Norwegian School of Economics
Bergen, Fall 2024

Norwegian IPOs: Pillaged by PE or Powered to Perform?

A study on the impact of Private Equity on post-IPO performance in Norway

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Master's thesis, Economics and Business Administration

Major: Financial Economics

NORWEGIAN SCHOOL OF ECONOMICS

Acknowledgements

This master's thesis marks the conclusion of our Master's degree in Economics and Business Administration, majoring in financial economics. The thesis reflects our almost five years of study at the Norwegian School of Economics, and it has been a great educational and academic experience. We chose this topic through our mutual interest in private equity and the stock performance of public companies. The partnership has been enjoyable and given us the opportunity to learn from and challenge each other.

We would like to thank Karin Thorburn, Research Chair Professor of Finance at the Norwegian School of Economics, for her invaluable guidance and expertise on how to best approach our research question.

Norwegian School of Economics

Bergen, December 2024

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Abstract

This thesis studies the post-IPO performance of companies listed on Oslo Stock Exchange from 2000 to 2022, with a focus on whether Private Equity-backed IPOs outperform other IPOs. IPOs are divided into two groups: PE-backed IPOs and non-backed IPOs. IPOs backed by venture capital (VC) are only included in the non-backed IPOs. To address the effects of underpricing and the greenshoe option, performance is analyzed from one month after the IPO on horizons of 6, 12, and 24 months. We define 6 and 12 months as short-term, while defining 24 months as long-term. Using the Calendar Time Portfolio approach and a long-short portfolio strategy, we derive alpha values adjusted for market factors via the Carhart Four-Factor Model.

Furthermore, we analyze the individual alpha values of the IPOs using cross-sectional regressions to explore the drivers of performance differences between PE-backed and non-backed IPOs. The explanatory variables are information available at the IPO and, therefore, the findings are relevant for predictive analysis. In cross-sectional regression, we also study the impact of an IPO being VC-backed.

The results indicate that PE-backed IPOs outperform other IPOs on a 12 month term after the IPO, aligning with findings from similar studies in other markets. Additionally, IPO performance is negatively correlated with continued PE-backing after IPO for the 6 month holding period. VC-backed IPOs correlate with a weaker short-term performance compared to other, non-PE-backed IPOs, which is in contrast with US-based research, but where research results have varied across markets. An interesting observation is the concentration of observations after 2010, driven by the growth of Norway's PE industry and the lingering effects of the financial crisis. This period will also be studied using the same methodology as for the full sample period. The results for the subsample somewhat differ from the full sample analysis, which encourages further research on how macroeconomic trends and cyclicality impact PE-backed IPOs' performance.

Keywords – initial public offering, private equity, post-IPO performance, IPO performance, venture capital

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1 Introduction

This thesis examines whether being private equity (PE) backed impacts post-IPO performance, focusing on companies listed on the Oslo Stock Exchange (OSE) from 2000 until 2022. The null hypothesis is that there is no difference in performance between PE-backed and non-backed IPOs. The alternative hypothesis is that PE-backed IPOs outperform the average IPO due to a better-functioning organizational structure and management set by the PE firm prior to the IPO, mitigating risk and improving operational performance. Our hypothesis further states that the market at the time of the IPO underestimates the value of this structure, causing a better performance of PE-backed IPOs.

VC-backed IPOs are categorized under non-backed IPOs rather than included with the PE-backed group. This allows for a more focused analysis of PE firms that invest in mature companies, such as those acquired through LBOs, and helps to better understand how their operational mechanisms influence post-IPO performance. In addition, the impact of VC on IPO performance will be examined through cross-sectional regression.

Our motivation to explore the performance of PE-backed IPOs stems from our curiosity about the PE industry and wanting to understand how their "final product" is received by the market and contributes to the value creation in society. What makes producing this master's thesis even more interesting is how PE has developed in the last two decades in Norway. The last decade in particular has presented a historically low policy rate, largely as a result of the financial crisis, but recently also due to the COVID-19 pandemic. This has created a great shift in capital allocation towards PE, where PE as a consequence has gained more attention in society.

PE exits are particularly fascinating as they provide a clear measure of the value created from the initial buyout to the point of exit. At this stage, PE firms aim to achieve a yield that justifies the risk, time, and illiquidity borne by their limited partners (LPs) when investing in the fund. Among the various exit strategies, IPOs are a frequently chosen route. Recent developments in the PE industry make the study of PE-backed IPOs especially compelling.

The analysis focuses on the 6-, 12-, and 24-month periods beginning one month after

the IPO. By excluding the first month of returns, the analysis avoids distortions caused by underpricing or the greenshoe option, a topic elaborated on in the literature review. The objective is to examine performance differences between these periods and explore potential factors driving these variations.

The focus on these specific periods is driven by our hypothesis that PE-backed companies should demonstrate superior post-IPO performance due to more efficient operations, exceeding market expectations in the short term. This would be reflected in the post-IPO return for PE-backed IPOs. This hypothesis motivates the analysis of performance across three distinct periods, where we expect to observe differences, with relative performance diminishing over time.

To evaluate whether PE-backed IPOs perform as well as other IPOs over the three holding periods, we employ the Calendar Time Portfolio (CTP) approach, followed by the construction of a long-short (LS) portfolio to capture performance differences. This method is well-regarded for addressing challenges such as event clustering and survivorship bias, making it a robust choice for our analysis. In the LS CTP regression, the excess return is explained by systematic factors given by the Carhart Four-Factor Model, making the constant represent the alpha.

Through a cross-sectional regression analysis with the IPOs' alphas as dependent variable, we aim to investigate the drivers of performance differences between PE-backed and non-PE-backed IPOs, with a primary focus on post-IPO involvement by the PE firm. Specifically, we examine whether continued ownership of the PE fund positively correlates with a post-IPO alpha. We hypothesize that PE funds that retain substantial ownership after IPO continue to enhance or stabilize operations through their ongoing participation. A positive and significant correlation with the dependent variable (alpha) means that investors may underestimate the value of continued PE-backing and discover this over time. Alternatively, they do not know at the IPO how long the PE firm will stay involved post-IPO, and hence initially do not price it correctly.

Furthermore, we will control for and analyze factors such as leverage, firm age, sector, and the influence of VC firms on IPOs through cross-sectional regressions. All variables are based on information available at the IPO, giving the study a predictive perspective on IPOs. Given the similarities in the participation of PE and VC funds, we anticipate

that VC-backing could also play a role in shaping post-IPO performance.

In addition to studying the full sample period, the paper also conducts an analysis on the post-2010 subsample period. We found the post-2010 subsample period interesting due to the graphs of cumulative returns, which indicated a difference in performance for the various holding periods, favoring the PE-backed IPOs. The purpose of the analysis is to show how the time period studied could impact our results, where macrotrends and cyclicality seem to play a role for PE-backed IPOs' performance. This analysis encourages further research on the topic.

There has been considerable research on the post-IPO performance of previously PE-funded companies, primarily focusing on larger markets such as the US and the UK. Among the most relevant studies is Levis (2011), who examines the performance of PE- and VC-backed IPOs compared to non-backed IPOs in the British market. As this paper will demonstrate, our findings from the Oslo Stock Exchange (OSE) align with those of other markets and with various theoretical frameworks. However, in certain areas, our results diverge from previous research, opening up for further discussion and research.

Our master's thesis offers insight into PE-backed IPOs on OSE and highlights unique trends in this category. Although several of our findings are robust, supported by a substantial sample size and extended time periods, others invite further discussion and present opportunities for future research.

2 Literature and empirical studies

2.1 Background on IPOs and PE

This section will present history and review relevant literature on IPOs and IPO performance theories. The research of Eckbo et al. (2023) and Levis (2011), which examines the role of PE in companies and its potential impact on IPO performance, forms a central foundation for our study. Their research is supported by several theoretical frameworks which will be presented later and will be relevant for our research on post-IPO performance.

2.1.1 Background on IPOs

Initial Public Offerings (IPOs) mark a major financial milestone, allowing a company to transition from private to public ownership to access broader capital markets and increase their investor liquidity. By going public, companies can raise capital to support growth, reduce their dependence on debt, and gain more shareholders. The decision to go public is one of the most important choices in corporate finance. As Pagano et al. (1998) observes, while an IPO can represent a natural stage in company growth, this perspective does not fully capture the strategic motivations driving this decision.

As Pagano et al. (1998) demonstrates, companies pursue IPOs for a variety of strategic and financial motivations that extend beyond immediate capital needs. One of the primary drivers is the access to larger pools of capital that public markets provide. This allows companies to finance growth initiatives or acquisitions, or other strategic investments that might be hard to finance through private sources. In addition, IPOs improve the bargaining power of a company with banks and other creditors, as the transparency and stability associated with being publicly listed makes the company a lower risk to creditors. This can lead to better loan terms and lower borrowing costs from banks. For early investors and founders, an IPO provides liquidity and the opportunity to diversify their investments. Lastly, a public listing improves the visibility and credibility of a company, which can have a positive influence on its relationship with stakeholders. Together, these factors highlight the strategic and financial benefits that make an IPO an attractive option

for many companies.

2.1.2 IPOs in Norway

The Norwegian IPO market is relatively small compared to global markets but has distinct sectoral concentrations that reflect the country's economic structure. Industries such as energy, aquaculture, and technology dominate the market, reflecting Norway's economic strength, as shown in Figure 2.1. In Norway, companies have three possible exchanges for an IPO: Oslo Børs, Euronext Growth and Euronext Expand. As of 2024, 338 companies are listed on Oslo Børs, reflecting the growing interest in public financing in Norway (Euronext, 2024b). IPO activity in Norway correlates with global economic cycles, but is also influenced by domestic factors such as oil prices, energy market dynamics, and government regulations.

The following section provides a historical overview of the Norwegian IPO market, setting the context for the subsequent analysis of post-IPO performance in Norway.

2.1.3 Historical Overview

The early 2000s saw slow growth in the Norwegian IPO market, driven by global economic conditions and increasing interest in sectors such as oil and gas. The market was relatively small, with limited participation from institutional investors. As shown in Figure 2.1, only 15 IPOs were recorded between 2000 and 2003. This period of stagnation was followed by an increase in IPO activity before the global financial crisis in 2008, reflecting a global economic boom.

