22,40 %	-26,44 %
Maximum	189,56 %	27,14 %	30,70 %
Median	-1,99 %	-0,79 %	-0,88 %
Mean	-0,32 %	-0,19 %	-0,69 %
Standard Deviation	17,99 %	6,72 %	8,36 %
Skewness	1,27	0,64	0,73
Kurtosis	7,71	2,82	2,75

NB

	Raw IPO Returns Firm Level Monthly Simple BM-adj. Returns	EW IPO Returns Portfolio Level Monthly Simple BM-adj. Returns	VW IPO Returns Portfolio Level Monthly Simple BM-adj. Returns
Minimum	-97,89 %	-18,84 %	-23,50 %
Maximum	730,77 %	12,57 %	15,65 %
Median	-1,16 %	-0,03 %	0,20 %
Mean	-0,06 %	0,03 %	0,10 %
Standard Deviation	19,85 %	5,02 %	4,36 %
Skewness	6,14	-0,38	-0,72
Kurtosis	160,96	1,68	4,77

Distributions

OSEBX Returns Value Weighted Index Monthly Simple Returns	Raw IPO Returns Firm Level Monthly Simple BM-adj. Returns	EW IPO Returns Portfolio Level Monthly Simple BM-adj. Returns	VW IPO Returns Portfolio Level Monthly Simple BM-adj. Returns
MIN: -27,93 % MAX: 19,10 % MED: 1,75 % MEAN: 0,95 % STD: 7,09 % SKEW: -0,86 KURT: 2,07			



[34] $Simple\ return = \left[\frac{(RI_t - RI_{t-1})}{RI_{t-1}}\right]$, as opposed to $logarithmic\ return = ln\left[\frac{RI_t}{RI_{t-1}}\right]$

[35] $Raw\ return = \left[\frac{(RI_t - RI_{t-1})}{RI_{t-1}}\right] \leftrightarrow ln\left[\frac{RI_t}{RI_{t-1}}\right]$, as opposed to $weighted\ returns = \left\{\left(ln\left[\frac{RI_t}{RI_{t-1}}\right]\right) \times w_i\ or\ \frac{1}{n_P}\right\} \leftrightarrow \left\{\left(\left[\frac{(RI_t - RI_{t-1})}{RI_{t-1}}\right]\right) \times w_i\ or\ \frac{1}{n_P}\right\}$

We include IPOs' benchmark-adjusted firm-level returns to illustrate the properties of the raw data set, while we apply the weighted data sets in the CAR, BHR and risk-adjusted returns' calculations. In the following, we comment on differences between IPO groups, across weighting methods. The equally weighted and benchmark-adjusted PE/VC IPO return distribution, which proxy for smaller capitalization firms, display a median and mean value lower than that of the NB IPOs, at -0,79 % (median) and -0,19 % (mean) compared to -0,03 % and 0,03 %, respectively. The equally-weighted PE/VC returns' distribution display a marginally higher standard deviation and nearly twice the kurtosis contrasted with the equally-weighted NB returns' distribution, indicating more numerous infrequent outliers in the former sample. This is natural, as the equally-weighted returns for the NB sample are fractions with a larger denominator.

The value-weighted returns, which proxy for larger capitalization firms, indicate that large PE/VC-backed IPOs perform even worse than smaller PE/VC-backed IPOs, returning a median and mean of -0,88 % and -0,69 %, respectively. The opposite is true for NB IPOs, as the value weighted-portfolio display a mean and median of 0,20 % and 0,10 %, respectively, higher than the equally-weighted NB portfolio values. The volatility of the value-weighted PE/VC portfolio returns is almost twice the size of the value-weighted NB portfolio, at 8,36 % versus 4,36 %.

The OSEBX returns distribution display a mean of 0,95 %, which is significantly higher than the equally- and value-weighted PE/VC portfolios, but only borderline significantly different from the value-weighted NB IPO portfolios, when applying a significance level of 5%[36]. We test whether any of the portfolios return significant alphas when regressed on the market, both using CAPM and multifactor models, in section 4.3.3.

[36] Two-Sample t-tests, Assuming Unequal Variances, returns the following one-tail t- and p-values with a null hypothesis stating that the means of the samples equals the mean of the OSEBX index:

EW PE/VC: t: 1,6510 / p: 0,0498
VW PE/VC: t: 2,1158 / p: 0,0175
EW NB: t: 1,4899 / p: 0,0686
VW NB: t: 1,4507 / p: 0,0739

5.3.2 Sponsoring

Cumulative Abnormal Returns

Table 4.7

Cumulative Abnormal Returns in Event Time

Cumulative abnormal returns (CARs) calculated with monthly rebalancing and the OSEBX as benchmark, for both PE/VC- and NB firms, equally- and value-weighted, in event time, over 6 months, 1 year, 3 years and 5 years. We calculate the benchmark adjusted abnormal return as: $\{ar_{i,t} = r_{i,t} - r_{BM,t}\}$, where $ar_{i,t}$ is the monthly abnormal return of IPO *i*, $r_{i,t}$ is the monthly raw initial return for IPO *i* and $r_{BM,t}$ is the monthly benchmark return. We separate PE/VC- from NB-firms, calculate the abnormal returns, and then aggregate the results on a portfolio basis. We calculate the equally-weighted portfolio of abnormal returns by adding the abnormal returns of *n* IPOs during month *t*: $\left\{AR_{p,t}^{EW} = \frac{1}{n_p}\sum_{i=1}^{n_p} ar_{i,t}\right\}$, where $AR_{p,t}^{EW}$ is the equally weighted abnormal return of portfolio *p* in month *t*. The value-weighted portfolio return formula is defined as: $\{AR_{p,t}^{VW} = \sum_{i=1}^{n_p} w_{i,t} \times ar_{i,t}\}$, where $w_{i,t}$ is the weight of the stock *i* in relation to the total size of portfolio *p* in month *t* and $AR_{p,t}^{VW}$ is the value-weighted abnormal return for portfolio *p* in month *t*. Market capitalization weights are aligned to the base year of 2010 using a time-varying GDP deflator. We accumulate both measures separately in event time, regardless of issue date, to obtain a CAR for each weighting method: $\{CAR_{t-T} = \sum_{t=1}^{T} AR_t\}$.

	PE/VC				NB			
Time Horizon	**6m CAR**	**1y CAR**	**3y CAR**	**5y CAR**	**6m CAR**	**1y CAR**	**3y CAR**	**5y CAR**
Equally-Weighted	-6,23 %	-21,01 %	-63,68 %	-113,04 %	-8,90 %	-17,16 %	-61,07 %	-99,16 %
Value-Weighted	-5,45 %	-4,05 %	-59,67 %	-150,47 %	-4,09 %	1,84 %	-11,01 %	-14,11 %

The value-weighted portfolio of NB IPOs clearly outperforms all other portfolios, over all time horizons, assuming similar relative volatility as the OSEBX. By definition, large NB capitalization firms attributes the most towards the observed results, while the largest PE/VC-backed IPOs performs the worst, which is unconventional, as one usually observes the largest deviations for the equally weighted returns[37]. The difference between the equally-weighted 5-year CARs is almost neglectable, -113,04 % for PE/VC IPOs and -99,16 % for NB IPOs, a difference of 13,88 %. However, Table 4.8 neglects to inform of the short run development of the of the value-weighted CAR for the PE/VC IPOs, as it always seems to be worse off than that of the NB IPOs. Figure 4.2 illustrates a run up of the CAR until the 18th month, where PE/VC IPOs outperforms NB IPOs with a difference of about 20 %. At first glance, this might be indicative short-sightedness among PEs/VCs, as postulated in Bergström, Nilsson and Wahlberg (2006), characterized by high initial returns with rapidly deteriorating returns in the long run, as their ownership stake is gradually reduced. However, we are aware of that some

[37] We received information from Professor Thore Johnsen at NHH on this issue.

companies were listed with abnormally high market capitalization, which might distort the results of the value-weighted CAR, if their development deviates substantially from that of the average company. Below, in Figure 4.2 and Figure 4.3, we have graphed the CARs' development both using original - and adjusted data, applying trimmed portfolios.

Table 4.8
Trimmed Cumulative Abnormal Returns in Event Time

Cumulative abnormal returns (CARs) calculated with monthly rebalancing and the OSEBX as benchmark, for both PE/VC- and NB firms, equally- and value-weighted, in event time, over 6 months, 1 year, 3 years and 5 years. We apply symmetrical trimming to all portfolios, which involves removing 5 % of the firms exhibiting extreme CARs, 2,5 % from each tail of the distribution. Each individual firm's weighted CAR is calculated as: $\{ar_{i,t-T}^{VW} = \sum [w_{i,t} \times ar_{i,t}]\}$, for the VW portfolio, and as: $\left\{ar_{i,t-T}^{EW} = \sum \left[\frac{1}{n_p} \times ar_{i,t}\right]\right\}$ for the EW portfolio through the full sample period of 60 months (cf. section 3.1.2 for notation details). Prior to aggregating on portfolio level, we remove the four firms from the PE/VC sample and the 16 firms from the NB sample (50 % in each tail) that exhibit the highest and lowest CARs. Subsequently, we recalculate the remaining returns according to new weights/fractions, and accumulate the CARs across the predefined time-horizons.

	PE/VC				NB			
Time Horizon	**6m CAR**	**1y CAR**	**3y CAR**	**5y CAR**	**6m CAR**	**1y CAR**	**3y CAR**	**5y CAR**
Equally-Weighted	-8,03 %	-21,86 %	-59,00 %	-99,64 %	-8,52 %	-17,31 %	-56,11 %	-89,38 %
Value-Weighted	-15,75 %	-36,52 %	-85,55 %	-134,07 %	-7,85 %	-12,05 %	-24,30 %	-57,03 %

Subsequent to trimming, the value-weighted NB portfolio still outperforms all other portfolios, in all periods, though relatively less substantial. The value-weighted portfolios convergences considerably while the difference between the equally-weighted portfolios is only slightly reduced. The difference in 5-year value-weighted CARs narrows from 136,36 % (-150,47 % - (-14,11 %) to 77,04 % (-134,07 % - (-57,03 %)), and the steep surge of the value-weighted PE/VC CAR up until t_{18} completely disappears, displayed in Figure 4.3. The stippled lines shows the development of the original value-weighted CARs, while we have trimmed the others for outliers. The dotted blue line emphasizes the substantial impact of including firms with extreme CARs, among them; Renewable Energy Corporation, which entered the stock exchange with a market capitalization of 66 billion NOK (deflated), and displayed a highly volatile development. Statoil, among others, contributed substantially to the value-weighted NB sample, with its 220 billion NOK (deflated) IPO marked capitalization and subsequently high returns, displayed by the stippled brown line in Figure 4.3.

Figure 4.2

Cumulative Abnormal Returns in Event Time

CARs are calculated applying monthly rebalancing and excluding initial returns, adjusted for the OSEBX return during the same period, equally and value weighted, over a maximum of 60 months. We align market capitalization weights to the base year of 2010 using a GDP deflator, and accumulate both measures separately in event time, regardless of issue date, to obtain a CAR for each weighting method. Cf. Table 4.7.

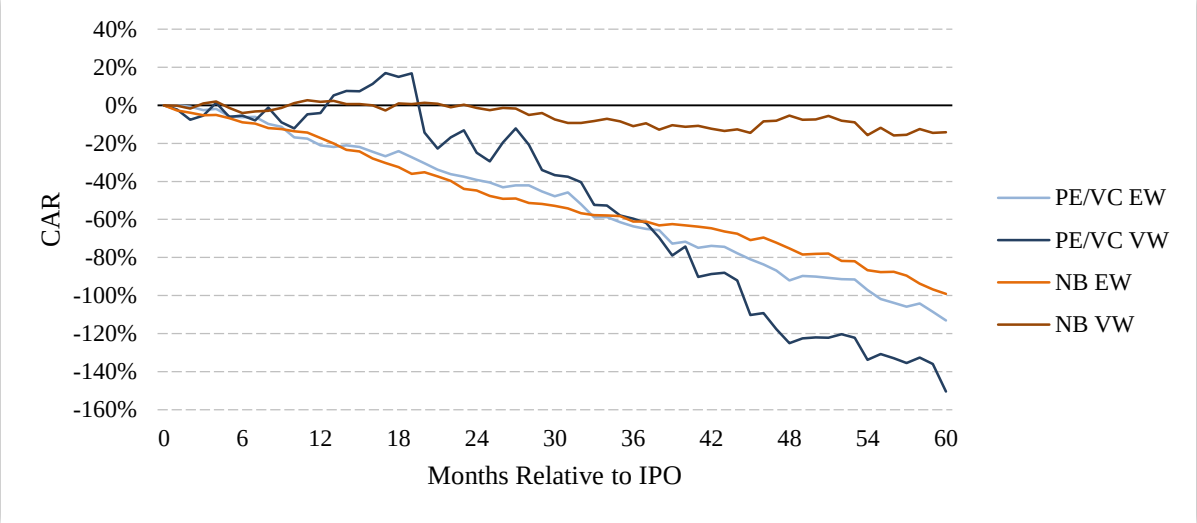
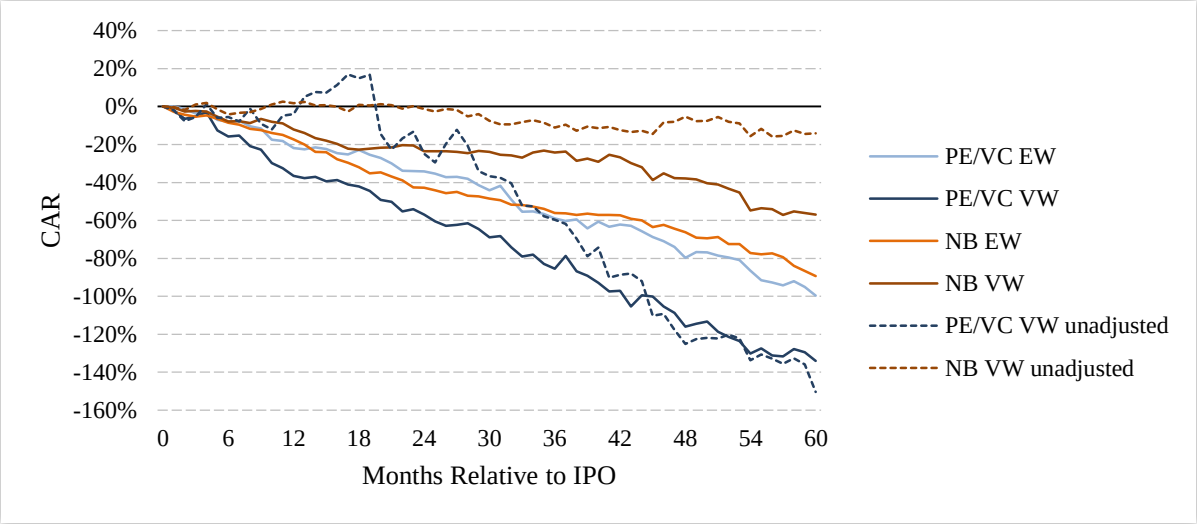


Figure 4.3

Analysis of Trimmed Cumulative Abnormal Returns in Event Time

The graph displays trimmed cumulative abnormal returns for PE/VC IPO- and NB IPO portfolios in event time. We apply symmetrical trimming to all portfolios, which involves removing 5 % of the firms exhibiting extreme CARs, 2,5 % from each tail of the distribution. Each individual firm's weighted CAR is calculated as: $\{ar_{i,t-T}^{VW} = \sum[w_{i,t} \times ar_{i,t}]\}$, for the VW portfolio, and as: $\left\{ar_{i,t-T}^{EW} = \sum\left[\frac{1}{n_p} \times ar_{i,t}\right]\right\}$ for the EW portfolio through the full sample period of 60 months (cf. section 3.1.2 for notation details). Prior to aggregating on portfolio level, we remove the four firms from the PE/VC sample and the 16 firms from the NB sample (50 % in each tail) that exhibit the highest and lowest CARs. Subsequently, we recalculate the remaining returns according to new weights/fractions, and accumulate the CARs across the full 60 months period. Cf. Table 4.8.