Companies that focused on capital-intensive industries were among the main IPO candidates. Euronext Growth was established in 2005, providing a new exchange for small and medium enterprises (SMEs) to raise capital (Euronext, 2024b). From 2004 to 2007, the market saw 79 IPOs, reflecting the global economic boom during this period, as shown in Figure 2.1.

The global financial crisis had a significant impact on IPO activity in Norway. From 2008 to 2010, the number of IPOs decreased significantly, with no IPOs in 2009, as shown in Table 2.1. This was due to increased market volatility and lower investor confidence after the financial crisis. The Norwegian government played a crucial role in stabilizing

the economy through expansive monetary policies, such as maintaining low interest rates (Norges Bank, 2024). Furthermore, the recovery of oil prices in 2010 to pre-crisis levels helped mitigate the long-term economic impact (Tradingeconomics, 2024).

The post-crisis years marked a recovery in IPO activity, with 71 IPOs recorded between 2011 and 2019, as noted in Table 5.1. This period also saw a diversification in IPO activity, with technology companies beginning to make their mark, alongside sectors such as financials.

The global uncertainty during the COVID-19 crisis did not affect the activity in the IPO market. In contrast, 2020 and 2021 were high-activity years, with 107 IPOs recorded in our sample during this period. Several factors contributed to this, including record low interest rates of 0% from May 2020 to September 2021 and increased investor demand for investments with growth prospects (Norges Bank, 2024).

The global economic slowdown in 2022, as a result of increasing inflation and interest rates, resulted in a significant decline in IPO activity in Norway. Only seven IPOs were recorded in our sample for the year, marking a sharp contrast to the boom in the previous two years.

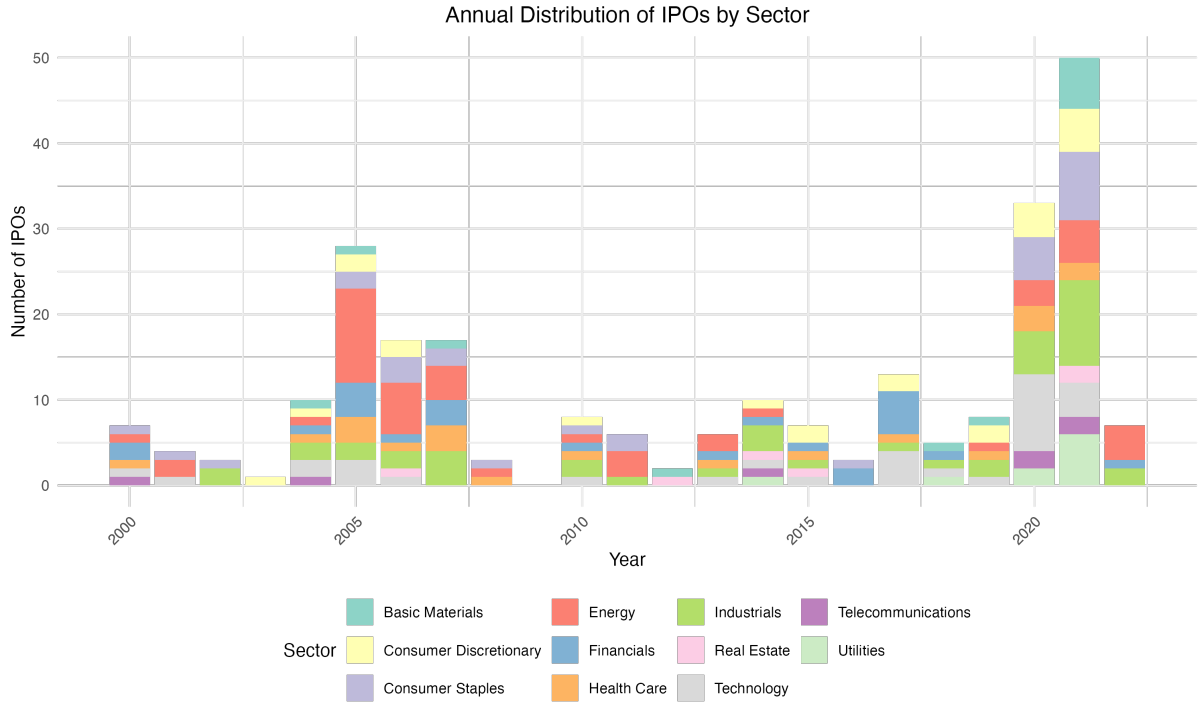

Figure 2.1: Annual Distribution of IPOs

2.2 Literature on PE

The structure of Private Equity firms or the 'sponsor' is designed such that investors can invest in a PE firm's fund. The PE firm invests the money raised by buying a target company, which then becomes one of their several portfolio companies in their fund (Eckbo et al., 2023). The PE firm and their investors will both earn a return on the success of their portfolio companies. An investment becomes successful through the PE firm's engagement with the company. These interactions aim to create value through improved operational efficiencies, typically through cost reduction, organizational restructuring, or changes in management. This would lead to an increase in the market value of the company, and the PE would pursue selling, or "exit", the company with a great yield.

The investment horizon of the fund is typically around ten years, and the investment horizon in each portfolio company around five years. The exit can be of various types, such as an IPO or selling to an acquirer. In this paper, we focus on the IPO as an exit and how portfolio companies that are taken public perform compared to the overall post-IPO performance. The PE firm and the investors in the fund, also called limited partners, benefit from a profit-maximizing exit.

In his 2011 study, Levis (2011) analyzed PE- and VC-sponsored IPOs on the London Stock Exchange from 1992 to 2005. He categorizes IPOs into three groups: PE-sponsored, VC-sponsored, and non-sponsored.

Levis (2011) described how PE firms achieve operational efficiencies through closer monitoring, management expertise, and higher debt levels, which are the key drivers of the PE model. He posits that these efficiencies likely persist even after the IPO, following the exit of PE sponsors. Additionally, he notes that lock-up agreements and performance incentives can maintain some level of sponsorship influence post-IPO, which may help reduce information asymmetry.

The study finds that the aftermarket performance of PE-backed IPOs exhibits significant positive buy-and-hold abnormal returns (BHAR) throughout the entire period, whereas VC-backed and non-sponsored IPOs tend to perform worse or even negative. These findings align with the research of Ritter (1991) on high first-day returns followed by underperformance for VC-backed and non-sponsored IPOs. Overall, the paper concludes

that PE-backed IPOs are more profitable and efficient compared to their VC-sponsored and non-sponsored counterparts, particularly when examining returns from the first day to 12 months post-IPO. However, he explains how the research results on VC-backed IPO returns seem to vary between the markets studied.

2.2.1 PE in Norway

The Norwegian PE industry began to take shape in the late 1980s and early 1990s (Ryssdal, 2024). Norvestor, established in 1989, and FSN Capital, founded in 1990, were among the pioneers laying the groundwork for PE investments in Norway. During the 2000s, Norway's PE market experienced substantial growth. Several funds were established, attracting interest from both domestic and international investors. In 2019, Norwegian and foreign PE players invested almost NOK 33 billion in Norway, the highest amount recorded at that time.

In 2021, Norwegian PE funds raised a record NOK 34.4 billion, 56% more than the previous record year of 2016. This milestone indicates increasing investor optimism despite challenges such as the COVID-19 pandemic (Albertsen et al., 2022).

Norwegian PE funds such as HitecVision, Norvestor, Cubera, Summa Equity, and FSN Capital have become prominent players, managing assets worth hundreds of billions of Norwegian kroner. In addition, international funds such as EQT, Nordic Capital, and Altor have established a strong presence in Norway, further improving the market (Ryssdal, 2024).

Despite macroeconomic uncertainty and rising interest rates, the Norwegian PE sector is expected to continue to grow. Investors remain interested, particularly in funds with proven returns and sustainable investment strategies.

PE in Norway has evolved from a niche activity to a central part of the financing of Norwegian businesses, exerting a significant influence on the economy. Its trajectory highlights the increasing role of PE in driving innovation, sustainability, and economic growth.

2.2.2 PE in the Norwegian IPO Market

PE has played an evolving role in the Norwegian IPO market. Historically, the early 2000s saw limited PE involvement, reflecting the smaller size and relative immaturity of the Norwegian capital market. However, the past decade has seen a gradual increase in PE-backed IPOs, particularly in sectors such as technology, renewable energy, and aquaculture, shown in Figure 2.1. PE firms provide operational expertise and financial discipline, which are critical for companies preparing for public listings.

The cyclical nature of PE activity in Norway reflects broader economic conditions. For example, during periods of high market valuations, PE firms are more likely to exit their investments through IPOs. In contrast, economic downturns tend to reduce PE-backed IPO activity as firms delay exits to maximize returns.

2.3 IPO Performance Literature

This section reviews previous research on post-IPO performance literature. It will present an overview of key theories and studies, including underpricing theory, the Winner's Curse hypothesis, market timing theory, information asymmetry theory, and agency theory. In addition, the literature on the roles of PE in IPOs will be discussed, with a focus on relevant findings within the Norwegian context.

2.3.1 Underpricing Theory and Winner's Curse

The underpricing theory, introduced by Rock (1986), explains how the information asymmetry between informed and uninformed investors influences the pricing of IPOs. Informed investors, who possess superior knowledge about the value of a company, selectively invest in IPOs they believe to be undervalued. Uninformed investors, lacking this knowledge, are more likely to receive allocations in overvalued IPOs, exposing them to greater risks. This phenomenon is known as the Winner's Curse, where uninformed investors 'win' shares in unfavorable offerings, which could discourage their participation in IPO markets altogether.

To mitigate this issue and attract uninformed investors, IPOs are deliberately underpriced. Offering shares at a discount ensures that non-informed investors can expect a positive

initial return, compensating them for the risks associated with asymmetric information. This underpricing serves to maintain a balance between informed and uninformed investors, ensuring sufficient demand for IPO shares.

Empirical evidence highlights the persistence of underpricing in IPO markets. For example, Ibbotson (1975) documented an average initial return of 11.4% during the 1960s. More recently, Ritter (2024) observed an average first-day return of 18.9% from 1980 to 2023, confirming the continued relevance of underpricing in modern IPOs. This consistent evidence underscores the critical role of underpricing as a solution to the Winner's Curse.

The underpricing theory, supported by the Winner's Curse hypothesis, offers a clear explanation of how IPO issuers counteract the effects of information asymmetry. By providing uninformed investors with a safety margin through underpricing, issuers create an environment conducive to broad market participation.

The underpricing theory and its supporting empirical evidence are central to our study, which examines the long-term performance of IPOs. Although underpricing is necessary to address information asymmetry in the short term, our analysis focuses on performance over extended periods. To isolate the sustained performance of PE-backed IPOs, we adjust for the "noise" caused by underpricing, ensuring that our results reflect genuine differences in post-IPO outcomes rather than short-term pricing effects.

Additionally, the greenshoe option provides further context for IPO price stabilization. This mechanism, commonly employed within the first 30 days post-IPO, allows underwriters to either sell additional shares or cover short positions. These actions help mitigate price volatility, complementing the role of underpricing in creating a favorable market environment (ESMA, 2001). By understanding these mechanisms, we can better assess how participation in PE impacts long-term performance beyond the initial offer period.

2.3.2 Market Timing

Market timing plays a crucial role in raising equity capital. Loughran and Ritter (1995) demonstrated that IPOs tend to underperform the market in the long run, specifically within a 3- to 5-year period. Their study examines several potential explanations for this new issue puzzle, suggesting that investor optimism may lead to initial overvaluation of newly public companies. Although these IPOs often show strong performance shortly

after listing, they tend to lag behind the market over the following years. This pattern raises questions about the timing and valuation of IPOs, especially within market timing theory.

A critical aspect of Loughran and Ritter's analysis is their exploration of the behavioral factors influencing IPO valuations. They argue that over-optimistic investors drive up the prices initially, which corrects over time. This insight into the effects of behavior on market dynamics aligns with market timing theory, where well-timed issuance can create financial advantages for companies and issuers.

The theory of market timing suggests that companies strategically adjust their capital structures in response to market conditions and Baker and Wurgler (2002) provide insight into this behavior. They find that firms tend to issue equity during periods of high market valuations, taking advantage of favorable conditions to raise capital more efficiently. This strategy allows companies to optimize their leverage ratios, as they can reduce reliance on debt when stock prices are strong. One significant finding of the study is the lasting impact of these timing decisions on a firm's capital structure: firms that issue equity during 'good' times maintain lower long-term leverage ratios, while those that miss these opportunities can end up with persistently higher debt levels. Baker and Wurgler's findings suggest a market inefficiency. If markets were fully efficient, firms would not consistently benefit from timing their financing decisions to align with favorable conditions.

Market timing plays a key role in corporate financing, as shown by Loughran and Ritter (1995) and Baker and Wurgler (2002). Loughran and Ritter reveal that IPOs often underperform long-term due to initial overvaluation driven by investor optimism, suggesting that firms time IPOs to benefit from high valuations. Baker and Wurgler show that companies adjust capital structures based on market conditions, issuing equity during favorable periods to maintain lower leverage ratios. Together, these studies highlight that market timing enables firms to maximize capital raised and maintain favorable capital structures, illustrating the practical impact of market timing theory in finance.

2.3.3 Information Asymmetry

Information asymmetry in financial markets occurs when one party has more knowledge than the other, as seen in IPOs where the issuing company has more information on true

value and risks than investors. A classic example of this theory is illustrated by Nobel Prize-winning economist George Akerlof in his article, 'The Market for "Lemons": Quality Uncertainty and the Market Mechanism' (Akerlof, 1970).

Akerlof describes how a market can malfunction as a result of information asymmetry, where sellers have more information about a product than buyers do. In his article, he uses the car market as an example for a market with uncertainty in quality (Akerlof, 1970). Here, buyers are unable to distinguish between high-quality and low-quality products ('lemons') due to limited information. As a result, high-quality products are crowded out of the market by low-quality ones, as buyers are unable to recognize the difference in quality between the goods.

Beatty and Ritter (1986) applied this theory to IPOs in their article "Investment banking, reputation, and the underpricing of initial public offerings", providing empirical support for the idea that information asymmetry leads to underpricing in IPOs. Underpricing occurs when underwriters want to attract uninformed investors by compensating them for the risk of potential overvaluation. In IPOs with higher risk, underpricing is more relevant, as these companies face larger information gaps that scare investors.

Beatty and Ritter (1986) argue that reputable underwriters help play an important role in signaling IPO quality. Firms of high quality tend to partner with quality underwriters. This assures investors that there is a low risk of overvaluation. The study finds that underpricing and underwriter reputation contribute to a solution of the "lemons problem" described by Akerlof, mitigating the problem of adverse selection and maintaining investor interest in IPOs.

Similarly, PE-backing can serve as a quality signal, as these firms have reputable connections and operational expertise, which increases investor confidence. This effect can help reduce the need for underpricing, as investors see less information risk in IPOs backed by reputable PE firms. The impact on post-IPO performance depends on the degree of institutional involvement; a retained stake post-IPO may indicate quality, positively influencing returns, while a rapid exit strategy can raise concerns about long-term prospects (Jenkinson & Ljungqvist, 2001).

2.3.4 Agency Theory

Agency theory is a concept within corporate finance, where shareholders (principals) rely on managers (agents) to make decisions that maximize firm value (Jensen & Meckling, 1976). This relationship can lead to agency costs, as managers can act in their own interests rather than in the best interests of shareholders, especially when external investors cannot control management's actions (Jensen, 1986).

In the context of IPOs, existing shareholders may face conflicts with new investors, who are reliant on management to act in ways that will maximize the long-term performance of the company. This may not align with the wishes of initial shareholders, such as PE investors, who have shorter investment horizons or clear performance targets (Jenkinson & Ljungqvist, 2001; Kaplan & Stromberg, 2009; Mikkelson et al., 1997). PE firms address these agency costs with close monitoring and governance structures that ensure that management actions align with their shareholder goals. However, since PE firms can potentially reduce their stake after the IPO, this management can weaken, leading to a potential increase in agency costs as the management gains more autonomy (Jensen, 1986).

Jensen (1986) further extends the research on agency theory by discussing the 'agency costs of free cash flow'. He argues that excess cash can lead to mismanagement, as managers may go for projects that maximize personal benefits rather than shareholder value. Institutionally backed companies often employ higher leverage to enforce financial discipline by restricting excess cash flow and directing resources toward high-value projects. This approach aligns the interests of management and shareholders, especially after an IPO, when capital inflow can increase agency-related risks.

Empirical research of Mikkelson et al. (1997) helps paint a picture of the role of ownership concentration in post-IPO performance. Significant ownership by institutional investors, such as PE firms, may contribute to better performance in the first year after the IPO, but the study finds that concentrated ownership does not necessarily lead to better performance in a 10-year period. In fact, performance often declines after IPOs, regardless of whether institutional owners keep their stake. This suggests that institutional governance mechanisms prior to an IPO can improve initial performance; these factors do not ensure

sustained operating efficiency after the IPO.

In general, while PE investors can reduce agency costs before an IPO through strong governance and leverage, the long-term impact on post-IPO performance is mixed, according to Mikkelson et al. (1997). Effective governance, financial discipline, and control might help control risks, but these factors alone do not guarantee operational efficiency and shareholder value after going public.

2.3.5 IPO Underperformance

The long-term underperformance of IPOs is a well-established phenomenon in the financial literature. Studies by Ritter (1991) and Loughran and Ritter (1995) highlight that IPO stocks generate significantly lower returns compared to other firms, particularly over 2- to 5-year periods following their issuance. This underperformance can be largely explained by the characteristics of IPO firms, including higher liquidity and lower leverage. IPOs tend to exhibit greater stock turnover. This is indicative of high liquidity and reduces their exposure to liquidity risk and consequently their expected returns. At the same time, IPO firms often operate with lower leverage post-issuance due to fewer assets in place and substantial equity proceeds, reducing their systematic risk exposure relative to more highly leveraged firms.

Empirical evidence from Eckbo and Norli (2004) supports this explanation using a sample of more than 6,000 Nasdaq IPOs from 1973 to 2002. They show that IPO stocks underperform not only the market, but also matched firms based on size and book-to-market ratios. Although IPOs occasionally deliver extreme positive returns, their overall return distribution skews downward, leading to weaker long-term performance. By incorporating a low minimum high (LMH) liquidity factor and macroeconomic risk variables, Eckbo and Norli demonstrate that IPO portfolios produce no significant abnormal returns (Jensen's alpha). This suggests that IPO underperformance is not an effect of price, but instead reflects lower exposures to risk factors, which is consistent with efficient market theory.

3 Hypotheses

3.1 Null and Alternative Hypothesis

3.1.1 Backed versus Non-Backed Hypotheses

The goal of this paper is to study whether PE-backed IPOs perform just as well or better than other IPOs over a period of 6, 12 and 24 months.

The null hypothesis assumes an efficient market that has correctly priced the PE and non-PE-backed IPOs. Therefore, there should be no difference in the risk adjusted return after one month after the IPO and thereafter between these two groups. The null hypothesis states that our CTP LS portfolio should provide an alpha that is insignificantly different from zero in all these periods. The method adjusts for differences in systematic risks and looks at the remaining unexplained return, alpha. The LS CTP method is explained in the methodology in this section.

In the case of a positive and significant alpha, the null hypothesis is rejected. The alternative hypothesis states that PE-backed IPOs outperform other IPOs on a 6-, 12-, or 24-month basis. Our hypothesis is that IPO companies that have been PE-backed will outperform non-backed IPOs due to being underpriced at one month after the IPO.

The hypothesis suggests that investors undervalue the organizational, governance, and managerial structures that are set up during the PE-ownership prior to the IPO and which causes a better operational efficiency for the company. This undervaluation causes the company to be underpriced. However, over time this underlying value becomes visible to the market through the company's operational performance, increasing company value, and provides a better return compared to non-backed IPOs.