On average, REC inflicts a market capitalization weight of 39,22% on the value-weighted PE/VC portfolio returns over the full 60 months timespan. Statoil's average sample period weight (27,40%), also distort the results of the NB portfolio, given the relatively infrequent flotations of firms of similar size. None of the portfolios outperforms the OSEBX index, displayed by the black full line running from the origin, but we observe that there is only a marginal difference between the index and the unadjusted value weighted NB portfolio. The main reason for this alignment is that they to some extent resemble each other, as the OSEBX is constructed as a value-weighted index containing the largest and most liquid companies listed at the OSE[38]. Large market capitalization companies as Statoil is heavily represented in the OSEBX (IPO date from 2001), which ensures that the value-weighted NB portfolio's CAR covariates and evolves in the same pattern as the OSEBX.

For IPOs in general, our calculations partly aligns with those of Ritter (1991) and Loughran and Ritter (1995), as the equally weighted CARs displays severely worse performance than the value weighted CAR of NB IPOs, indicating that large capitalization firms outperform small capitalization firms, typically young growth firms. However, the value-weighted PE/VC CAR does not fit this description, as it indicates even worse performance among large capitalization PE/VC-backed IPOs than for any of the other portfolios. Our results directly oppose those of Bergström, Nilsson, and Wahlberg (2006) and Levis (2011), as we find marked worse performance among large PE/VC IPOs relative to all other IPOs, and poorer performance by smaller PE/VC issues relative to the remaining groups (NB EW and NB VW). On the other hand, our absolute sample size and the relative composition of PE and VC firms within the PE/VC sample, makes it difficult to distinguish between the two groups, which in turn renders their results less comparable to ours.

Our results also contradicts the findings of Brav and Gompers (1997), as they find underperformance of smaller NB firms relative to smaller VC firms, which in turn is

[38] The OSEBX is an investable index that aim at containing a representative sample of all listed shares on the OSE. OSE audits the OSEBX on a semi-annual basis and implement changes on December 1. and June 1. The securities are free-float adjusted, accounting for the proportion of a listed firm that is publically traded. In the period between revision dates, the number of shares for each index member is held fixed, excluding capital-adjustments dilutive to existing shareholders. The OSEBX is dividend-adjusted. As of 26 March 2013 consists of 55 companies, but during our sample period the number of included companies varies from 52 to 81.

substantially decreased when applying value-weighting. We find the direct opposite; the equally weighted NB portfolio performs marginally better than the equally weighted PE/VC portfolio, while the difference widens, rather than narrows when value-weighting returns. Further, the value-weighted NB portfolio outperforms all other portfolios, both before and after trimming. Below, we replicate the methodology applied in Ritter (1991) when calculating t-statistics for the CAR calculations. The null hypothesis states equal CARs for the market and each respective IPO portfolio.

Table 4.9

t-tests: Equally-Weighted Cumulative Abnormal Returns for Initial Public Offerings in the Period of 1996 to 2010

The equally weighted portfolios' abnormal returns (AR_t^{EW}) and cumulative abnormal returns $CAR_{1,t}$ in percent, with associated t-statistics for the 60 months after going public (excluding initial returns). $\left\{AR_t^{EW} = \frac{1}{n}\sum_{i=1}^{n_p} ar_{i,t}\right\}$, where $ar_{i,t}$ is the benchmark-adjusted abnormal return in month t. The t-statistics for the equally weighted abnormal return for month *t* is computed for each month as: $\{AR_t * \sqrt{n_t}/sd_t\}$, where AR_t is the equally weighted abnormal return for month *t*, n_t is the number of observations in month *t*, and sd_t is the cross-sectional standard deviation of the adjusted returns for month *t*. The t-statistic for the cumulative abnormal return in month *t*, $CAR_{1,t}$, is computed as: $\{CAR_{1,t} * \sqrt{n_t}/csd_t\}$, where n_t is the number of firms trading in each month, and csd_t is computed as: $\left\{csd_t = [t * var + 2(t-1) * cov]^{\frac{1}{2}}\right\}$, where t is the event month, var is the average (over 60 months) cross-sectional variance, and cov is the first-order autocovariance of the AR_t series. The samples originates from the calculations described in Table 4.7 and 4.8.

PE/VC Equally-weighted						**NB Equally-weighted**					
Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat	Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat
1	67	-0,09 %	-0,05	-0,09 %	-0,04	1	298	-2,78 %	-3,37	-2,78 %	-2,60
6	66	-0,50 %	-0,23	-6,23 %	-1,15	6	291	-2,10 %	-1,87	-8,90 %	-3,36
12	65	-3,56 %	-2,37	-21,01 %	-2,72	12	274	-2,84 %	-2,32	-17,16 %	-4,44
36	48	-2,16 %	-1,00	-63,68 %	-4,09	36	198	-2,84 %	-2,66	-61,07 %	-7,76
60	36	-4,48 %	-2,09	-113,04 %	-4,87	60	161	-2,44 %	-2,06	-99,16 %	-8,80

PE/VC Equally-weighted (trimmed)						**NB Equally-weighted (trimmed)**					
Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat	Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat
1	63	0,06 %	0,03	0,06 %	0,03	1	282	-2,85 %	-3,39	-2,85 %	-2,69
6	62	-1,08 %	-0,51	-8,03 %	-1,48	6	275	-1,99 %	-1,70	-8,52 %	-3,24
12	61	-3,63 %	-2,29	-21,86 %	-2,82	12	258	-2,35 %	-2,01	-17,31 %	-4,51
36	45	-2,34 %	-1,05	-59,00 %	-3,78	36	184	-2,12 %	-2,09	-56,11 %	-7,13
60	35	-4,47 %	-2,03	-99,64 %	-4,36	60	152	-2,66 %	-2,16	-89,38 %	-8,00

Both equally weighted portfolios performs significantly worse than the index, PE/VC IPOs by the first year, and NB IPOs by the first month (assuming critical *t*-value ≈ 2). However, the different sample sizes affect the t-statistics so that it seems like PE/VC IPOs display better short-run performance. However, as Figure 4.2 also illustrates, both groups share an almost identical development in CARs over time, both in the short- and long-run. Over the full sample

period of 60 months, both portfolios return significant *t*-values, and we reject the null hypothesis stating equal CARs for the market and the two portfolios. The t-tests for the trimmed samples yields similar results.

Table 4.10
t-tests: Value-Weighted Cumulative Abnormal Returns for Initial Public Offerings in the Period of 1996 to 2010

The value weighted portfolio abnormal return (AR_t^{VW}) and cumulative abnormal returns $CAR_{1,t}$ in percent, with associated t-statistics for the 60 months after going public (excluding initial returns). $\{AR_t^{VW} = \sum_{i=1}^{n_p} w_i \times ar_{i,t}\}$, where $ar_{i,t}$ is the benchmark adjusted abnormal return in month t. The t-statistics for the value weighted abnormal return for month t is computed for each month as $\{AR_t * \sqrt{n_t}/sd_t\}$, where AR_t is the value weighted abnormal return for month *t*, n_t is the number of observations in month *t*, and sd_t is the cross-sectional standard deviation of the adjusted returns for month *t*. The t-statistic for the cumulative abnormal return in month *t*, $CAR_{1,t}$, is computed as $\{CAR_{1,t} * \sqrt{n_t}/csd_t\}$, where n_t is the number of firms trading in each month, and csd_t is computed as $\left\{csd_t = [t * var + 2(t-1) * cov]^{\frac{1}{2}}\right\}$, where t is the event month, var is the average (over 60 months) cross-sectional variance, and cov is the first-order autocovariance of the AR_t series. The samples originates from the calculations described in Table 4.7 and 4.8.

PE/VC Value-weighted						NB Value-weighted					
Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat	Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat
1	67	-2,19 %	-1,15	-2,19 %	-0,99	1	298	-0,27 %	-0,32	-0,27 %	-0,25
6	66	0,57 %	0,27	-5,45 %	-1,00	6	291	-2,68 %	-2,39	-4,09 %	-1,55
12	65	0,70 %	0,47	-4,05 %	-0,52	12	274	-0,76 %	-0,62	1,84 %	0,48
36	48	-1,79 %	-0,83	-59,67 %	-3,83	36	198	-2,49 %	-2,34	-11,01 %	-1,40
60	36	-14,56 %	-6,80	-150,47 %	-6,47	60	161	0,38 %	0,32	-14,11 %	-1,26

PE/VC Value-weighted (trimmed)						NB Value-weighted (trimmed)					
Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat	Month of seasoning	Number of firms trading	AR_t %	*t*-stat	CAR_t %	*t*-stat
1	63	-1,87 %	-0,95	-1,87 %	-0,83	1	282	-0,68 %	-0,82	-0,68 %	-0,62
6	62	-3,10 %	-1,39	-15,75 %	-2,84	6	275	-2,44 %	-2,17	-7,85 %	-2,89
12	61	-3,98 %	-2,53	-36,52 %	-4,62	12	259	-3,11 %	-2,42	-12,05 %	-3,05
36	44	-2,70 %	-1,21	-85,55 %	-5,31	36	187	-1,08 %	-0,98	-24,30 %	-3,02
60	34	-4,55 %	-2,37	-134,07 %	-5,67	60	155	-0,94 %	-0,78	-57,03 %	-5,00

Table 4.10 reflects the development displayed in Figure 4.2 and 4.3. The PE/VC sample significantly underperforms the market within 3 years, while the NB sample does not seem to underperform during the full sample period of 60 months. However, the trimmed samples reveal significant underperformance of both IPO groups by the first 6 months, though pronouncedly worse for the PE/VC sample. The original run-up during the first year has disappeared, and the trimmed, largest PE/VC IPOs display the poorest performance over all periods, across all portfolios. Subsequent to trimming the value-weighted NB sample, it also display significant underperformance relative to the index. The estimated CARs for all

portfolios, except the unadjusted value-weighted NB portfolio, indicate statistically- and economically significant long-run underperformance, relative to the OSEBX index.

Buy-and-Hold Returns

Table 4.11

PE/VC-Backed IPOs' Buy-and-Hold Returns and Wealth Relatives

PE/VC BHRs calculated in calendar time over 6 months, 1 year, 3 years and 5 years with corresponding wealth relatives, indicating whether the yearly IPO cohorts outperformed the OSEBX index during the same period. The BHRs are defined as: $R_{p,T} = \prod_{t=1}^{T} (1 + r_{p,t})$, where $R_{p,T}$ is the portfolio's BHR measured without the initial returns, from the first month subsequent to the year of the offering, over time *T*, and $r_{p,t}$ is the sum of the portfolio firms' returns in month *t*. We invest a value-weighted share in each IPO at the first trading day subsequent to the year of flotation and redistribute the value amount according to each IPOs relative weight when a firm delists, while rebalancing monthly. We then divide the BHRs of the PE/VC and NB IPO portfolios by the BHR of the OSEBX, accumulated through the same period in time, to compute Wealth Relatives: $\left\{WR_{p,T} = \frac{R_{p,T}}{R_{BM,T}}\right\}$, where $R_{BM,T}$ is the BHR of the OSEBX. A WR < 1 indicate that portfolio *p* underperformed the market, while a WR > 1 indicate that portfolio *p* outperformed the market.

		Buy-and-Hold Returns				Wealth Relatives			
Year	**N**	**6 m**	**1 y**	**3 y**	**5 y**	**6 m**	**1 y**	**3 y**	**5 y**
1996	2	-7,73 %	28,30 %	-14,64 %	16,72 %	0,74	0,97	0,59	0,92
1997	6	-12,85 %	-66,30 %	160,22 %	-95,28 %	0,84	0,46	2,33	0,07
1998	4	58,85 %	109,97 %	31,75 %	54,96 %	1,30	1,39	1,01	1,16
1999	2	30,50 %	-12,74 %	-83,86 %	-65,33 %	1,27	0,86	0,27	0,28
2000	6	-41,88 %	-38,25 %	-60,07 %	-35,23 %	0,59	0,72	0,46	0,38
2001	2	2,35 %	-24,21 %	-9,99 %	-2,56 %	1,14	1,10	0,63	0,37
2002	2	86,49 %	199,61 %	319,70 %	68,55 %	1,62	2,02	1,45	0,40
2003	1	11,11 %	78,22 %	189,99 %	189,99 %	0,92	1,28	1,13	2,20
2004	8	14,13 %	62,25 %	35,74 %	49,26 %	0,95	1,16	0,66	0,96
2005	15	40,91 %	56,19 %	-15,85 %	99,96 %	1,23	1,18	1,24	1,50
2006	7	91,99 %	125,21 %	-55,76 %	-92,35 %	1,66	2,02	0,52	0,09
2007	8	-21,91 %	-48,01 %	-34,14 %	-42,16 %	0,84	1,13	0,73	0,64
2008	1	50,03 %	47,52 %	220,90 %	-	1,17	0,90	1,86	-
2009	0	-	-	-	-	-	-	-	-
2010	3	-21,31 %	-51,60 %	-	-	0,82	0,55	-	-

As previously mentioned, the BHR calculations for PE/VC IPOs may not be reliable, as the small sample size leaves the impression that most years' BHRs/WRs display arbitrary values, invalidating generalization and comparisons[39]. However, our data set is given, and the BHR calculations should be viewed as a supplement to the CAR- and risk-adjusted returns

[39] E.g. 2009 displays zero listing backed by PE/VC, while the remaining years experience few and varying samples sizes. For 2010 we only include BHRs and WRs for 6 months and 1 year, as 31.12.2013 lies ahead.

calculations. We comment in detail on differences between IPO segments where the yearly cohorts' wealth relatives differ substantially, especially when they move in opposite directions. Figure 4.4 below, where we graph the temporal development of each IPO groups' periodic wealth relative, illustrates the results of both Table 4.11 and 4.12, in a comparative manner.