3.1.2 Continued Ownership Post-IPO Hypotheses

In the cross-sectional regression, we study how PE and VC not exiting at IPO but continuing their ownership after the IPO impacts the post-IPO performance. We study this effect over a 6-, 12-, and 24-month holding period where the dependent variable is the individual alpha of each company. The dummy variable for post-IPO ownership is

described in the Appendix B.1.

Our null hypothesis states that a continued ownership from PE or VC will impact an IPO's alpha insignificantly different from zero. This hypothesis states that whether or not a PE- or VC-backed company continues their ownership or not should not have any effect on post-IPO performance. This suggests that the market correctly values the effect of continued PE or VC ownership.

In the case of a rejected null hypothesis, our alternative hypothesis states that a continued ownership from PE or VC will impact an IPO's alpha significantly different from zero. We hypothesize that continued ownership of PE and VC post-IPO will impact the IPO performance positively through enhancing or maintaining the mechanisms implemented before IPO. The alternative hypothesis suggests that the market initially underestimates the effect of continued ownership of PE or VC after the IPO. This undervaluation is later revealed through the company's operational performance, which is reflected in the return post-IPO.

4 Methodology

This section outlines the methodological framework for evaluating and comparing the post-IPO performance of PE-backed and non-backed IPOs. We combine asset pricing models and advanced statistical techniques to address key biases and provide reliable insights into drivers of post-IPO performance. The section introduces the asset pricing models and portfolio construction approach, explains the statistical methods employed, and discusses the methodology's limitations.

4.1 Asset Pricing Models

4.1.1 Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM) is an essential model within theoretical finance. Introduced by Sharpe (1964) in 1964, this model calculates the expected return of an asset based on its risk relative to the market. The formula for CAPM is given by equation 4.1. R_f represents the risk-free rate, β_i the beta of the asset i and $E(R_m)$ the expected return of the market. In total, these parameters contribute to the calculation of the required return of asset i.

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \tag{4.1}$$

CAPM explains an asset's expected return based on market risk (beta), calculated as the covariance of the asset's returns with market returns relative to market variance.[1] While foundational for understanding risk-return trade-offs, its single-factor approach is insufficient for capturing the different drivers of post-IPO performance. This measures how sensitive the asset is to market movements; assets with a beta greater than 1 are more volatile than the market, whereas those with a beta less than 1 are less volatile.

The model also has limitations. It explains the expected return based on a single risk factor, which simplifies the dynamic nature of real financial markets. CAPM assumes that all investors have the same expectations and can borrow and lend at the risk-free rate

[1] $\beta = \frac{\text{Cov}(R_i, R_m)}{\text{Var}(R_m)}$

(R_f), which is often not the case in practice. Furthermore, more recent empirical studies have shown that other risk factors also affect returns. Despite its limitations, CAPM remains an important tool for understanding the trade-off between risk and return and continues to be widely used today as an asset pricing model. CAPM is the foundation for researchers to seek more advanced models that incorporates additional risk factors. Such models include the Fama-French Three-Factor Model.

4.1.2 Fama-French Three-Factor Model

Building on CAPM, the Fama-French Three-Factor Model incorporates size (SMB) and value (HML) factors, addressing its limitations by accounting for additional drivers of asset returns (Fama & French, 1993).

Developed by Fama and French (1993), the Fama-French Three-Factor Model extends the CAPM by adding additional risk factors to provide a more complete explanation of asset returns. The model introduces two new factors alongside the market risk premium (MKT)[2] from CAPM; the size factor (SMB) and the book-to market factor (HML). The size factor represents the difference in returns between small-cap and large-cap stocks, highlighting the trend that smaller firms often yield higher returns than larger firms. The book-to-market factor incorporates the difference in returns between value stocks (high book-to-market ratios) and growth stocks (low book-to-market ratios), which recognizes the premium associated with value investing. Equation 4.2 presents the formula for the model.

$$E(R_i) = R_f + \beta_{MKT} \cdot MKT + \beta_{SMB} \cdot SMB + \beta_{HML} \cdot HML + \epsilon \tag{4.2}$$

Empirical findings suggest that including the size (SMB) and the book-to-market (HML) factor significantly improves the model's ability to explain variations in stock returns beyond what CAPM can achieve (Fama & French, 1993). These factors have proven relevant for understanding the performance of small value-oriented firms that consistently outperform their large-cap and growth competitors in various markets.

The model is particularly relevant for analyzing post-IPO performance in our research, as PE-backed firms often have characteristics associated with the size and value factors.

[2] $MKT = E(R_m) - R_f$

These firms tend to be smaller and operate in niche sectors, aligning with the size factor (SMB). Furthermore, the operational strategies used by PE firms to maximize performance - including cost reduction, efficiency improvements, and long-term value creation - align closely with the principles captured by the book-to-market factor (Kaplan & Stromberg, 2009; Ritter, 1991).

Using the Fama-French Three-Factor Model as a part of our methodology allows us to effectively measure the post-IPO performance of PE- and VC-backed firms compared to other firms. This approach provides insights into how these additional factors influence long-term performance and whether institutional backing correlates with higher risk-adjusted returns.

4.1.3 Carhart Four-Factor Model

The Carhart Four-Factor Model was introduced by Mark Carhart in his 1997 research, the model examines the persistence of mutual fund performance and the factors that explain it (Carhart, 1997). Carhart demonstrated that after accounting for momentum, reflecting the tendency of stocks with strong past returns to continue outperforming in the short term, the performance of mutual fund performance disappeared. Once adjusted for the four factors, the mutual fund returns were found to be close to zero.

The model is based on the Fama-French Three-Factor Model, which includes market premium (MKT), the size factor (SMB) and the book-to-market factor (HML) as shown in equation 4.3. It also includes the momentum factor (MOM), calculated as the difference in returns between stocks with high performance and those with low performance in the last 12 months. Carhart (1997) found that momentum explains a significant portion of stock performance, and funds with an overweight in stocks with strong performance tend to outperform in the short term.

$$E(R_i) = R_f + \beta_{MKT} \cdot MKT + \beta_{SMB} \cdot SMB + \beta_{HML} \cdot HML + \beta_{MOM} \cdot MOM + \epsilon \quad (4.3)$$

The Carhart Four-Factor Model is directly relevant to our research, as it provides a framework with another dimension relevant to evaluating post-IPO performance. Momentum effects, often linked to short-term market dynamics, can significantly influence

the post-IPO performance of PE-backed companies. By including a momentum factor, alongside market premium, size, and value factors, the model allows for a more complete analysis of abnormal returns associated with PE-backed IPOs. This is essential to understand whether the observed performance of PE-backed IPOs can be attributed to the operational and strategic improvements brought about by PE firms or whether it is largely due to the momentum effects in the market.

The model offers a valuable extension to the other models for analyzing stock returns by including momentum, which has an effect on short-term performance. It provides a more robust framework for assessing whether PE-backed IPOs deliver superior risk-adjusted returns compared to non-backed IPOs, contributing to a deeper understanding of the factors influencing post-IPO performance.

4.2 Research Methodologies in IPO Studies

This section underscores the importance of selecting an appropriate methodology to analyze long-term IPO performance. Various biases, such as event clustering and survivorship bias, can distort the analysis and lead to results that do not accurately reflect reality. Therefore, it is crucial to apply a method capable of mitigating these biases to ensure accurate and reliable findings. In this context, the Calendar Time Portfolio (CTP) approach will be introduced as a robust solution.

4.2.1 Calendar Time Portfolio

Mitchell and Stafford (2000) criticized traditional event-time methodologies such as BHAR for assuming independence across observations, which can inflate results and mislead conclusions. In his studies on IPO performance, Ritter (1991) employed BHAR to evaluate long-term abnormal returns, but subsequent critiques, including those of Mitchell, highlighted the methodological limitations of this approach. Independence is often not valid due to the clustering of corporate events by industry and time.

Mitchell and Stafford (2000) presents the CTP approach as a solution that accounts for cross-sectional dependence within the sample. The method constructs monthly portfolios that track the performance of all the firms observed over time. By creating a new portfolio each month that updates the composition, the approach allows for overlapping events.

This minimizes the issues related to clustering and survivorship of events.

Their empirical research found that adjusting for dependence eliminated much of the evidence for long-term abnormal returns. For mergers, seasoned equity offerings, and share repurchases, initial findings of significant abnormal performance were largely overestimated. Using the CTP approach, which accounts for cross-sectional correlations, most returns became statistically insignificant. This suggests that previous claims of abnormal performance were methodological faults rather than genuine market inefficiencies.

The method is especially relevant to our research questions as we aim to evaluate the long-term post-IPO performance of PE-backed versus non-backed companies. By addressing biases such as event clustering and survivorship bias, the CTP approach ensures that our results are real estimates and not distorted by methodological flaws. Furthermore, dynamic portfolio construction aligns with the nature of IPO performance analysis. Such events overlap and have varying market conditions, and this must be taken into account to draw reliable conclusions. This is why the CTP approach is the ideal framework for evaluating the effects of institutional backing on post-IPO returns and providing a clear understanding of long-term performance trends.

4.2.2 Event Clustering

A key challenge in IPO performance analysis is event clustering, which refers to the tendency of IPOs to occur in waves or during specific market conditions. These clusters often arise in "hot markets," characterized by increased optimism and increased investor demand. Such periods result in concentrated IPO activity, leading to cross-sectional dependence between observations. This dependence violates the assumption of independence within samples, a critical assumption in traditional event-time methodologies such as BHAR. As noted in Mitchell and Stafford (2000), failure to address this issue can give wrong results.

To address these limitations, the CTP approach constructs rolling portfolios that incorporate overlapping events. Unlike BHAR, which treats events as independent, CTP captures the dynamics of clustered IPO activity by accounting for cross-sectional correlations. This ensures that performance measurements reflect real effects rather than biases introduced by clustering. By incorporating the CTP approach, our methodology is

adjusted for event clustering and provides a more robust framework for analyzing IPO performance.

4.2.3 Survivorship Bias

Survivorship bias is a critical issue in performance analysis as it arises when only companies that remain active until the end of the observation period are included, potentially skewing results. Mitchell and Stafford (2000) underlines the importance of addressing this bias by including all companies that meet the initial selection criteria, regardless of their status during the observation period.

In our analysis, we ensure that all IPOs with available data are included, even if they were delisted or otherwise inactive during parts of the observation window. This approach ensures a complete and unbiased analysis of long-term post-IPO performance.

4.3 Application of the CTP Approach

As outlined in Section 4.2.1, the CTP approach provides a robust framework for evaluating long-term IPO performance analysis. This method is particularly effective in addressing biases such as clustering of events and survivorship bias, as discussed in Sections 4.2.2 and 4.2.3. It enables a systematic comparison of IPO performance over three observation periods: 6 months, 12 months, and 24 months. To minimize the impact of underpricing and potential greenshoe options, the first observation for each stock is excluded, as detailed in Section 2.3.1. By constructing rolling portfolios, the CTP approach accounts for overlapping events, providing a more accurate analysis of long-term performance trends.

4.4 Portfolios

Our analysis classifies IPOs into two main portfolios based on their backing at the time of the IPO: PE-backed and non-backed. To evaluate performance, we examine returns over three time horizons: 6, 12, and 24 months. This section outlines the construction of these portfolios and the methodology used to compare their performance.

4.4.1 PE-Backed vs. Non-Backed

To compare the post-IPO performance between PE-backed IPOs and non-backed IPOs, we divide the sample into two different categories. The PE-backed portfolio consists of companies that were supported by PE at the time of their IPO, while the non-backed portfolio includes companies without such backing.

4.4.2 Long-Short Portfolio

To further analyze whether PE-backed IPOs outperform other IPOs, we construct a long-short (LS) portfolio. This portfolio allocates 100% of its capital to the backed portfolio (long position) and shorts 100% of the non-backed portfolio. Monthly returns for the long and short positions are calculated over the observation period (2000-2024), isolating the impact of PE-backing on post-IPO performance.

Empirical research supports the efficiency of long-short strategies for identifying performance differences while taking into account market conditions. For example, Jegadeesh and Titman (1993) demonstrated that such strategies effectively capture return differences, as seen in their study on momentum investing. Similarly, Asness et al. (2013) found that long-short strategy portfolios isolate systematic performance differences (alpha) by reducing market-wide influences.

Using a long-short approach, we focus on the unique impact of PE involvement on IPO performance, excluding broader market trends. This methodology ensures that our analysis highlights the specific effects of PE-backing on long-term post-IPO returns.

4.5 Statistical Analysis

This section presents the statistical techniques used to evaluate the post-IPO performance of PE-backed and non-backed companies in Norway. The analysis uses the Carhart Four-Factor Model, as described in Section 4.1, to calculate the risk-adjusted returns for the two portfolios. The regression results allow for a direct comparison of the groups, while a LS portfolio is constructed to isolate the performance differential between PE-backed and non-backed IPOs. Through these approaches, we assess the influence of PE-backing on post-IPO performance.

The primary objective of the statistical analysis is to determine whether PE-backing

improves post-IPO performance by looking at the abnormal return. In addition, we employ a cross-sectional regression analysis to determine the firm-specific characteristics that drive these returns.

4.5.1 Risk-Adjusted Returns

To evaluate portfolio performance, risk-adjusted returns are calculated using the Carhart Four-Factor Model. By regressing the portfolio's returns on the four factors, we are able to obtain the risk-adjusted returns.

The intercept (α) represents the portfolio risk-adjusted return that cannot be explained by market, size, value, or momentum risks. Comparing the alphas of the PE-backed and non-backed portfolios under both models provides insight into the impact of PE-backing on performance.

4.5.2 Regression Analysis: Long-Short Portfolio

The LS portfolio allows a direct comparison of performance differences between the two groups. The regression model used to analyze the returns of the LS portfolio includes the Fama-French factors and the Carhart momentum factor (MOM), as shown in Equation 4.4.

$$R_{LS,t} = \alpha + \beta_1 \cdot \text{MKT}_t + \beta_2 \cdot \text{SMB}_t + \beta_3 \cdot \text{HML}_t + \beta_4 \cdot \text{MOM}_t + \epsilon_t \tag{4.4}$$

In this equation ($R_{LS,t}$) represents the monthly return of the LS portfolio. The intercept (α) measures the abnormal return, capturing the additional return from PE-backing that is not explained by systematic risk factors. This is a key metric for evaluating whether PE-backed IPOs achieve superior risk-adjusted returns, providing insight into the impact on long-term performance.

The regression coefficients (β_1), (β_2), (β_3), (β_4) represent the exposure of the portfolio to market (MKT), size (SMB), value (HML) and momentum (MOM), respectively. These variables control for systematic risks and ensure that the results reflect the impact of PE-backing.

By incorporating these factors, the LS portfolio regression isolates the performance

differential between PE-backed and non-backed IPOs. This methodology provides a robust framework for assessing whether PE-backing contributes to long-term outperformance, independent of broader market trends and systematic risks.

4.6 Cross-Sectional Analysis

This section outlines the methodology for the cross-sectional analysis conducted to identify firm-specific characteristics that influence the post-IPO performance of PE-backed and non-backed IPOs.

4.6.1 Firm Specific Regressions

To assess post-IPO performance and uncover performance drivers, we calculated each firm's individual alpha (α), representing the abnormal return not explained by market-wide factors, over 6-, 12-, and 24-month periods. The regression model is shown in Equation 4.5.

$$R_{i,t} - r_f = \alpha_{i,t} + \beta_1 \cdot \text{MKT}_t + \beta_2 \cdot \text{SMB}_t + \beta_3 \cdot \text{HML}_t + \beta_4 \cdot \text{MOM}_t + \epsilon_{i,t} \tag{4.5}$$

In this model, the dependent variable is the excess return of firm i at time t, regressed on market-wide factors. The intercept, α_i, captures the firm-specific abnormal return, which serves as the basis for further analysis. The distribution of alphas for the 6-, 12-, and 24-month period, shown in A.1, A.2, and A.3 in the Appendix confirms a normal distribution with expected values close to zero. The complete regression outputs are provided in Table B.4 in the Appendix.

We analyze the alphas obtained from these regressions to investigate the firm-specific characteristics that influence abnormal returns. Independent variables included continuous variables such as leverage ratio, market capitalization, and firm age. Dummy variables were used to assess the effects of venture capital funding (VC-backed) and post-IPO ownership of PE or VC firms. Sectoral differences were accounted for using industry-specific dummy variables.

To ensure reliable inference, robust standard errors were applied to address potential heteroskedasticity, correcting for non-constant error variance. This approach provided

a comprehensive insight of how firm-specific characteristics contribute to post-IPO performance and the differences between PE-backed and non-backed IPOs.

5 Data

5.1 Data Sample

Our dataset consists of 248 IPOs, including IPOs listed on both the Oslo Stock Exchange (OSE) and its junior markets. Over the years, the junior markets have undergone several name changes, such as Oslo Axess, Merkur Market, and later Euronext Growth Oslo and Euronext Expand. To maintain consistency, we collectively refer to these as "junior markets" throughout this thesis.

We chose to exclude over-the-counter listings (OTC), focusing specifically on public listings and their impacts. OTC listings were excluded because they typically differ significantly from public listings in terms of liquidity and transparency, which could distort the comparability of post-IPO performance. By focusing on public listings, we aim to analyze the effect of becoming available to the broader market for the first time. The dataset includes observations of companies that were taken of the public market after their observation period ended to ensure not omitting any observations in the relevant periods.

The time period of IPOs from 2000 to 2022 was selected based on the availability of data from Børsprosjektet NHH and Refinitiv Workspace. Although we intended to analyze IPOs from 1990, this was not possible due to data limitations. The sample period of IPOs ends in 2022 to allow for a thorough examination of post-IPO performance.

5.2 Data Sources and Preparation

The primary list of IPOs was sourced from Bloomberg, covering IPOs on OSE within the chosen period (Bloomberg, 2024). Additionally, we supplied this data with IPOs from Datastream via Refinitiv Workspace (Refinitiv Workspace, 2024). However, discrepancies arose between the sources, with each listing a different number of IPOs. To address this, we performed manual verification and adjustments using Excel and RStudio, ensuring a consistent and comprehensive dataset throughout the observation period. It is important to note that no single source, including Bloomberg, Datastream, or other databases, provided a complete list of IPOs on OSE for our sample period, necessitating this additional step.

We also gathered data on Norwegian stocks from Børsprosjektet NHH via Titlon, a financial database covering all OSE stocks from 1980 onward (Titlon, 2024). This included stock performance and market capitalizations, which are vital for assessing post-IPO performance. Using adjusted prices, we ensured that dividends, splits, and other corporate actions were accounted for, providing a more accurate reflection of each stock's post-IPO performance.

5.3 Data Cleaning and Adjustments

Several challenges emerged during the data collection process, particularly gaps in stock performance data for some companies in Titlon's dataset. To address these issues, missing data was supplemented with information from Datastream, Bloomberg, and in certain cases, company annual reports. Where discrepancies between sources occurred, manual adjustments were performed using Excel and RStudio to reconcile the differences.

These steps were essential to ensure the completeness and accuracy of the dataset, providing a solid foundation to analyze post-IPO performance. Although this cleaning process was time-consuming, it was crucial to maintaining the integrity of the data, especially for tracking stock performance and market capitalization trends, which are central to our analysis.

5.4 Sample Characteristics

This section presents the key characteristics of our data sample, including the distribution of IPOs over time, ownership structures, sectoral representation, and firm age at the time of the IPO.

5.4.1 Distribution of IPOs

The dataset includes IPOs for 22 years, from 2000 to 2022, as shown in Table 5.1. IPO activity during this period shows notable variations, with significant peaks and lows influenced by macroeconomic conditions and market sentiment. The highest level of IPO activity occurred in 2021, with 50 IPOs, while no IPOs were recorded in 2009. These patterns reflect the cyclical nature of IPO markets, driven by underlying market conditions,

as discussed in Section 2.1.3.