Table 4.12

NB IPOs' Buy-and-Hold Returns and Wealth Relatives

NB BHRs calculated in calendar time over 6 months, 1 year, 3 years and 5 years with corresponding wealth relatives, indicating whether the yearly IPO cohorts outperformed the OSEBX index during the same period. The BHRs are defined as: $R_{p,T} = \prod_{t=1}^{T} (1 + r_{p,t})$, where $R_{p,T}$ is the portfolio's BHR measured without the initial returns, from the first month subsequent to the year of the offering, over time *T*, and $r_{p,t}$ is the sum of the portfolio firms' returns in month *t*. We invest a value-weighted share in each IPO at the first trading day subsequent to the year of flotation and redistribute the value amount according to each IPOs relative weight when a firm is delisted, and rebalance monthly. We then divide the BHRs of the PE/VC and NB IPO portfolios by the BHR of the OSEBX, accumulated through the same period in time, to compute Wealth Relatives: $\left\{WR_{p,T} = \frac{R_{p,T}}{R_{BM,T}}\right\}$, where $R_{BM,T}$ is the BHR of the OSEBX. A WR < 1 indicate that portfolio *p* underperformed the market, while a WR > 1 indicate that portfolio *p* outperformed the market.

		Buy-and-Hold Returns				Wealth Relatives			
Year	**N**	**6 m**	**1 y**	**3 y**	**5 y**	**6 m**	**1 y**	**3 y**	**5 y**
1996	20	28,18 %	65,88 %	90,05 %	95,68 %	1,03	1,25	1,31	1,55
1997	51	11,33 %	-15,15 %	-3,37 %	-61,53 %	1,07	1,16	0,86	0,58
1998	23	22,78 %	54,27 %	56,74 %	54,32 %	1,01	1,02	1,20	1,15
1999	8	29,59 %	-57,34 %	-95,77 %	-91,16 %	1,26	0,42	0,07	0,07
2000	22	-3,31 %	-6,21 %	-2,92 %	55,17 %	0,98	1,10	1,11	0,91
2001	15	7,99 %	-5,45 %	66,97 %	223,69 %	1,21	1,37	1,17	1,23
2002	3	-0,18 %	45,57 %	373,80 %	613,14 %	0,86	0,98	1,64	1,67
2003	3	-28,38 %	-32,36 %	42,77 %	-53,05 %	0,59	0,49	0,55	0,36
2004	14	40,73 %	73,92 %	270,79 %	182,19 %	1,17	1,24	1,80	1,81
2005	30	20,14 %	43,51 %	-16,24 %	160,70 %	1,04	1,09	1,24	1,96
2006	25	13,72 %	-4,84 %	-45,46 %	-62,60 %	0,98	0,85	0,65	0,42
2007	49	-8,73 %	-60,84 %	-25,16 %	-13,52 %	0,98	0,85	0,83	0,96
2008	15	25,38 %	24,58 %	60,67 %	-	0,98	0,76	0,93	-
2009	3	-24,77 %	22,90 %	88,08 %	-	0,88	1,03	1,57	-
2010	17	4,65 %	-9,89 %	-	-	1,06	1,06	-	-

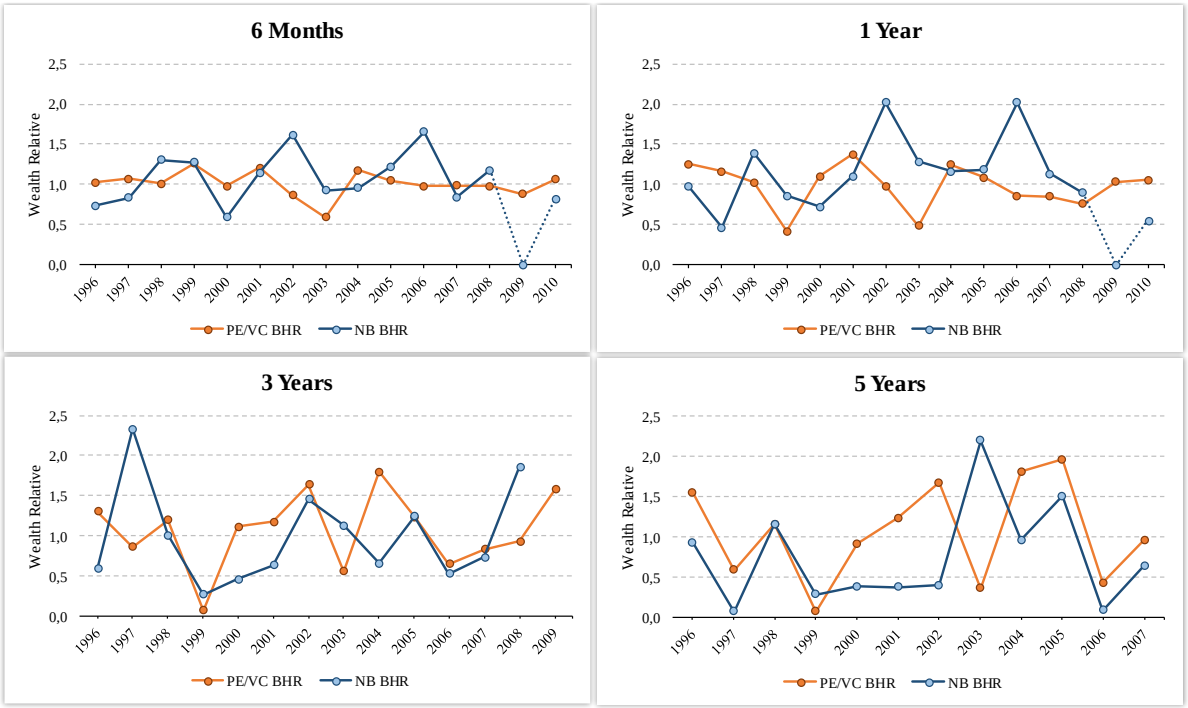
Among the short-run wealth relatives of 6 months and 1 year, we observe the largest deviations between the yearly cohorts of 2002 and 2006, where PE/VC IPOs perform well above the aggregate market, while NB IPOs return marginally less. Both groups exhibit few offerings during 2002, two for the PE/VC-backed sample and three for the NB sample, while there were floated 7 PE/VC IPOs and 25 NB IPOs during 2006. During 2002, Q-Free and Apptix went public in the auspices of Televenture Management and Convexa Capital, respectively, while

Subsea 7, Birdstep Technology and Lerøy Seafood Group form the development of the 2002-cohort for the NB sample. All companies, in both samples, remain active through the full five-year measurement period subsequent to the offering. The vastly differing values between the 2006-cohorts, where the PE/VC portfolio outperform the market by a factor of 2 during the first year, while the NB portfolio performs slightly worse than the market, originates from the run-up of the large market capitalization firm, REC. The hype surrounding REC lasted for approximately 20 months, before the stock ultimately plummeted, which characterize the long-run WRs, measured over three and five years, of 0,52 and 0,09, respectively.

Figure 4.4

Development in Wealth Relatives for PE/VC and NB IPOs across time

The graphs display the development in wealth relatives for both groups of IPOs over 6 months, 1 year, 3 years and 5 years. The wealth relative is defined as: $WR_{p,T} = \left(R_{p,T}/R_{BM,T}\right)$, where $R_{p,T}$ is the BHR in calendar time of IPOs floated in year *T*, and $R_{BM,T}$ is the BHR of the OSEBX during the same period. A wealth relative above one indicate that the cohort of IPOs outperformed the OSEBX, while a wealth relative below one indicate that the IPOs underperformed the OSEBX.



Arguing whether or not the underlying management fund, Hafslund Venture, contributed towards the hype surrounding the IPO of REC (e.g. marketing) is beyond the scope of our

thesis, but the observed difference is unlikely to have arisen due to superior management skill[40].

The PE/VC IPOs floated during 1997 exhibit a peculiar aggregated development in the after-market, characterized by worse performance than both the index and the NB IPO portfolio in the short-term, while the 3-year BHR surges, prior to declining drastically after 5 years. The index performs poorly during 1998, experiencing a drop of nearly 50 %, but the PE/VC-backed firms CorrOcean, Iterated Systems and Navis, with an initial accumulated market weight of 65 % performs even worse. This explains the poor performance in the short-run, while the development of the 3- and 5-year BHRs is mainly attributable to Marine Harvest, which experienced a tenfold increase in its stock price, which peaked in August of 2000. As a consequence of the collapsing market price for salmon in 2001, the stock price declined well below the IPO price within the end of 2002, biasing both the perceived long-run over- and underperformance of the portfolio. In other words, market dynamics seems to have affected the development of the PE/VC-backed IPOs floated in 1997, rather than various PE/VC-attributes.

The difference between the 2003-cohorts stands out as pronounced for both the short- and long-run BHRs, arising from the acquisition of NextGenTel Holding by the Swedish telecom firm TeliaSonera in 2006. NextGenTel is the only company in the PE/VC portfolio for 2003. It remained listed for nearly three years, and ultimately supplied initial investors with a BHR of 190 %.

The remaining wealth relatives measured over three- and five years often display similar values across IPO segment. We have explained why PE/VC IPOs have overperformed NB IPOs, which often arise due to general market dynamics, rather than the claimed attributes of active management funds. Figure 4.4 indicate that PE/VC IPOs supply marginally higher BHRs in the short term, while relatively underperforming both the market and NB IPOs in the long-run. PE/VC IPOs 6-month and 1-year WRs exceeds those of NB IPOs in 7 and 8 out of

[40] As we point out under section 3.1.2, portfolios comprised of equally weighted returns might proxy for management skill if they outperform the market or another group of IPOs. However, the clear dominance of REC in the value weighted portfolio, both in terms of market capitalization and abnormally high short-term returns, resemble a financial bubble rather than a result of superior management skill.

14 observed years, respectively, while the 3- and 5-year WRs only exceed those of NB WRs in 5 and 2 years out of 13 and 12 available yearly observations, respectively. Average 6-month and 1-year WRs equal 1,01 and 0,98 for NB IPOs, respectively, while they are somewhat higher for PE/VC IPOs, at 1,08 and 1,12, reflecting relatively better short term performance of PE/VC IPOs. 3-year and 5-year WRs equals 1,07 and 1,06 for NB IPOs, while declining to 0,99 and 0,75 for PE/VC IPOs, thereby unveiling similar long-run performance patterns as those found in the CAR calculations.

5.3.3 Market Capitalization and Risk

Table 4.13
Monthly Risk-Adjusted Returns

We calculate risk-adjusted returns using monthly, calendar time, simple portfolio returns. We aggregate the returns of all active IPO firms, in each respective group, that were listed in the five years previous to the month of the observation, equally- and value weighted. We exclude firms that remain active for longer than five year subsequent to the IPO, enabling us to measure the risk-adjusted return related to the IPO. Panel A display the risk-adjusted returns for the portfolio of PE/VC IPOs, using CAPM $\left\{r_{p,t}{}^{EW/VW} - r_{f,t} = \alpha + \beta_p\left(r_{M,t} - r_{f,t}\right) + u_t\right\}$, Fama and French three factor model $\left\{r_{p,t}{}^{EW/VW} - r_{f,t} = \alpha + \beta_p\left(r_{M,t} - r_{f,t}\right) + s(SMB_t) + h(HML_t) + u_t\right\}$ and the Fama and French extended model, including liquidity and momentum $\left\{r_{p,t}{}^{EW/VW} - r_{f,t} = \alpha + \beta_p\left(r_{M,t} - r_{f,t}\right) + s(SMB_t) + h(HML_t) + [\,l(LIQ_t) + m(UMD_t)] + u_t\right\}$. We estimate the models using all 199 monthly observations. Panel B displays the same procedure using NB IPOs portfolio returns, while Panel C regress on the excess returns of the PE/VC IPO portfolio over the NB IPO portfolio. We calculate risk-adjusted returns using equity- rather than asset betas, as it is argued in Fama and French (1992) that the combination of size- and value-factors absorbs the apparent roles of leverage in average stock returns. For the CAPM regressions, our betas incorporates the effect of leverage. We have corrected the coefficients' standard errors for heteroskedasticity and autocorrelation using Newey-West (NW) standard errors, and tested for unit root by applying Dickey-Fuller-tests; we are unable to detect any highly persistent time-series.