Beyond variations in IPO volume, the dataset reveals significant differences in post-IPO performance across various periods. For example, IPOs in 2020 achieved an average six-month return of 38.64%, yet their average 24-month return declined to -6.33%. In contrast, years with fewer IPOs, such as 2004, experienced higher long-term returns, with an average 24-month return of 181.06%.

Interestingly, the difference between the overall average return and the annual average return might suggest a potential positive correlation between the number of IPOs in a given year and their 6- and 12-month performance. In years with more IPOs, the 6- and 12-month returns seem to be higher, indicating that companies going public in these years may perform better in the short term. This trend appears to reverse over a 24-month holding period. The observations mentioned could be relevant for studying the market timing of IPOs and how they might impact IPO performance. The market timing of IPOs will also be discussed in Section 7 as there is a difference in market timing between PE-backed and non-backed IPOs, which can be seen in Figure 5.1.

The observed trends align with theoretical concepts discussed in the literature review, such as market timing theory, covered in Section 2.3.2. The theory suggests that firms are more likely to go public during periods of optimism, which can lead to higher IPO volumes but weaker long-term performance. These frameworks help us to use the dataset to explore how PE-backing affects long-term performance.

Year	Number of IPOs	Avg. Return (6M)	Avg. Return (12M)	Avg. Return (24M)
2000	7	-14.26%	-29.84%	-50.66%
2001	4	-29.14%	-38.18%	-16.27%
2002	3	-62.60%	-44.95%	20.90%
2003	1	-60.32%	-56.13%	153.23%
2004	10	19.22%	45.86%	181.06%
2005	28	49.04%	67.78%	103.61%
2006	17	27.36%	16.21%	-29.60%
2007	17	-10.40%	-28.49%	-47.86%
2008	3	-36.63%	-48.90%	242.67%
2009	0	-%	-%	-%
2010	8	-3.03%	-6.84%	-19.47%
2011	6	-10.03%	-12.12%	4.86%
2012	2	17.94%	25.79%	82.46%
2013	6	39.38%	12.54%	17.17%
2014	10	17.43%	2.64%	-7.23%
2015	7	-5.59%	7.14%	58.58%
2016	3	8.86%	19.92%	23.66%
2017	13	5.10%	15.89%	31.04%
2018	5	-23.70%	0.97%	20.09%
2019	8	12.16%	25.74%	60.23%
2020	33	38.64%	26.41%	-6.33%
2021	50	-13.42%	-19.52%	-27.03%
2022	7	10.47%	3.51%	29.78%
Annual Average Return	**248**	**-1.07%**	**-0.66%**	**37.50%**
Average Return of all IPOs	**248**	**9.75%**	**8.08%**	**15.80%**

Table 5.1: Summary of IPO Returns by Year

5.4.2 Ownership Structure

A thorough understanding of ownership structures, both before and after IPOs, is fundamental to our thesis. Ownership data provides critical information on the role of PE in shaping long-term performance. By analyzing ownership transitions, we aim to understand whether and how PE involvement influences the operational and financial outcomes of IPOs over time. Data were collected from Pitchbook and Refinitiv Workspace, which provided information about previous ownership (Pitchbook, 2024; Refinitiv Workspace, 2024).

For this analysis, smaller ownership stakes were excluded to ensure relevance, with a primary focus on significant PE ownership. Table 5.2 summarizes the ownership structure of our sample of 248 companies, focusing on the proportion of companies that were PE-backed at the time of their IPO and in the post-IPO period.

The post-IPO variable is a dummy variable indicating whether the VC or PE exited at the time of the IPO. It does not provide information on the duration of their ownership after the IPO. This has both a positive and a negative implication. It can tell us whether a continuation of ownership from an IPO is positively or negatively correlated with the short- and long-term performance, potentially providing the finding with a predictive

implication for IPOs. However, it also provides some inaccuracies by not studying the impact of how long after the IPO they maintain ownership. That would be an interesting perspective for further research on continued ownership post-IPO.

Category	**Count at IPO**	**At IPO (%)**	**Count post IPO**	**Post IPO (%)**
PE-backed	70	28.23	54	21.77
Non PE-backed	178	71.77	194	78.23
Total	**248**	**100.00**	**248**	**100.00**

Table 5.2: PE Ownership at IPO and Post IPO

Table 5.2 shows that out of 248 companies, 70 (28.23%) were PE-backed at the time of their IPO, while 178 (71.77%) were not. After the IPO, the number of companies that were PE-backed decreased to 54 (21.77%), reflecting that some PE investors exited their positions at the IPO stage. In particular, 178 companies (71.77%) were not PE-backed at all during the observation period.

To further contextualize the ownership structure, Figure 5.1 provides a breakdown of IPO activity by year, distinguishing between PE-backed and non-backed IPOs. This table highlights the distribution of PE-backed IPOs over time and underlines the increasing role of PE involvement in recent years.

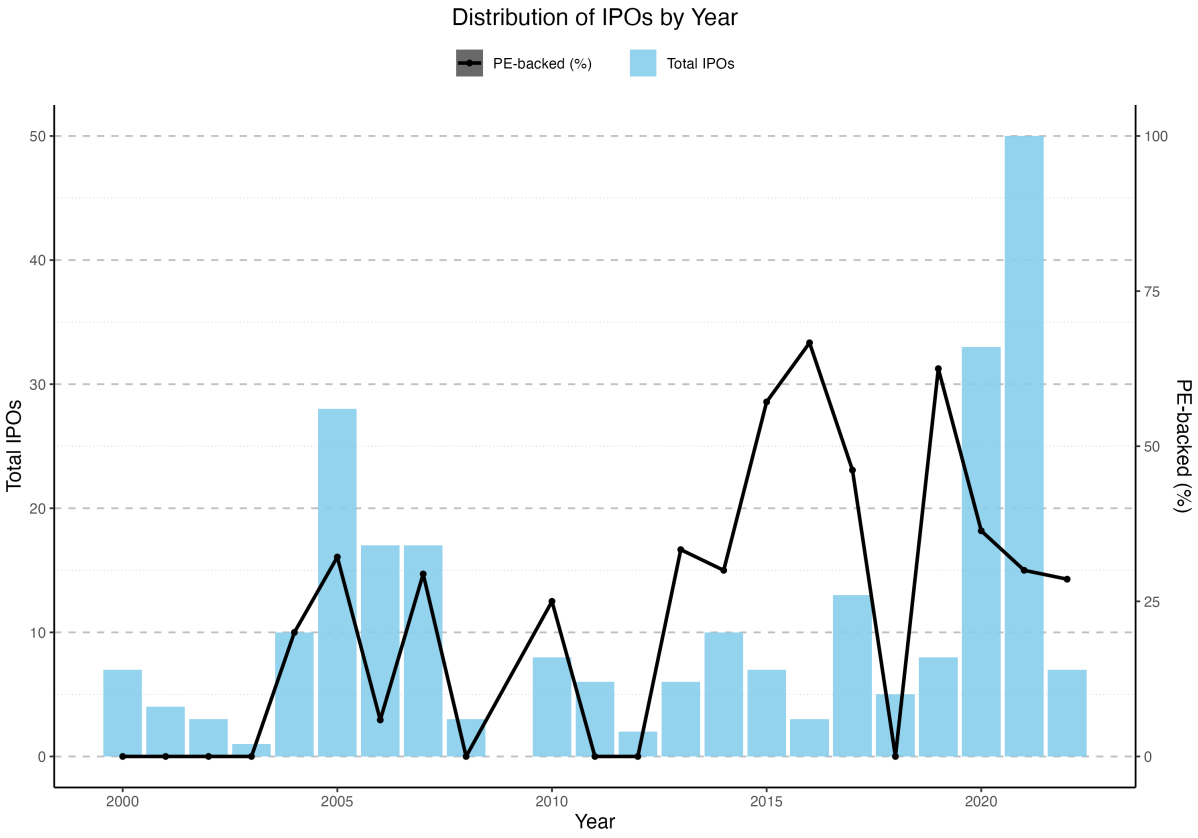

Figure 5.1: IPO Distribution Per Year

5.4.3 Sectoral Breakdown

Sectors in the dataset are categorized using the Industry Classification Benchmark (ICB), which is the standard adopted by Euronext for its exchanges (Euronext, 2024a). The sectors include Basic Materials, Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Real Estate, Technology, Telecommunications, and Utilities. Table 5.3 provides an overview of the distribution of IPOs in sectors and shows the proportion of IPOs supported by PE within each sector.

Sector	PE-backed	Non-backed	Total IPOs	PE-backed (%)
Basic Materials	3	9	12	25.00
Consumer Discretionary	13	10	23	56.52
Consumer Staples	6	22	28	21.43
Energy	9	37	46	19.57
Financials	4	20	24	16.67
Health Care	4	16	20	20.00
Industrials	9	32	41	21.95
Real Estate	2	4	6	33.33
Technology	17	14	31	54.84
Telecommunications	2	5	7	28.57
Utilities	1	9	10	10.00
Total	**70**	**178**	**248**	**28.23**

Table 5.3: Sector Summary of IPOs by PE-Backing

Table 5.3 provides an overview of PE- and non-backed IPOs by sector. The table shows that the Consumer Discretionary and Technology sectors had the highest percentage of PE-backed IPOs, with 56.52% and 54.84%. This reflects the alignment between PE investments and growth-oriented industries. In contrast, Utilities and Financials had the lowest amounts of PE-backed IPOs, at 10.00% and 16.67%. This aligns with the lower appeal of these sectors for PE investors, as these sectors traditionally have a lower growth potential.

5.5 Dependent Variables

5.5.1 CTP - Returns

The dependent variable in our CTP regressions is the excess monthly return of IPOs. Table 5.4 provides the descriptive statistics for these returns on different time horizons: 6 months, 12 months, and 24 months. To mitigate the potential impact of underpricing and the greenshoe option, as discussed in Section 2.3.1, the first monthly return observed is excluded from the analysis.

To address the influence of extreme outliers, returns were winsorized at the 1% level. This adjustment minimizes the impact of exceptionally high or low returns, ensuring a more robust analysis while preserving the integrity of the dataset. Winsorization is particularly relevant given the skewness observed in the distribution of returns, as reflected in the

descriptive statistics in Table 5.4.