Panel A: PE/VC IPOs						
	$CAPM_{EW}$	**$CAPM_{VW}$**	**$FF3_{EW}$**	**$FF3_{VW}$**	**$FF5_{EW}$**	**$FF5_{VW}$**
α	-0.005	0.006	-0.008	-0.008	-0.005	-0.009
	(0.007)	(0.013)	(0.006)	(0.006)	(0.006)	(0.007)
β	0.913***	1.079***	0.797***	0.956***	0.862***	0.878***
	(0.064)	(0.077)	(0.071)	(0.087)	(0.073)	(0.129)
SMB			0.121***	0.098*	0.129***	0.108*
			(0.041)	(0.058)	(0.042)	(0.058)
HML			-0.339*	-0.408*	-0.364*	-0.426*
			(0.179)	(0.218)	(0.185)	(0.228)
LIQ					0.188	-0.122
					(0.221)	(0.314)
UMD					-0.099	-0.236**
					(0.078)	(0.092)
Months	199	199	199	199	199	199
Adj. R^2	0.533	0.502	0.569	0.530	0.577	0.544

Panel B: NB IPOs						
	$CAPM_{EW}$	**$CAPM_{VW}$**	**$FF3_{EW}$**	**$FF3_{VW}$**	**$FF5_{EW}$**	**$FF5_{VW}$**
α	-0.004	-0.000	-0.006	0.000	0.000	0.002
	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
β	0.873***	0.955***	0.788***	0.983***	0.935***	1.040***
	(0.043)	(0.048)	(0.047)	(0.049)	(0.051)	(0.048)
SMB			0.110***	-0.062*	0.118***	-0.064*
			(0.042)	(0.037)	(0.041)	(0.038)
HML			-0.148	-0.066	-0.178	-0.066
			(0.121)	(0.083)	(0.128)	(0.085)
LIQ					0.367***	0.116
					(0.132)	(0.094)
UMD					-0.015	0.075
					(0.049)	(0.057)
Months	199	199	199	199	199	199
Adj. R^2	0.658	0.746	0.677	0.750	0.695	0.755

Panel C: PE/VC - NB IPOs						
	$CAPM_{EW}$	**$CAPM_{VW}$**	**$FF3_{EW}$**	**$FF3_{VW}$**	**$FF5_{EW}$**	**$FF5_{VW}$**
α	-0.001	-0.004	-0.002	-0.009	-0.005	-0.011
	(0.004)	(0.009)	(0.004)	(0.007)	(0.004)	(0.009)
β	0.040	0.113	0.009	-0.027	-0.073	-0.162
	(0.039)	(0.093)	(0.043)	(0.098)	(0.067)	(0.159)
SMB			0.010	0.160**	0.011	0.173**
			(0.043)	(0.066)	(0.043)	(0.068)
HML			-0.191*	-0.342*	-0.187*	-0.360
			(0.100)	(0.204)	(0.106)	(0.224)
LIQ					-0.179	-0.239
					(0.149)	(0.334)
UMD					-0.084	-0.311**
					(0.067)	(0.125)
Months	199	199	199	199	199	199
Adj. R^2	0.003	0.009	0.028	0.028	0.044	0.099

Standard errors in parentheses
* p < 0.10, ** p < 0.05, *** p < 0.01

We obtained the Fama and French HML factor from Bernt Arne Ødegaard, who supply empirics on the OSE available from his webpage (domain belonging to the University of Stavanger[41]), while substituting the SMB factor by creating a long-short portfolio of the OSESX and OBX, respectively[42]. The liquidity and momentum factors originates from Ødegaards' calculations. We use local Fama and Franch factors, as Griffin (2002) finds they

[41] http://finance.bi.no/~bernt/financial_data/ose_asset_pricing_data/index.html

[42] After discussing the issue with Professor Thore Johnsen at NHH, we proxy for the SMB factor applying the difference between the OSESX and the OBX index, as MSCI applies a similar approach in evaluating the active management of the Norwegian government pension fund. The OSESX is a total return index consisting of the 10 % lowest capitalized stocks, while the OBX is comprised by the 25 most liquid stocks in the OSE Benchmark index (OSEBX) as measured by six-month trading volume.

are country-specific, hence local factors better explain time-series variation in stock returns than the global factors calculated at Kenneth Frenchs' website.

We test the regression models for autocorrelation (Appendix 6.7) and use Newey-West heteroskedasticity and autocorrelation-corrected standard errors to validate inference, according to the Newey and West (1987) procedure. We also transform the models using Cochrane-Orcutt and Prais-Winsten[43] to observe whether the resulting estimators deviate substantially from the OLS models' estimates, which might indicate spurious results (e.g. unit root/highly persistent time-series). We observe no such deviations, and the Dickey-Fuller[44] tests confirm the absence of unit root in our data-series (Appendix 6.8). The time-series does not seem to suffer from trending data, as the added linear trends returns insignificant coefficients.

Panel A) PE/VC IPOs

PE/VC IPOs' alpha estimates vary across the different models, almost consistently returning negative values, though statistically insignificant. The models we apply, return annualized alphas ranging from -10,8 % to 7,2 %[45]. While both portfolios return insignificant alphas using conventional significance levels, the equally-weighted portfolio borders at significance on a 10 % level with a p-value of 10,2 % and an annualized alpha of -9,6 % ($FF3_{EW}$). The market factor decreases as the factor loadings of SMB and HML returns significant coefficients for both portfolios in the three- and five-factor models, indicating a positive tilt towards small capitalization firms, and a negative tilt towards high book-to-market capitalization firms, relative to the OSEBX. This is consistent with common characteristics of sectors that PEs/VCs usually engage in, such as IT, cleantech and life sciences. In addition, large PE/VC IPOs seems

[43] Both Cochrane-Orcutt and Prais-Winsten transformations, are methods of estimating multiple linear regression models with Auto Regressive Processes of Order One [AR(1): a time-series model whose current value depends linearly on its most recent values plus an unpredictable error term] errors and strictly exogenous explanatory variables. However, unlike Prais-Winsten, Cochrane-Orcutt does not use the equation for the first time-period. With large sample sizes, there is little difference between them, but as our samples are small, we choose to apply both.

[44] Dickey-Fuller Test: *t* test of the unit root null hypothesis in an AR(1) model. Unit root is a highly persistent time-series process where the current value equals last period's, plus a weakly dependent disturbance.

[45] We multiply the monthly alpha by 12 to attain the annualized equivalent.

to have a significant negative tilt towards momentum, on a 5 % level, indicating fewer past "winners" for the PE/VC portfolio than for the index ($FF5_{VW}$).

Estimating a model over the full sample period, yields market factors for both portfolios below 1 (FF5), though not significantly different, which becomes clear when we estimate rolling regressions using an expanding window. However, when applying rolling regressions with an overlapping, moving window to capture time-variety, PE/VC IPOs seems to exhibit less than full market exposure during both financial crises, and significantly so for large firms during the subprime lending crisis (Figure 4.6). It is particularly interesting to observe how the expanding window regressions display a shift from an upward- to a downward trend in the market exposure subsequent to 2008 (Figure 4.5).

Figure 4.5

PE/VC IPOs Market Exposure; Rolling Model with Expanding Window

The graphs display the development of PE/VC IPOs aggregate excess market exposure when applying an initial window of 24 months, and then expanding the window by one month for each observation, using the extended Fama and French model. We have subtracted 1 from the beta estimates, to make the origin indicate the threshold for full market exposure. The stippled lines represent 95 % confidence bands (2 standard errors).

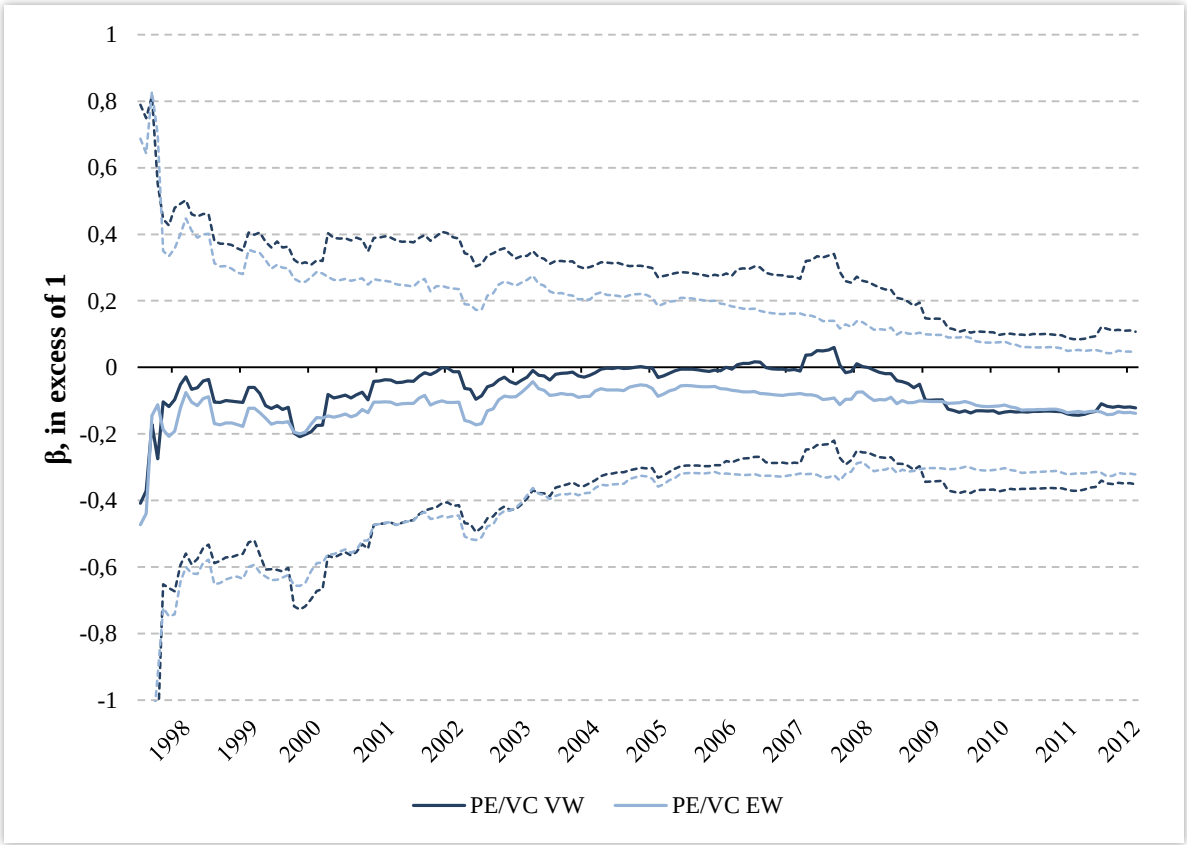
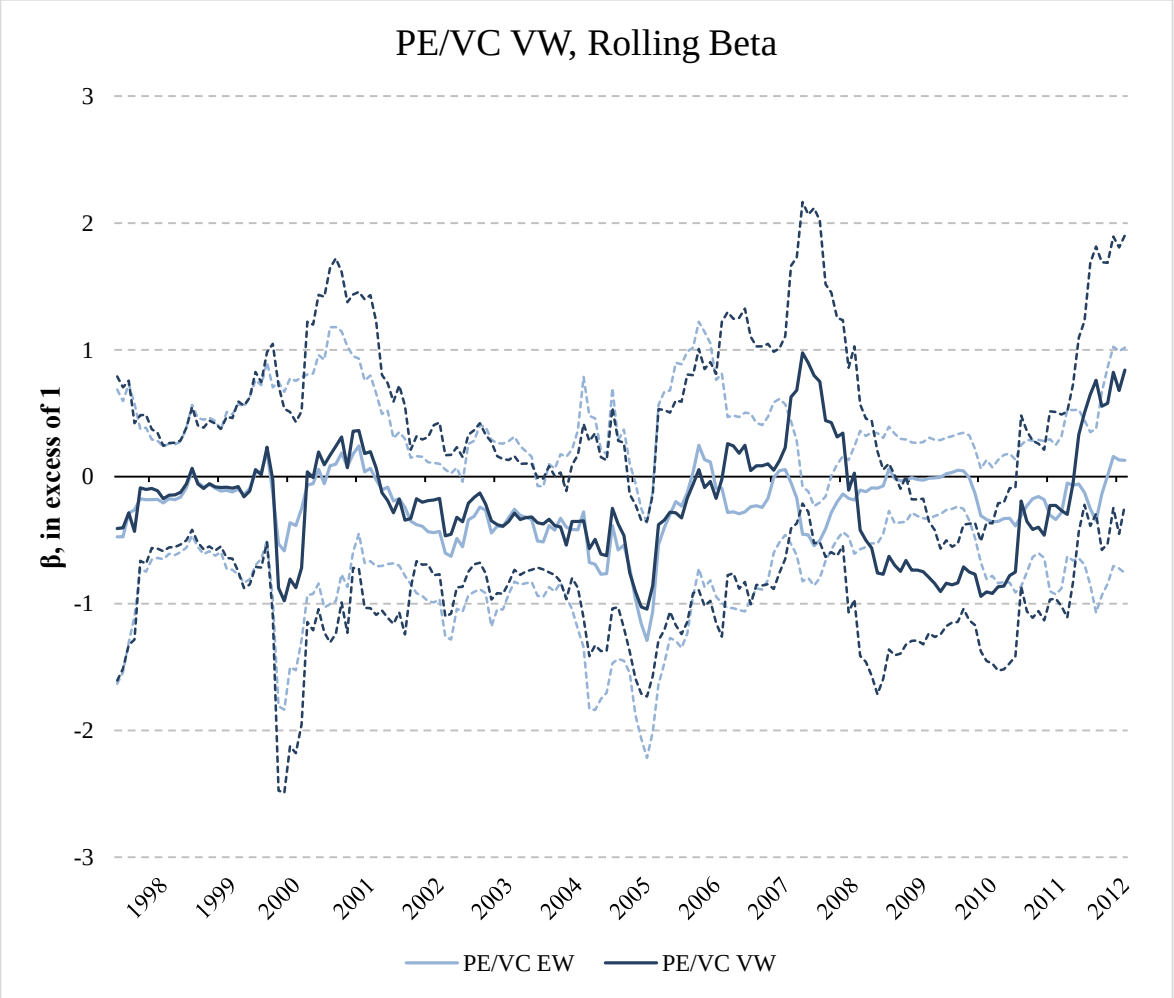


Figure 4.6

PE/VC IPOs Market Exposure; Rolling Model with Moving Window

The graphs display the development of PE/VC IPOs aggregate excess market exposure when applying an initial window of 24 months, and then moving the window by one month for each observation, capturing the time-variation of market exposure. We use the extended Fama and French model. We have subtracted 1 from the beta estimates, to make the origin indicate the threshold for full market exposure. The stippled lines represent 95 % confidence bands (2 standard errors).



The negative market exposure during 2004/2005 might have contributed to the observed PE/VC poor long-run performance, as this period experienced favourable equity returns. While we failed to find significant alphas for any of the portfolios when using the full sample period, we find time-varying alphas significantly different from zero, displayed in Figure 4.7 and 4.8. Both large, and small PE/VC-backed firms, seems to have struggled in providing excess returns subsequent to both financial crises, while more pronouncedly so for large capitalization firms. Large firms also drifted towards a borderline positive and significant alpha towards the market peak in 2008, most likely due to RECs evolvement prior to the financial crisis, while small firms drifted in the opposite direction.

Figure 4.7

PE/VC IPOs Equally-Weighted Time-Varying Alpha Estimates

The graphs display the development in PE/VC IPOs time-varying alpha estimates using the extended Fama and French-model on equally weighted portfolio returns. We estimate the model using a rolling window of 24 monthly observations, and plot the 95 % confidence bands (2 standard errors) indicating historical periods of risk-adjusted returns significantly different from zero, at the 5 % level.

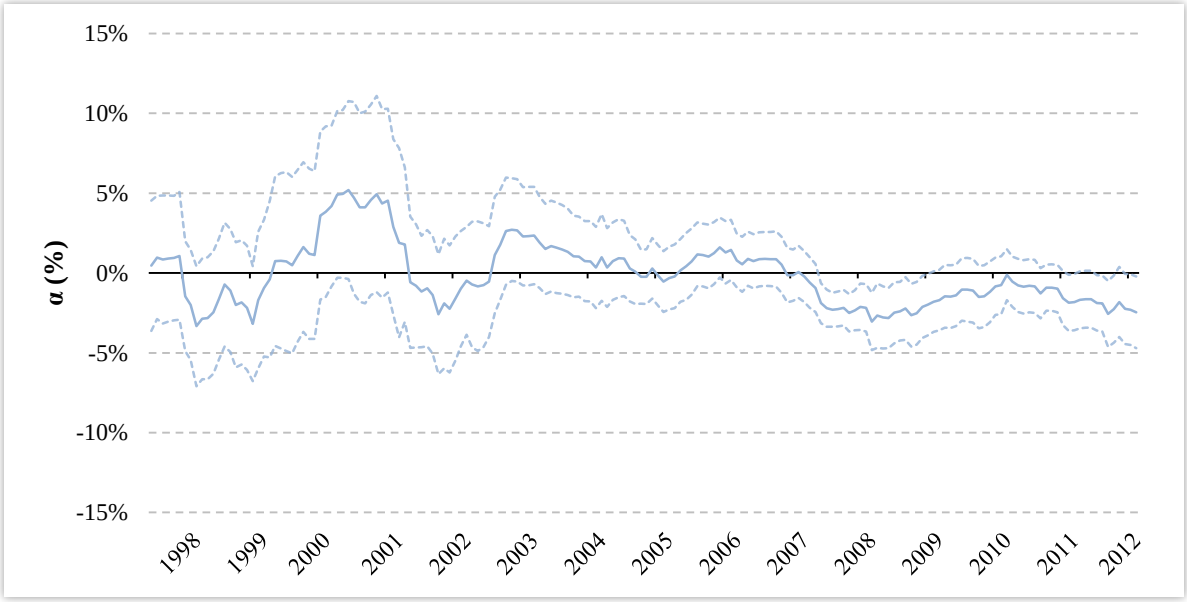
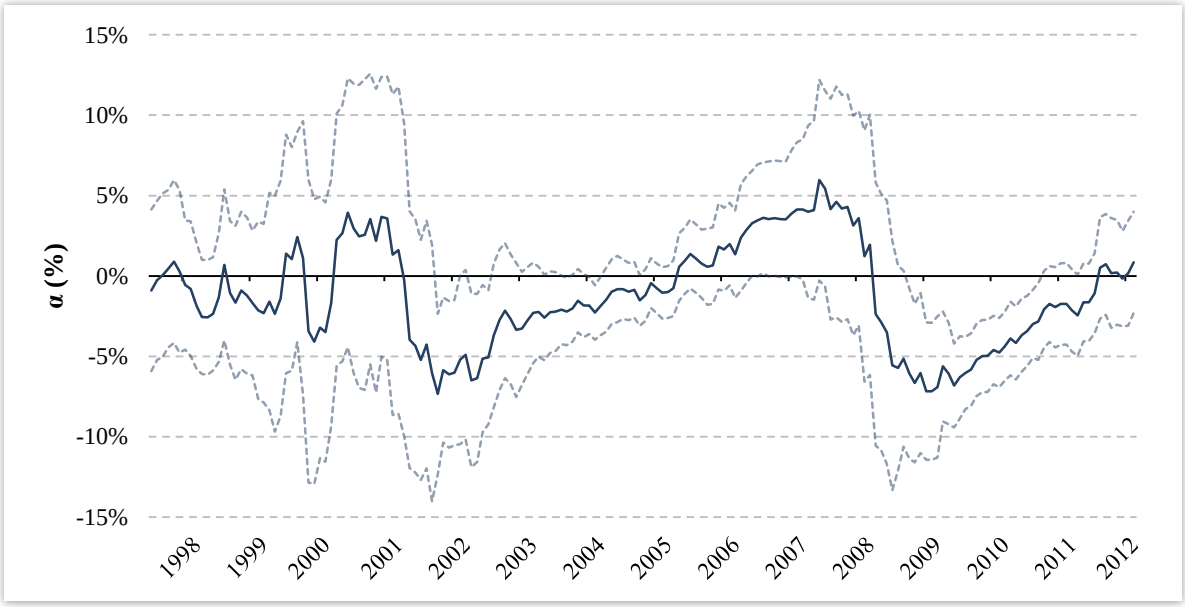


Figure 4.8

PE/VC IPOs Value-Weighted Time-Varying Alpha Estimates

The graphs display the development in PE/VC IPOs time-varying alpha estimates using the extended Fama and French-model on value weighted portfolio returns. We estimate the model using a rolling window of 24 monthly observations, and plot the 95 % confidence bands (2 standard errors) indicating historical periods of risk-adjusted returns significantly different from zero, at the 5 % level.



The PE/VC portfolios also show generally positive exposures to the SMB factor (Figure 4.14), with the exception of the period covering the dot.com-bubble, while the exposures to the HML factor (Figure 4.15) is significantly negative prior to- and during the dot.com-bubble for both large- and small capitalization firms. This seems natural, as many funds invested in growth firms prior to the crash. Additionally, large PE/VC IPOs tilted significantly towards liquid stocks in the period between the 2008 financial crisis, up until 2011[46] when the OSEBX approached levels resembling those prior to the crisis. This contrasts to the period leading up to the dot.com-bubble, were PE/VC-backed firms displayed higher exposure towards illiquid firms than the index. This seems natural, as small growth firms usually trades less frequently than large value-firms. Full sample regressions reveals that large IPO firms tilt negatively towards past losers, returning a negative coefficient on the UMD factor. Most of this effect originates from a short period following the 2008 financial crisis.

Panel B) NB IPOs

NB IPOs' annualized alpha-estimates ranges from -7,2 % to 2,4 %. While statistically insignificant, the range is narrower than for the PE/VC sample. We observe similar results from the $FF3_{EW}$ model for the NB sample, as the estimated alpha's p-value borders at significance on a 10 % level (10,4 %), with an annualized value of -7,44 %. The 5-factor model yields beta values that indicate consistent full market exposure, which is natural, as NB IPOs closely resemble the OSEBX index. In periods where PE/VC IPOs exhibit declining market exposure, the NB IPOs does not differ significantly from full exposure ($\beta = 1$). NB IPOs also seem to tilt towards illiquid stocks, at least among smaller IPOs, which also seems natural given that the sample contains a larger number of illiquid stocks than the PE/VC sample, and relative to the OSEBX.

Time varying alpha-estimates in Figure 4.9 and 4.10 reveal that NB IPOs have experienced less negative alphas in both magnitude and frequency. Both NB portfolios consistently display higher/less-negative exposures to the risk factors.

[46] We excluded the graphs displaying the time-varying exposures to liquidity and momentum. These are available upon request.

Figure 4.9

NB IPOs Equally Weighted Time-Varying Alpha Estimates

The graphs display the development in NB IPOs time-varying alpha estimates using the extended Fama and French-model on equally weighted portfolio returns. We estimate the model using a rolling window of 24 monthly observations, and plot the 95 % confidence bands (2 standard errors) indicating historical periods of risk-adjusted returns significantly different from zero, at the 5 % level.

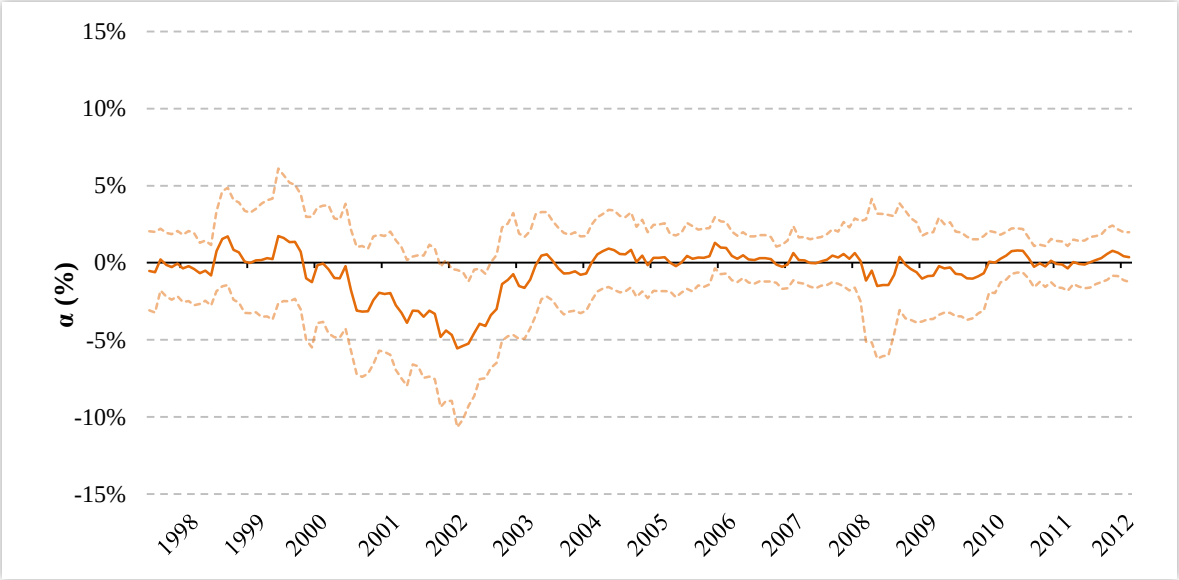
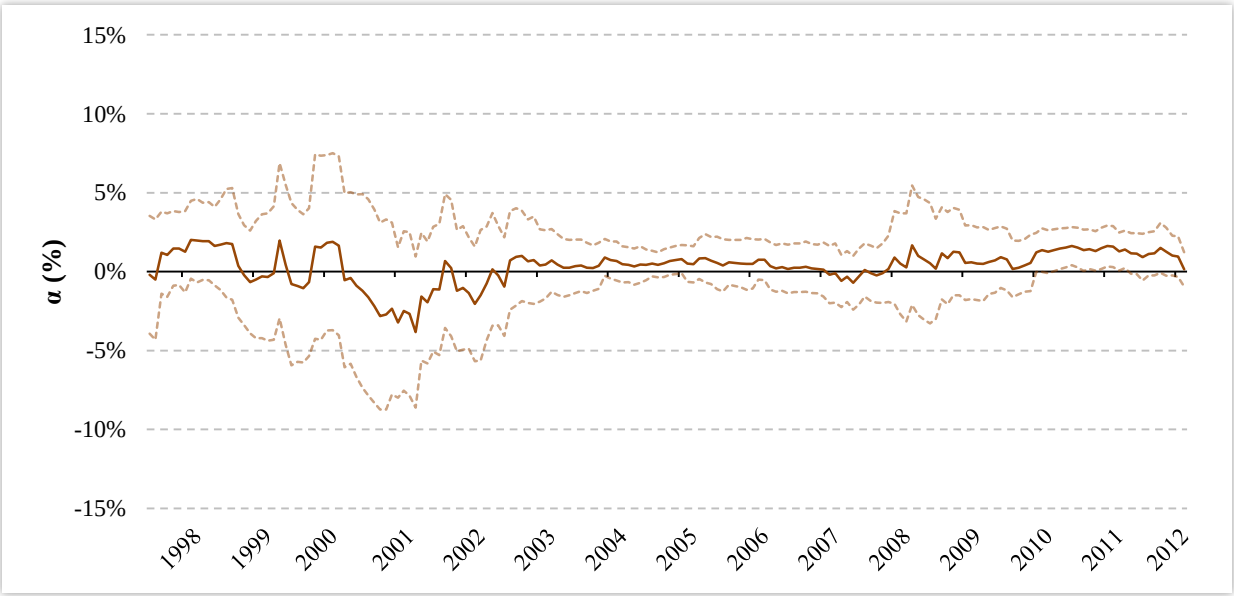


Figure 4.10

NB IPOs Value Weighted Time-Varying Alpha Estimates

The graphs display the development in NB IPOs time-varying alpha estimates using the extended Fama and French-model on value weighted portfolio returns. We estimate the model using a rolling window of 24 monthly observations, and plot the 95 % confidence bands (2 standard errors) indicating historical periods of risk-adjusted returns significantly different from zero, at the 5 % level.



Panel C) Difference between PE/VC and NB IPOs

Our estimated models find no significant differences in alphas, when applying the full sample period. However, for the two portfolios exhibiting generally polarizing performance, the PE/VC and NB VW portfolios; the $FF5_{VW}$-model estimate a negative alpha (-1,14 %, monthly) with a p-value of 15,1 %, indicating borderline significant poorer performance of larger PE/VC IPOs, relative to larger NB IPOs. Even though our estimates fail to find any significant alphas for either IPO group, the time-varying estimates show a substantial difference in the aftermath of the 2008 financial crises, where NB IPOs outperform PE/VC IPOs, especially larger issues (Figure 4.12).

Figure 4.11

Excess PE/VC IPOs Equally Weighted Time-Varying Alpha Estimates

The graphs display the development of the excess PE/VC IPOs time-varying alpha estimates using the extended Fama and French-model on equally weighted portfolio returns. We estimate the model using a rolling window of 24 monthly observations, and plot the 95 % confidence bands (2 standard errors) indicating historical periods where risk-adjusted returns for PE/VC IPOs were significantly different from NB IPOs, at the 5 % level.