Metric	6-month returns	12-month returns	24-month returns
Observations	245	236	220
Mean (%)	3.76	2.52	11.12
Median (%)	-2.11	-4.83	-13.05
St.Dev (%)	41.11	60.17	113.02
Min (%)	-81.33	-87.97	-99.06
Max (%)	180.07	350.63	750.63
Quartile 25 (%)	-22.00	-38.45	-63.89
Quartile 75 (%)	20.00	25.34	41.44

Table 5.4: Descriptive Statistics of Cumulative Returns

The dataset includes 245 observations for 6-month returns, 236 for 12-month returns, and 220 for 24-month returns, as some companies were delisted during the observation period. The mean return increases over time, starting at 3.76% for 6 months, 2.52% for 12 months, and reaching 11.12% at 24 months. However, the median returns are negative for all periods, with the lowest value being -13.05% at 24 months. This indicates a skewed distribution driven by a small number of high-performing IPOs.

The standard deviation of the returns increases with time, reflecting the increased variability in the returns as the holding period stretches. The SD values are 41.11%, 60.17%, and 113.02% for 6, 12, and 24 months, respectively. The range of returns is considerable, with a minimum of -99.06% and a maximum of 750.63% over 24 months.

These descriptive statistics highlight the wide variation in IPO performance in the Norwegian market, supporting the need for further analysis to identify patterns and drivers of long-term performance.

5.5.2 Cross-Sectional - Alphas

The dependent variable in our cross-sectional regression is the firm-specific alpha, calculated over 6-, 12-, and 24-month periods. These alphas are derived by regressing the returns on the risk factor estimates, capturing the abnormal returns unexplained by the systematic factors in the Carhart Four-Factor Model, as presented in Equation 4.5. The distributions of these alphas are shown in Figures A.1, A.2, and A.3 in the Appendix.

To ensure unbiased results, the alphas are estimated using robust regression techniques, mitigating the effects of heteroskedasticity or other data irregularities. The distributions for the 6-, 12- and 24-month periods exhibit mean values close to zero, highlighting the effectiveness of the model in explaining average returns. However, variance in the distributions, including extreme values, reveals significant over- or underperformance for some firms.

5.6 Independent Variables

In this section, we outline the independent variables used in our analysis. These include risk factor estimates used in both CTP and cross-sectional regressions and firm-specific characteristics used only in cross-sectional analysis.

5.6.1 Risk-Factor Estimates

The Fama-French values used in this research were sourced from from Professor Bernt Arne Ødegaard's Norwegian Financial Data (Ødegaard, 2024). Covering the period 1980 to 2023, this dataset offers a complete collection of financial data for the Norwegian market. It includes size (SMB), value (HML), and momentum (MOM) factors, which are essential for analyzing risk-adjusted returns. These factors are widely used in asset pricing studies to assess financial asset performance and to account for market-wide influences. The data is publicly accessible on Professor Ødegaard's website (Ødegaard, 2024).

The market premium is calculated as the difference between the market return and the risk-free rate. Market return data was obtained from the Oslo Stock Exchange Benchmark Index (OSEBX) through Refinitiv (Refinitiv Workspace, 2024), while the risk-free rate was obtained from Ødegaard's Norwegian Financial Data (Ødegaard, 2024). The risk-free rate consists of 1-month forward looking estimates based on government securities and NIBOR, with monthly data available from 1980 to the present. The market premium is a critical component of the methodology, providing a solid foundation for evaluating post-IPO performance.

5.6.2 Sector

Sectors are represented as dummy variables in the cross-sectional regression analysis, with each sector assigned a binary variable: 1 if the firm belongs to the sector and 0 otherwise. This approach enables us to isolate the impact of sectoral affiliation on post-IPO performance. The sectoral distribution is summarized in Table 5.3.

Including sector-specific dummy variables allows us to control for industry-specific factors that may influence post-IPO outcomes. For instance, growth-oriented sectors such as Technology and Consumer Discretionary are expected to outperform more stable sectors such as Utilities post-IPO. This hypothesis is supported by trends observed in our dataset and aligns with the existing literature on PE investment patterns (Kaplan & Stromberg, 2009).

5.6.3 Capital Structure

The leverage ratio, representing the capital structure of the firms, was obtained from Refinitiv (Refinitiv Workspace, 2024). The argument for using book value of equity, rather than market capitalization, is that the book value remains unaffected by over- or undervaluation at IPO and is independent of the market timing. However, using market capitalization is also a valid approach as it reflects the market's expectations for future cash flow and their potential to service debt. In addition, using market capitalization can provide a more comparable measure between industries, especially those where book values diverge significantly from cash flow or market valuation. Table 5.5 provides summary statistics for the leverage ratio, alongside other independent variables, such as firm age and market capitalization.

The mean leverage ratio is 257%, while the values range from -1969% to 29998%. The presence of negative values reflects firms with negative common equity. This highlights the variability in how companies manage their capital structures. Furthermore, the median leverage ratio of 62.90% indicates that most companies operate with relatively low debt levels, and the distribution is likely to be skewed due to a few highly leveraged firms. As we use book-value-of-equity, the leverage ratios show a higher spread in values than it would have with market capital.

Metric	Firm Age	Market Cap (NOK)	Leverage Ratio (%)
Mean	22.98	4,667,756,487.46	257.00
Median	11.00	1,280,589,025.00	62.90
Minimum	0.00	5,696,000.00	-1969.00
Maximum	194.00	154,970,027,390.80	29998.00
Std.Dev	34.49	13,637,133,024.89	1724.00
Q1	4.00	495,313,265.60	15.80
Q3	24.00	3,361,000,000.00	159.00

Table 5.5: Summary Statistics for Independent Variables

5.6.4 Firm Age

Firm age, defined as the time between a company's founding and its IPO date, is a key independent variable in this study. Data were sourced from Datastream and logarithmically transformed for consistent scaling (Refinitiv Workspace, 2024). The descriptive statistics in Table 5.5 show a mean firm age of 22.98 years, with a median age of 11 years. Firm ages range from newly founded companies (0 years) to firms as old as 194 years, highlighting the diversity of firms entering the IPO market. The impact of firm age will be explored further, as younger firms may have different risk-return profiles compared to more mature companies.

5.6.5 Market Capitalization

Market capitalization data, representing the size of firms at the time of their IPO, were obtained from Bloomberg and Datastream (Bloomberg, 2024; Refinitiv Workspace, 2024). Like firm age, market capitalization is logarithmically transformed to ensure consistent scaling in regression analysis. As shown in Table 5.5, the mean market capitalization is 4.67 billion NOK, while the median is lower at 1.28 billion NOK. This indicates the presence of a few large-cap firms skewing the distribution. The values range from 5.70 million to 154.97 billion, reflecting the diversity of firms in the dataset. Market capitalization is a key factor in explaining post-IPO performance, as performance dynamics may differ between larger and smaller firms.

5.6.6 VC-backing

Data on venture capital (VC) ownership were collected from Pitchbook and Datastream (Pitchbook, 2024; Refinitiv Workspace, 2024). This variable is included in the cross-sectional analysis to better understand the firm-specific characteristics that drive alpha. Table 5.6 shows that of the 248 companies, 38 (15.32%) were backed by VC investors at the time of their IPO, while 210 (84.68%) were not. After the IPO, only 23 companies (9.27%) continued to have VC-backing, indicating that most VC investors exited their positions during or shortly after the IPO.

Category	**Count at IPO**	**At IPO (%)**	**Count post IPO**	**Post IPO (%)**
VC-backed	38	15.32	23	9.27
Not VC-backed	210	84.68	225	90.73
Total	**248**	**100.00**	**248**	**100.00**

Table 5.6: VC Ownership at IPO and Post IPO

6 Analysis

This section presents the findings of the CTP and cross-sectional regression analyzes. The CTP regressions results offer insights into the relative performance of PE-backed and non-backed IPOs since the 2000s, examined across different holding periods. These results provide an overview of performance trends and associations with market factors. Complementing this, the cross-sectional regression analysis investigates firm-specific characteristics, aiming to identify factors associated with variations in IPO performance and each firm's alpha. In this section, we will also conduct an analysis of IPOs post-2010. By isolating the period following the financial crisis, we aim to study how the post-financial crisis might have impacted the post-IPO performance and how this might have affected our full sample results. Finally, a robustness section evaluates the consistency of the findings.

6.1 Calendar Time Portfolio Analysis

This section discusses the results of equal-weighted portfolio regressions, presented in Table 6.1, as these provide a more balanced perspective by giving equal importance to all IPOs, regardless of size. The value-weighted results, which are included in Table B.2 in the Appendix, are discussed to a lesser extent due to the potential skew caused by larger IPOs dominating the portfolio. By prioritizing equal-weighted results, we aim to present findings that better reflect the broader performance trends of IPOs in the dataset.

6.1.1 6-Month Holding Period

The regression results for the 6-month holding period provide statistically insignificant alphas, suggesting that there is no clear evidence of excess returns attributable to PE-backing during this period. The LS portfolio also has an insignificant alpha, indicating no statistically significant difference in alpha between PE-backed and non-backed IPOs over this holding period.

Both PE-backed and non-backed portfolios show a strong and statistically significant association with the market premium at the 1% level, highlighting that IPO performance is strongly related to market movements. The SMB, HML, and MOM factors do not

show significant results in the 6-month holding period. The adjusted R^2 values range from -0.09% to 16.6%, suggesting a limited explanatory power for the model in the short horizon.

6.1.2 12-Month Holding Period

For the 12-month holding period, the non-backed portfolio shows a statistically significant alpha at the 5% level. This suggests a potential association between non-backed IPOs and weaker performance during this period. The LS portfolio has a positive alpha (1.2%) that is marginally significant. This indicates a weak association between PE-backing and improved risk-adjusted performance relative to non-backed IPOs over 12 months. This suggests a rejection of our null hypothesis, and the alternative hypothesis suggests that PE-backed IPOs outperform non-backed IPOs over a 12-month holding period. However, the significance is marginal.