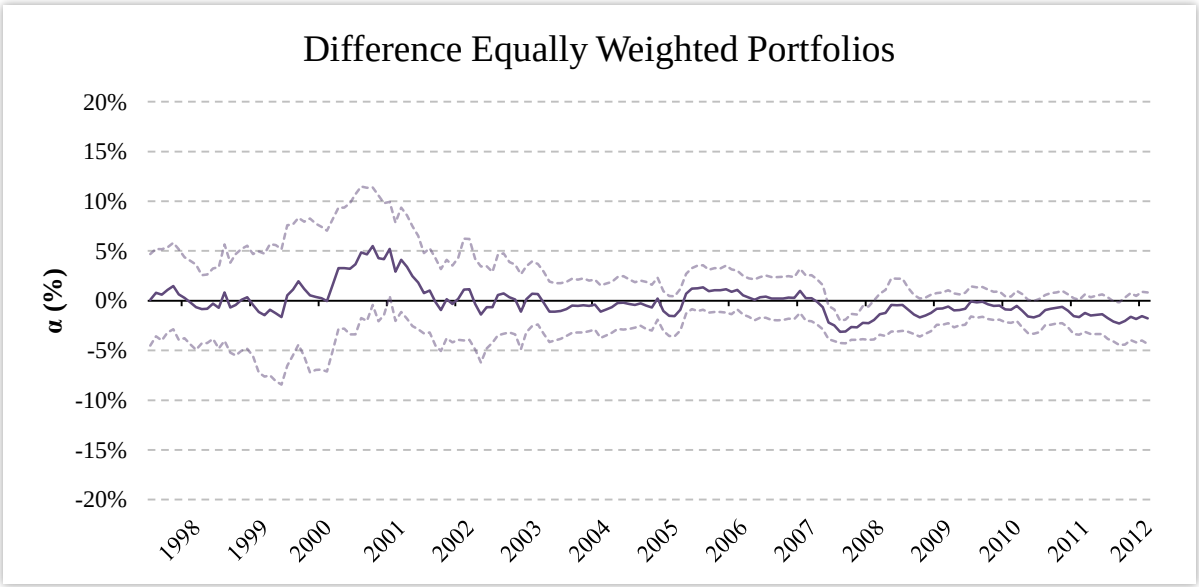
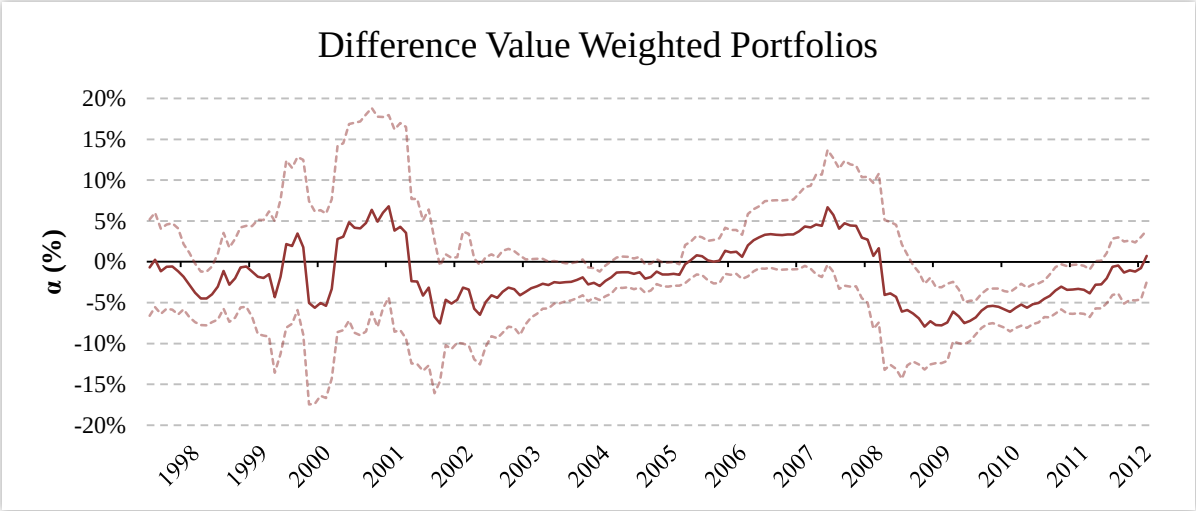


Figure 4.12

Excess PE/VC IPOs Value Weighted Time-Varying Alpha Estimates

The graphs display the development of the excess PE/VC IPOs time-varying alpha estimates using the extended Fama and French-model on value weighted portfolio returns. We estimate the model using a rolling window of 24 monthly observations, and plot the 95 % confidence bands (2 standard errors) indicating historical periods where risk-adjusted returns for large PE/VC IPOs were significantly different from large NB IPOs, at the 5 % level.



Below, we have supplied the regressions outputs from the multi-factor estimates, showing periods of over/under-exposure to systematic risk factors.

Figure 4.13

Time-Varying Factor Exposures to the Markets Excess Return

The graphs display the time-varying development of the factor exposures of all portfolios to the markets excess return, applying the Fama and French extended model. We estimate the model using a rolling window of 24 monthly observations. The graph display exposure to the market risk premium (β) in excess of one, which is full market exposure.

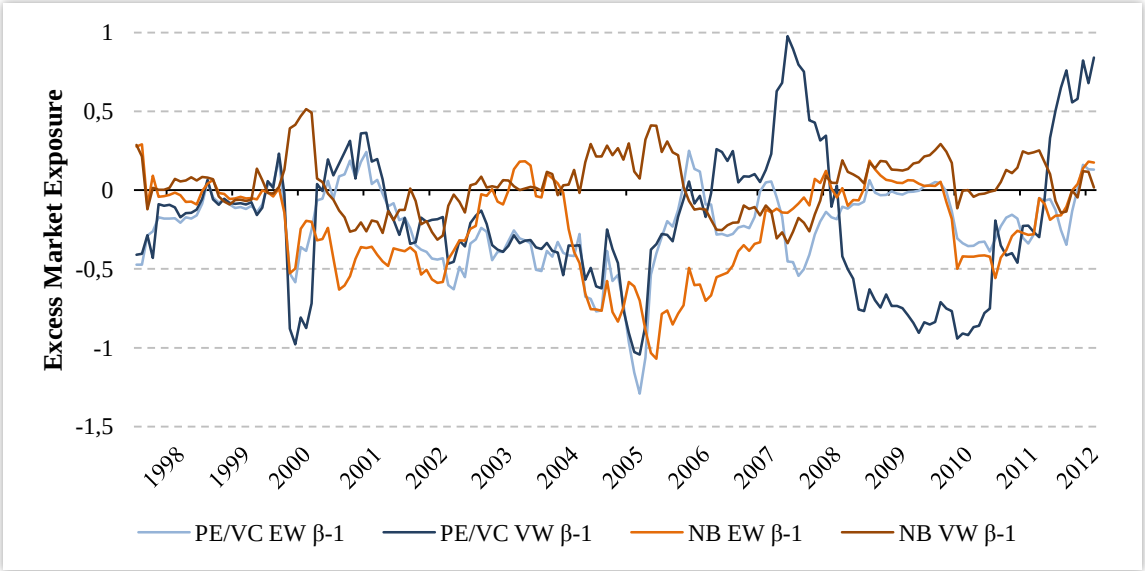


Figure 4.14

Time-Varying Factor Exposures to the SMB Portfolio

The graphs display the time-varying development of the factor exposures of all portfolios to the SMB portfolio, applying the Fama and French extended model. We comprise the SMB portfolio by taking a long position in the OSESX index and a short position in the OBX index. We estimate the model using a rolling window of 24 monthly observations.

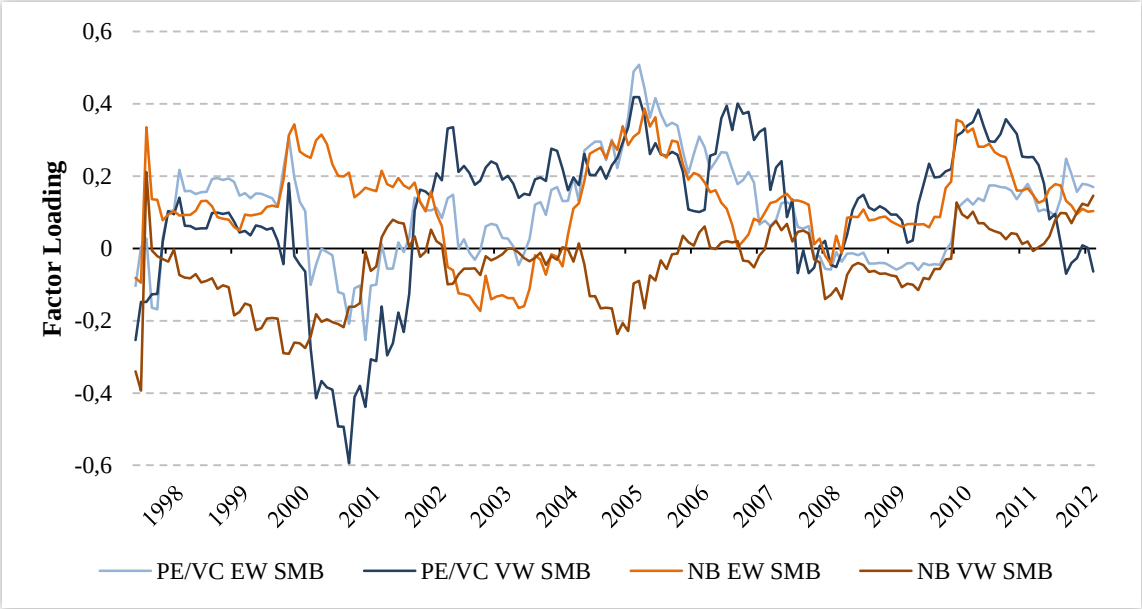
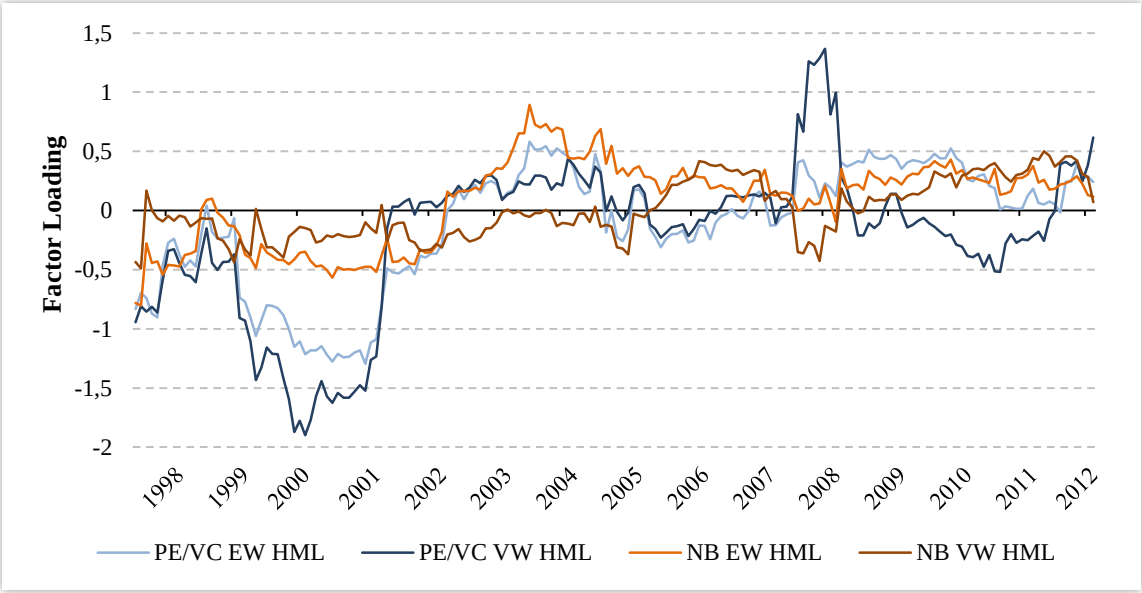


Figure 4.15

Time-Varying Factor Exposures to the HML Portfolio

The graphs display the time-varying development of the factor exposures of all portfolios to the HML portfolio, applying the Fama and French extended model. We obtain the HML portfolio from Ødegaards' website, and estimate the model using a rolling window of 24 monthly observations.



The decreasing and increasing market exposure of PE/VC IPOs seems to align nicely with periods of positive equity returns, except for the period of 2004/2005. Evaluating whether or not this reflects a proactive or reactive response to market sentiment by PE/VC portfolio firms, is beyond the scope of our thesis, but would further indicate to what extent the guidance of PE and VC facilitates long-run returns. We believe the portfolio firms' returns post IPO most likely reflects market sentiment rather than the effect of active management involvement.

Interestingly, the value-weighted PE/VC portfolio exhibits virtually no market exposure during the dot.com-bubble and subsequent to the subprime lending crisis of 2008. Both larger and smaller PE/VC IPOs tilt significantly towards growth firms *prior* to the dot.com bubble, while quickly reverting a value-tilt subsequent to the crash. Also, leading up to the financial crisis of 2008, larger PE/VC IPOs display significant exposure to the value- and market-factor, while this development abruptly ends with the market downturn in 2008. At the end of 2012, larger PE/VCs' market exposure has increased to similar levels.

5.4 Summary of Hypotheses' Results

Below, we summarize our findings from the hypotheses formulated in section 2.4, displayed in Figure 3.1.

5.4.1 Underpricing

H_1: PE/VC IPOs do not exhibit lower underpricing than NB IPOs.

We keep the null hypothesis for both equally- and value weighted samples, stating equal average level of underpricing across IPO groups (5 % and 10 % level).

H_2: Risk does not affect the level of underpricing

We reject the null stating that risk does not affect the level of underpricing (5 % level).

H_3: Market capitalization does not explain differences in levels of underpricing

We keep the null, stating that market capitalization does not explain differences in levels of underpricing (5 % and 10 % level).

5.4.2 Long-Run Performance

H_4: PE/VC IPOs do not exhibit better long-run performance than NB IPOs.

We keep the null stating that PE/VC-backed firms do not exhibit better long-run performance than NB firms. While we do not perform t-tests on the differences between CARs, as the sample-sizes differs considerably, we observe a substantial negative performance of both PE/VC IPO portfolios, where especially large firms underperforms both the index and the other IPO portfolios.

H_5: Risk-adjusted returns does not differ across PE/VC- and NB IPO portfolios.

While the full sample regressions returns insignificant differences in alphas, the time-varying rolling regressions display significant poorer performance of PE/VC IPOs in the period following the 2008 financial crisis, up until 2011, especially for larger IPOs. Additionally, PE/VC IPOs underperforms significantly, relative to NB IPOs during two short periods, one in 1998 and one in 2004. Therefore, we reject the null hypothesis, while adding that there is significant time-variation in both risk-exposures and performance differences (5 % level)

H_6: Market capitalization has no effect on long-run performance.

We reject the null stating that market capitalization has no effect of long-run performance. However, the effect of market capitalization moves in opposite directions across IPOs. The time-varying rolling regressions indicates that the largest PE/VC firms significantly underperforms relative to the index and all other IPOs in certain periods, while the largest NB IPOs displays the best performance among the IPO groups. The CAR calculations support this view. Small capitalization firms across samples display similar performance patterns, though the PE/VC IPOs performs marginally worse than small capitalization NB IPOs.

6. Conclusion

6.1 Underpricing

The original data suggests that larger PE/VC IPOs exhibit severe underperformance relative to other portfolios, in event time. However, subsequent to adjusting the samples for outliers, we observe that average underpricing of PE/VC-backed IPOs declines below that of NB IPOs, both for the equally- and value-weighted portfolios. However, we are unable to find statistically significant differences. We find that risk affect the level of underpricing on firm level, after adjusting for outliers, while size and PE/VC-involvement seems to be insignificant. Calendar time portfolios does not reveal any major differences in the level of underpricing across years, when accounting for the relative sample sizes representing the yearly IPO cohorts.

6.2 Long-Run Performance

We apply several methods when assessing the long-run performance of each IPO group, both individually and comparatively. The cumulative abnormal returns reveals severe underperformance of larger PE/VC-backed IPOs, both relative to the index and to all other IPOs. Smaller PE/VC-backed IPOs display significant underperformance relative to the OSEBX, while only marginally worse than smaller NB IPOs. Larger NB IPOs performs better than all other IPOs, and not significantly different from the OSEBX index. The results are robust to outliers, besides for larger NB IPOs, which also underperforms relative to the OSEBX, when applying symmetrical trimming. Additionally, the short-term abnormal performance of the larger PE/VC IPO portfolio disappears when we account for outliers, mainly because Renewable Energy Corporation is removed from the sample.

At first glance, the BHR calculations display widely differing wealth relatives across time, between IPO groups. However, most of the years displaying pronounced differences in IPO cohorts' wealth relatives, suffers from small sample sizes. In the remaining periods, differences usually arise due to market dynamics rather than influence from active ownership. PE/VC IPOs display somewhat higher wealth relatives than NB IPOs in the short term, while NB IPOs' long-term wealth relatives exceed those of PE/VC IPOs, on average.

Our risk-adjusted returns calculations find annualized alphas ranging from -10,8 % to 7,2% for PE/VC IPOs, across all models and both PE/VC portfolios. Even though none of the models yields significant alphas, the Fama-French 3-factor model ($FF3_{EW}$) estimate an annualized alpha of -9,6 %, borderline significant on a 10 % level. NB IPOs' annualized alphas ranges from -7,2 % to 2,4 %. We observe similar results with regards to the significance of the NB sample's alphas as for the PE/VC sample; the $FF3_{EW}$ model estimate an annualized alpha of -7,44 % with a p-value of 10,2 %. Regressing on the excess return of PE/VC IPOs for the full sample period of 199 months, yields insignificant results concerning differences in returns. However, for the value-weighted portfolios, which consistently displays polarizing performance, the $FF5_{VW}$-model return a negative alpha with a p-value of 15,1 %. This indicates that PE/VC IPOs underperforms through the full sample period, though on a slightly lower level of significance than conventionally applied.

The monthly time-varying estimates, calculated using rolling regressions, displays a more nuanced picture of the relative long-run performance and risk-exposures of all the portfolios. Both equally- and value-weighed PE/VC IPOs significantly underperform relative to corresponding NB IPOs during the financial crisis of 2008, while displaying relatively better performance during the dot.com-bubble. The value-weighted PE/VC IPO portfolio exhibit approximately no market exposure during the dot.com-bubble and subsequent to the 2008 financial crisis, while the exposure increases drastically leading up to the latter one. However, declining market exposure during 2004/2005, might contribute towards the observed underperformance, as this period provided favourable equity returns. The equally-weighted PE/VC portfolio rarely exhibits beta values significantly different from one. Both larger and smaller PE/VC IPO portfolios display a significant tilt towards growth firms prior to the dot-com-bubble, while reverting towards value-firms after the market downturn in 2001. Leading up to the 2008 financial crisis, larger PE/VC IPOs display a significant positive exposure to the value- and market factor, while abruptly declining subsequent to the crisis. At the end of 2012, larger PE/VCs' market exposure has increased to similar levels.

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7. Appendix

7.1 Cross-Sectional OLS Multiple Regression Model Assumptions (Gauss-Markov Theorem; 1-5)

1) The population model can be stated as follows

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik} + u_i$$

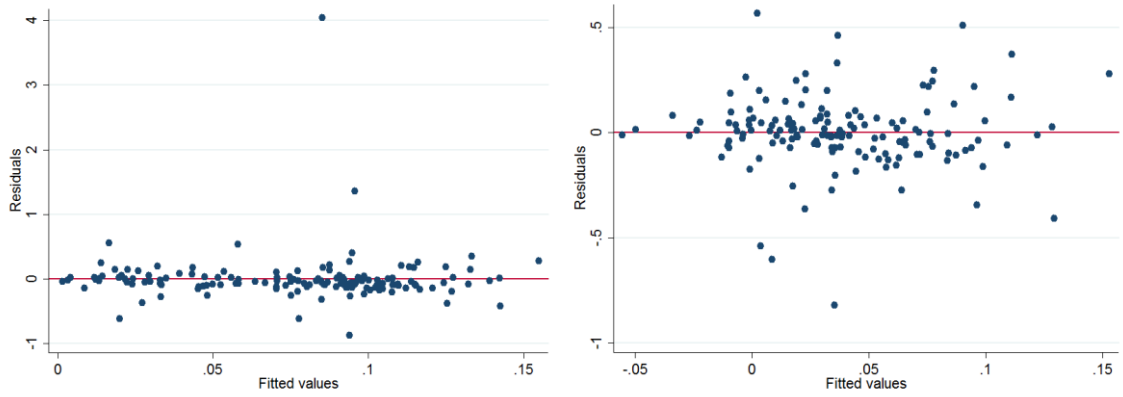
where $\beta_0, \dots, \beta_k$ are $k + 1$ unknown population parameters, and u is an unobserved random error term.

2) We have a random sample of size $n, \{(x_{i1}, \dots, x_{ik}, y_i) : i = 1, \dots, n\}$
3) In the sample (and in the population), none of the independent variables are constant, and there is no exact linear relationships among the independent variables (collinearity).
4) Zero Conditional Mean: $E(u|x_1, x_2, \dots, x_k) = 0$
5) Constant variance: $Var(u|x_1, x_2, \dots, x_k) = \sigma^2$
6) The population error u is independent of the explanatory variables $x_1, x_2, \dots, x_k$ and is normally distributed with mean zero and variance σ^2.
   $u \sim Normal(0, \sigma^2)$, "the error term is independent and identically distributed.
   This assumption is required when conducting inference.

7.2 Diagnostic Plots of Residuals

Figure 6.1
Diagnostic Plots of Residuals for Evaluating Homoskedasticity

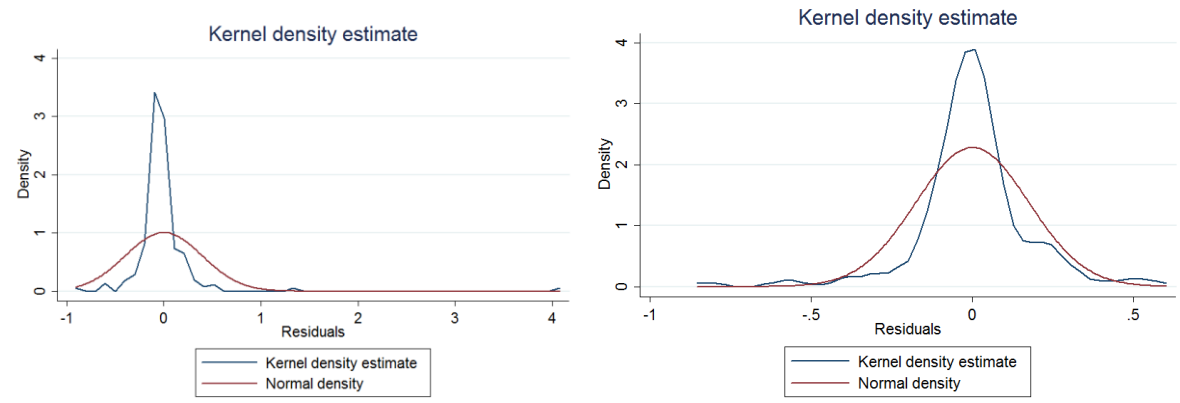
The graph on the left display the original underpricing sample's residuals. The graph on the right display the underpricing sample's residuals after we removed the initial returns of Camposol (413,27 %) and Norwegian Applied Technology (145,92 %).



7.3 Diagnostics: Normality of Residuals

Figure 6.3
Normality of Residuals, Original and Adjusted Samples

The graph on the left display the original underpricing sample's residuals density distribution together with the normal density distribution given the sample's mean and variance. The graph on the right display the underpricing sample's residuals density distribution after we removed the initial returns of Camposol (413,27 %) and Norwegian Applied Technology (145,92 %), along with the resulting normal density distribution.



7.4 Time Series OLS Regression Model Assumptions

Assumption 1) The model is linear in parameters

With the regression represented in the form of

$$y = \beta_0 + \beta_1 x + u$$

u represents the error term, containing factors other than *x,* affecting *y*. With *u* fixed, *x* has a linear effect on *y*. This is not as restrictive as it may seem, as both *x* and *y* can be redefined to take account of non-linearities, for example in logarithmic form.

Assumption 2) There is no perfect collinearity among the explanatory variables

The assumption requires some variation in the explanatory variables, but also restrict perfect correlation between them, in other words, no explanatory variable should be a perfect linear function of the others. High degree of correlation between the explanatory variables is on the other hand often an issue with time series data.

Assumption 3) The Zero Conditional Mean Assumption

Often called the strict exogeneity assumption, requiring that u_t is uncorrelated with all the independent variables at all *t*, past and future values.

Assumption 4) Homoscedasticity

Requires constant variance of the error terms. In other words, the variance cannot depend on *x*, and do not change over time.

Assumption 5) No serial correlation (Autocorrelation)

The error terms cannot correlate over time. If Corr(u_t, x_t) ≠ 0, the errors are serially correlated, which effect inference though invalid t-statistics and standard errors.

Assumption 6) Normally distributed error terms

u_t is independently and identically distributed (i.i.d.) as Normal (0, σ^2), t = 1, 2, …, n. This assumption is necessary if we are to conduct correct inference.

7.5 IPO Firm- and PE/VC Fund Information

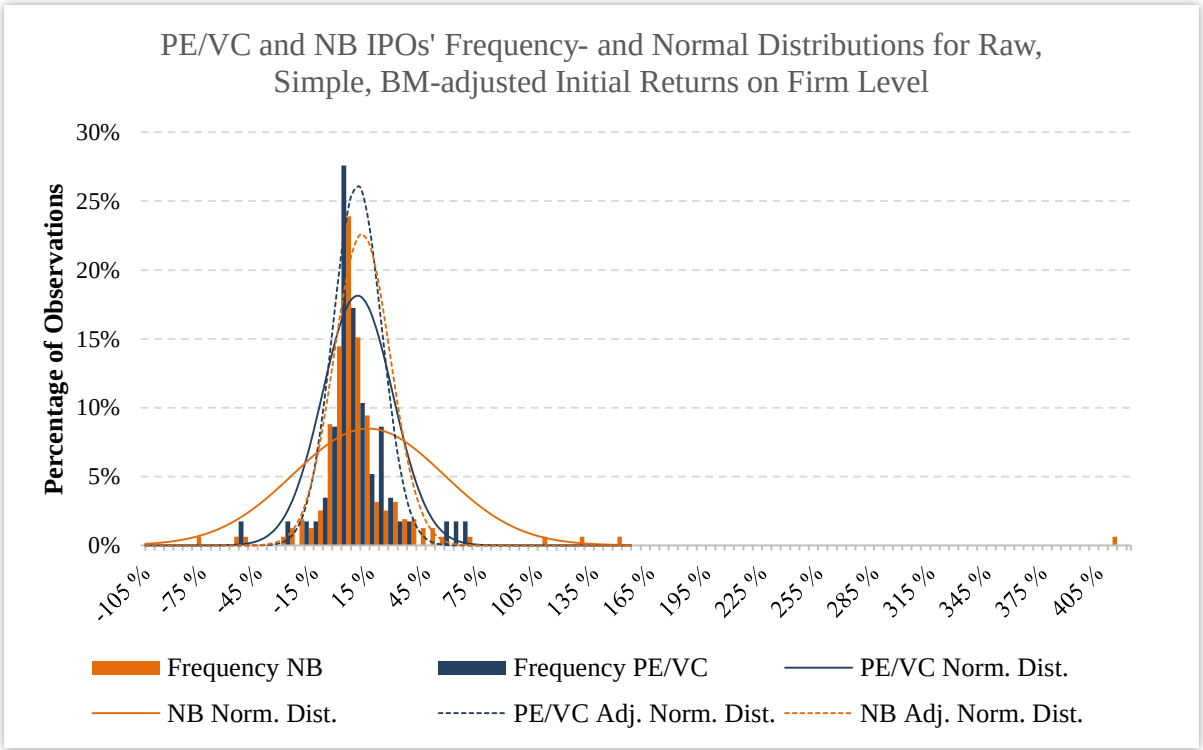
Table 6.1
PE/VC Firms with Fund and GP Information

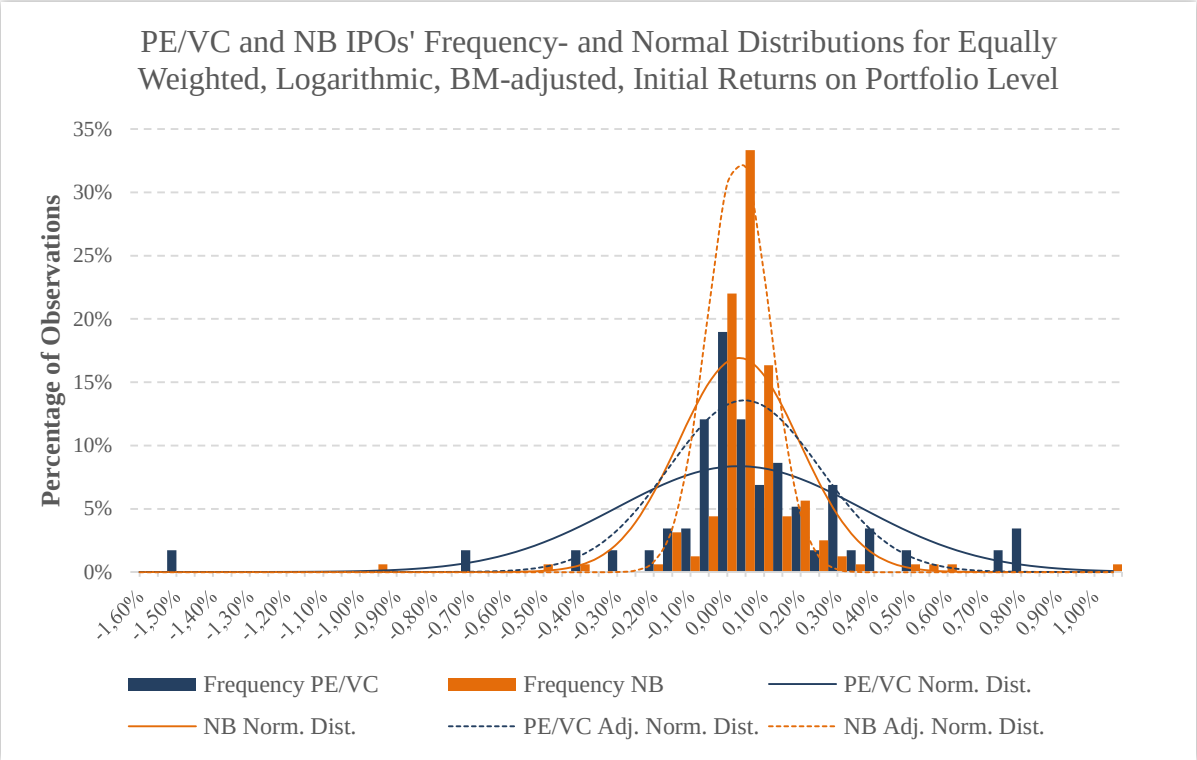
The list displays IPOs backed by PEs/VCs and which fund that has been active prior to the IPO. Company names in parenthesis reflects the companies last known name in Datastream, either subsequent to a name change or prior to delisting. Where names are missing, we have been unable to identify which fund that had been involved.

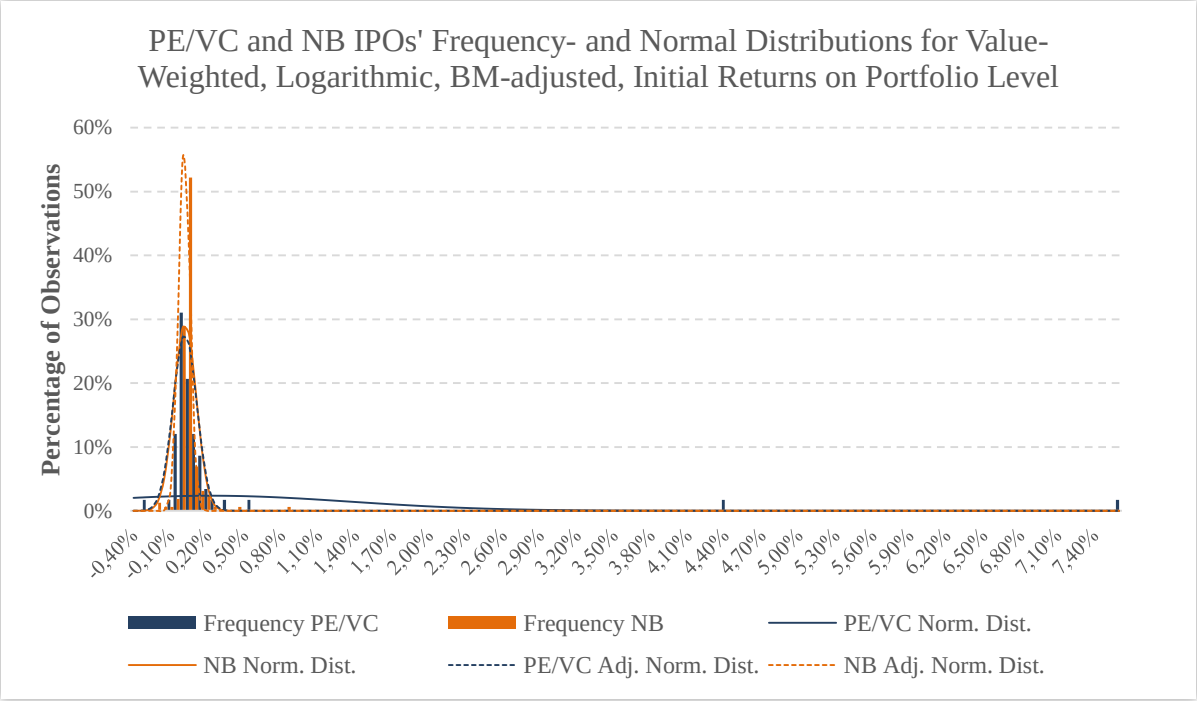
Listing Date	Company	Fund Managers	Fund Name
06.10.2010	CellCura ASA	Maturo Kapital	BTV-Fond
21.05.2010	Bridge Energy ASA	Lime Rock Partners	Lime Rock Partners lll
05.02.2010	North Energy ASA	ProNord	Kap Nord Fond
22.07.2008	Global IP Solutions Holding AB	Kistefos Venture Capital	Kistefos Venture Capital
09.11.2007	Norwegian Energy Company ASA (Noreco	HitecVision	HitecVision III
11.10.2007	Pronova BioPharma ASA	Herkules Capital	Herkules Private Equity Fund I
12.06.2007	Badger Explorer ASA	Convexa Capital, Procom Venture	Convexa Capital IV AS, Procom Venture AS, Convexa Capital II AS
06.06.2007	InvivoSense ASA	Viking Venture Management	Viking Venture I
31.05.2007	SCAN Geophysical ASA	Norvestor Equity	Norvestor IV LP
30.03.2007	Electromagnetic Geoservices ASA	Warburg Pincus	-
27.03.2007	Algeta ASA	HealthCap Venture Capital, NorgesInvestor, Incitia Ventures, Advent Venture Partners	Healthcap, NorgesInvestor III, Selvaag Venture Capital (Incita), Advent Venture Partners
23.03.2007	NEAS ASA	Reiten & Co Capital Partners	Nordic Capital Partners IV
21.12.2006	Reservoir Exploration Technology ASA	Lime Rock Partners	-
10.11.2006	AKVA group ASA	Norvestor Equity	Norvestor Fund l
12.10.2006	Marine Farms ASA	Marin Forvaltning	Marin Vekst I
07.07.2006	Clavis Pharma ASA	Neomed Management	NeoMed Innovation III LP
05.07.2006	Trolltech ASA	Teknoinvest Management, Northzone Ventures	Teknoinvest VIII KS, Northzone III
03.07.2006	AGR (Ability Group)	Altor Equity Partners	-
09.05.2006	Renewable Energy Corporation ASA	Hafslund Venture	-
14.12.2005	NorDiag ASA (NORD)	Procom Venture	SåkorninVest
13.12.2005	Funcom N.V.	Northzone Ventures, Nordic Venture Partners, Teknoinvest	Northzone IV K/S, Nordic Venture Partners II
12.12.2005	Grenland Group (Agility Group)	NorgesInvestor	NorgesInvestor II
06.12.2005	Future Information Research Management ASA (FIRM)	Norvestor Equity	-
18.11.2005	Odim ASA	Verdane Capital	-
04.11.2005	Biotec Pharmacon ASA	Norgesinvestor, Verdane Capital	
24.10.2005	Cermaq ASA	NorgesInvestor	NorgesInvestor II
24.10.2005	Powel ASA	Viking Venture Management, Norvestor Equity	Viking Venture I
27.06.2005	Revus Energy ASA	HitecVision	HitecVision Private Equity III
24.06.2005	Kongsberg Automotive Holding ASA	IK Investment Partners,FSN Capital Partners	FSN Capital I, IK Investment Partners unkown
09.06.2005	VIA Travel Group (VIA Egencia)	NorgesInvestor	NorgesInvestor III
26.04.2005	Polimoon ASA (Promens)	CVC Capital Partners	-
04.04.2005	IMAREX (International Maritime Exchange ASA)	Incitia Ventures, R S Plateou Venutre Capital	Selvaag Venture Capital (Incitia), R S Plateou Venture Capital
18.03.2005	APL ASA	HitecVision, Energy Ventures	HitecVision III,
27.01.2005	DynaPel Systems, Inc.	Verdane Capital	-
17.12.2004	Bjørge ASA	Norvestor Equity	Norvestor Fund l
12.11.2004	Active 24 ASA (Før Active ISP)	Verdane Capital, European Capital Ventures	Four Seasons Venture ll, European Capital Ventures PLC
06.07.2004	Privatbanken ASA	Altatria	Altaria SMB I
04.06.2004	AXXESSIT ASA	Convexa Capital,Ferd Capital	NorgesInvestor Vekst,Convexa Capital Fund, Ferd Capital
25.05.2004	Findexa Limited	Texas Pacific Group	-
10.05.2004	Mamut ASA	Northzone Ventures	Northzone II
29.03.2004	Catch Communications ASA	Kistefos Group	Kistefos Venture Capital

11.03.2004	Opera Software ASA	Teknoinvest Management, Verdane Capital	KS Teknoinvest VII, Four Seasons Venture III AS, Teknoinvest VIII KS, Four Seasons Venture II AS, KS Teknoinvest VI, Norgesinvestor Vekst AS
19.12.2003	NextGenTel Holding ASA	Northzone Ventures	Northzone III
08.04.2002	Apptix ASA	Convexa Capital	Convexa Capital
03.04.2002	Q-Free ASA	TeleVenture Management	Telenor Venture II
13.06.2001	Consorte Group ASA (Intelecom)	NorgesInvestor	NorgesInvestor II
10.05.2001	Scribona AB	Norvestor Equity	Norvestor Fund ll
29.06.2000	TeleComputing	Convexa Capital	Convexa Capital Fund
19.06.2000	Customax	NorgesInvestor	NorgesInvestor I
19.06.2000	Webcenter Solutions (Webcenter Unqiue, Mefjord)	Norvestor Equity	Norvestor Fund l
29.05.2000	PhotoCure	Bio Fund Management, Teknoinvest	Bio Fund Ventures I, Teknoinvest fund unknown
14.04.2000	Expert Eilag	NorgesInvestor	NorgesInvestor I
14.03.2000	Stepstone	Northzone Ventures, Verdane Capital	Northzone I, Four Seasons Venture II
13.07.1999	Infostream	Verdane Capital	-
02.06.1999	Axis-Shield plc; UK	Teknoinvest Management	-
08.07.1998	Eltek	TeleVenture Management	Telenor Venture I
06.07.1998	Synnøve Finden Meierier	Norvestor Equity	Norvestor Fund l
15.05.1998	Luxo	NorgesInvestor	NorgesInvestor I
02.04.1998	Scandinavian Retail Group (Voice)	Norvestor Equity	Norvestor Fund l
23.12.1997	Navis	HitecVision	-
15.12.1997	Norcool Holding	NorgesInvestor	NorgesInvestor I
01.10.1997	Iterated Systems, USD (MediaBin)	Teknoinvest Management	-
01.07.1997	Pan Fish (Marine Harvest)	Norvestor Equity	Norvestor Fund l
27.06.1997	EDB	Norvestor Equity	Norvestor Fund l
11.06.1997	CorrOcean (Roxar)	Norvestor Equity	Norvestor Fund l
22.05.1996	Agresso (Unit4 Agresso)	Verdane Capital	-
25.04.1996	Provida	Verdane Capital	-

7.6 Frequency- and Normal Distributions for Underpricing Data




PE/VC and NB IPOs' Frequency- and Normal Distributions for Equally Weighted, Logarithmic, BM-adjusted, Initial Returns on Portfolio Level
Percentage of Observations
35%
30%
25%
20%
15%
10%
5%
0%
-1,60% -1,50% -1,40% -1,30% -1,20% -1,10% -1,00% -0,90% -0,80% -0,70% -0,60% -0,50% -0,40% -0,30% -0,20% -0,10% 0,00% 0,10% 0,20% 0,30% 0,40% 0,50% 0,60% 0,70% 0,80% 0,90% 1,00%
Frequency PE/VC
Frequency NB
PE/VC Norm. Dist.
NB Norm. Dist.
PE/VC Adj. Norm. Dist.
NB Adj. Norm. Dist.


PE/VC and NB IPOs' Frequency- and Normal Distributions for Value-Weighted, Logarithmic, BM-adjusted, Initial Returns on Portfolio Level
Percentage of Observations
60%
50%
40%
30%
20%
10%
0%
-0,40% -0,10% 0,20% 0,50% 0,80% 1,10% 1,40% 1,70% 2,00% 2,30% 2,60% 2,90% 3,20% 3,50% 3,80% 4,10% 4,40% 4,70% 5,00% 5,30% 5,60% 5,90% 6,20% 6,50% 6,80% 7,10% 7,40%
Frequency PE/VC
Frequency NB
PE/VC Norm. Dist.
NB Norm. Dist.
PE/VC Adj. Norm. Dist.
NB Adj. Norm. Dist.

7.7 Test for Auto-Correlation

	CAPM		FF3		FF5	
	F-Value	Prob > F	F-Value	Prob > F	F-Value	Prob > F
PE_EW	2,69	0,1026	1,89	0,1713	2,20	0,1396
PE_VW	0,08	0,7818	0,24	0,6218	0,00	0,9893
NB_EW	0,14	0,7094	0,74	0,39	1,35	0,2473
NB_VW	0,39	0,5309	0,38	0,54	0,37	0,5422
PEEW-NBEW	1,44	0,2311	2,00	0,159	1,93	0,1661
PEVW-NBVW	0,10	0,7476	0,80	0,371	0,21	0,6486

1) We estimate the equation: $y_t = \beta_0 + \beta_1 x_{t1} + \cdots + \beta_k x_{tk} + u_t, t = 1,2, \dots, n$, by OLS and save the residuals, $\{\hat{u}_t : t = 1, 2, \dots, n\}$.
2) Then we estimate: $\hat{u}_t \; on \; \hat{u}_{t-1}, x_{t1}, x_{t2}, \dots, x_{tk}, t = 2, \dots, n.$
3) Finally, we compute the heteroskedasticity-robust *t* statistic for the coefficient in front of $\hat{u}_{t-1}$, and test: $H_0 : \rho = 0$.

7.8 Dickey Fuller-Tests for Unit Root

Data Series	Test Statistic	1 % Critical Value	5 % Critical Value	10% Critical Value
PE_EW	-8.937	-3.477	-2.883	-2.573
PE_VW	-10.993	-3.477	-2.883	-2.573
NB_EW	-8.946	-3.478	-2.883	-2.573
NB_VW	-9.697	-3.479	-2.883	-2.573
RM	-10.503	-3.480	-2.883	-2.573
OSESX-OBX	-18.610	-3.481	-2.883	-2.573
HML	-12.636	-3.482	-2.883	-2.573
UMD	-13.233	-3.483	-2.883	-2.573
LIQ	-14.928	-3.484	-2.883	-2.573
PEEW_NBEW	-15.735	-3.485	-2.883	-2.573
PEVW_NBVW	-14.461	-3.486	-2.883	-2.573