As in the 6-month holding period, the market premium remains strongly and significantly associated with the returns for the PE-backed and non-backed portfolios at the 1% level. The SMB factor is marginally significant for the non-backed portfolio, suggesting a weak association with smaller firms' performance. The HML and MOM factors remain insignificant in all regressions, including the LS portfolio. The adjusted R^2 values range from 0.6% to 28.6%, indicating moderate goodness of fit.

6.1.3 24-Month Holding Period

For the 24-month holding period, there is no statistically significant alpha, indicating that the overperformance of the 12-month holding period diminishes over time for all portfolios.

Among factor loadings, the market premium remains strongly and positively associated with returns for PE-backed and non-backed portfolios at the 1% significance level, underscoring the importance of market-wide movements in driving the performance of the IPO. The SMB factor is statistically significant for both the PE-backed (5%) and non-backed (1%) portfolios, highlighting a stronger association between smaller firms and higher returns in these portfolios. The HML factor is negative and statistically significant at the 5% level, suggesting a preference for growth-oriented companies within

the PE-backed portfolio. In contrast, the momentum factor shows no significance in the 24-month regressions.

The adjusted R^2 values range from 1.5% for the LS portfolio to 39.4% for the non-backed portfolio, suggesting that the included factors explain a substantial portion of the variance in the non-backed portfolio but have more limited explanatory power for the LS portfolio.

	6-Month			12-Month			24-Month		
	Dependent variable: Excess Return			*Dependent variable: Excess Return*			*Dependent variable: Excess Return*		
	Backed	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**
market_premium	0.768***	0.723***	−0.270	0.588***	0.875***	−0.220	0.702***	0.927***	−0.250*
	(0.132)	(0.134)	(0.232)	(0.095)	(0.132)	(0.140)	(0.088)	(0.076)	(0.138)
smb	0.214	0.106	0.155	0.183	0.284**	−0.050	0.223**	0.321***	−0.054
	(0.166)	(0.106)	(0.149)	(0.141)	(0.113)	(0.142)	(0.096)	(0.100)	(0.111)
hml	−0.133	−0.029	−0.093	−0.149	−0.053	−0.085	−0.145**	−0.066	−0.043
	(0.119)	(0.081)	(0.102)	(0.100)	(0.087)	(0.096)	(0.068)	(0.083)	(0.077)
mom	0.079	0.072	−0.010	0.027	−0.044	−0.026	0.006	−0.053	0.062
	(0.129)	(0.099)	(0.146)	(0.084)	(0.111)	(0.100)	(0.065)	(0.075)	(0.110)
Constant	0.007	−0.006	0.007	0.003	−0.010**	0.012*	−0.001	−0.004	0.002
	(0.010)	(0.006)	(0.012)	(0.006)	(0.005)	(0.007)	(0.005)	(0.004)	(0.006)
Observations	138	240	129	179	269	175	217	286	217
R^2	0.123	0.180	0.023	0.179	0.297	0.029	0.272	0.403	0.033
Adjusted R^2	0.097	0.166	−0.009	0.161	0.286	0.006	0.258	0.394	0.015
Residual Std. Error	0.080 (df = 133)	0.102 (df = 235)	0.081 (df = 124)	0.074 (df = 174)	0.089 (df = 264)	0.079 (df = 170)	0.064 (df = 212)	0.068 (df = 281)	0.087 (df = 212)
F Statistic	4.776*** (df = 4; 133)	12.923*** (df = 4; 235)	0.733 (df = 4; 124)	9.488*** (df = 4; 174)	27.264*** (df = 4; 264)	1.257 (df = 4; 170)	19.816*** (df = 4; 212)	47.357*** (df = 4; 281)	1.797 (df = 4; 212)
Note:									*p<0.1; **p<0.05; ***p<0.01

Table 6.1: Regression Results: Equal-Weighted Portfolios' Excess Returns

6.1.4 Summary of Trends

The CTP analysis provides some evidence on trends in alpha and market factors over different time horizons. Alphas for both PE-backed and non-backed portfolios are insignificant at 6 months, suggesting no clear evidence of excess returns in the short term. At 12 months, the non-backed portfolio shows significant underperformance, while the marginally significant positive alpha of the LS portfolio (1.2%) indicates a weak association between PE-backing and better relative performance. By 24 months, all alphas are insignificant, reflecting the diminishing impact of PE-backing on excess returns over time.

Market factors play a consistent role, and the market premium is significant at the 1% level throughout all periods, underscoring the influence of broader market movements. The SMB factor becomes increasingly significant over time, highlighting the role of smaller firms in driving returns, particularly for non-backed IPOs. The HML factor is significant only for PE-backed IPOs at 24 months, reflecting a growth-oriented profile. Momentum remains insignificant throughout, while adjusted R^2 values show stronger explanatory power for the non-backed portfolio compared to the LS portfolio, where performance differences are less clearly captured.

6.2 Cross-Sectional Regression Analysis

This section presents the results of the cross-sectional regressions, as shown in Table 6.2. The analysis aims to identify the firm-specific and sectoral characteristics that drive post-IPO performance (alpha) over three distinct holding periods: 6 months, 12 months, and 24 months. Although CTP analysis focuses on aggregate portfolio performance, cross-sectional regression specifically looks at the drivers of individual firm-level alphas.

Firm-specific alphas are retrieved by regressing each firm's excess return on the Carhart Four Factors. This approach adjusts for systematic risk, allowing us to precisely examine the differentiating characteristics of each group. The pooled regression includes observations for all IPOs and regresses alpha on multiple independent variables. This aims to provide a deeper insight into the dynamics of post-IPO performance.

6.2.1 6-Month Holding Period

The 6-month analysis identifies a statistically significant positive relationship between PE-backing (*pe_backed*) and alpha in both models (with and without sectoral controls), indicating that PE-backing is consistently associated with superior short-term performance.

However, the variable *pe_post_ipo* exhibits a negative and marginally statistically significant association with alpha, suggesting that continued ownership of PE after the IPO is linked to weaker short-term results. For VC-backed IPOs, the findings are mixed: while *vc_post_ipo* is positively and significantly correlated with alpha, *vc_backed* shows a negative and significant association, suggesting a relative underperformance of VC-backed IPOs compared to others over six months.

Firm-specific variables, including *log(market_cap)*, *leverageratio*, and *log_firmage*, show no significant relationships with alpha, suggesting that firm size and age do not play a prominent role in explaining short-term performance. Similarly, the sectoral variables do not show statistically significant associations in this period.

6.2.2 12-Month Holding Period

At the 12-month horizon, the significance of PE-backing (*pe_backed*) weakens, with its coefficient only marginally positive and significant in the model without sectoral controls. Continued PE ownership (*pe_post_ipo*) is marginally significant, suggesting that continued ownership still has a negative correlation with alpha over 12 months.

Firm age (*log_firmage*) has a marginally significant and positive correlation with alpha, suggesting that older firms tend to perform better during this period. Meanwhile, other sector- and firm-specific variables remain insignificant.

6.2.3 24-Month Holding Period

In the 24-month regression, the positive association between PE-backing (*pe_backed*) and alpha remains significant across both models, suggesting that PE-backed IPOs sustain higher long-term performance compared to non-backed IPOs.

Continued PE involvement (*pe_post_ipo*) is marginally significant and has a negative coefficient when including sectors. For VC-backed IPOs, *vc_post_ipo* shows a significant

negative association with alpha, indicating that prolonged VC involvement correlates with reduced long-term performance. Several sectoral variables are statistically significant in the 24-month holding period, while firm-specific variables remain insignificant.

Regression Results: Alpha for IPOs

Dependent variable: Alpha

	6-Month		12-Month		24-Month	
	With Sectors	**Without Sectors**	**With Sectors**	**Without Sectors**	**With Sectors**	**Without Sectors**
log(market_cap)	0.009	0.009	−0.003	−0.003	−0.00004	−0.0004
	(0.007)	(0.006)	(0.003)	(0.002)	(0.002)	(0.002)
leverageratio	0.001	0.001	−0.0002	−0.0002	0.0002	0.0002
	(0.001)	(0.001)	(0.0005)	(0.0005)	(0.001)	(0.001)
log_firmage	−0.004	−0.002	0.005*	0.005*	0.003	0.003
	(0.006)	(0.006)	(0.003)	(0.003)	(0.002)	(0.002)
sectorConsumer Discretionary	0.007		0.027		0.025	
	(0.039)		(0.025)		(0.016)	
sectorConsumer Staples	−0.015		0.002		0.018	
	(0.035)		(0.022)		(0.012)	
sectorEnergy	−0.056		0.008		0.027**	
	(0.038)		(0.022)		(0.012)	
sectorFinancials	0.002		0.009		0.023**	
	(0.034)		(0.021)		(0.011)	
sectorHealth Care	−0.019		0.002		0.021	
	(0.041)		(0.026)		(0.015)	
sectorIndustrials	−0.007		0.018		0.026**	
	(0.037)		(0.022)		(0.011)	
sectorReal Estate	−0.022		0.011		0.010	
	(0.035)		(0.020)		(0.011)	
sectorTechnology	−0.011		0.021		0.026*	
	(0.044)		(0.022)		(0.013)	
sectorTelecommunications	0.042		0.057		0.050***	
	(0.040)		(0.038)		(0.018)	
sectorUtilities	0.018		0.005		0.004	
	(0.047)		(0.026)		(0.018)	
pe_backed	0.046*	0.053**	0.028	0.028*	0.028**	0.026*
	(0.026)	(0.026)	(0.017)	(0.017)	(0.014)	(0.014)
pe_post_ipo	−0.079**	−0.085***	−0.034*	−0.030*	−0.024*	−0.020
	(0.032)	(0.032)	(0.019)	(0.018)	(0.015)	(0.014)
vc_backed	−0.064*	−0.050*	−0.027*	−0.021	0.010	0.011
	(0.033)	(0.029)	(0.015)	(0.014)	(0.010)	(0.009)
vc_post_ipo	0.077**	0.073**	0.010	0.009	−0.032**	−0.030**
	(0.037)	(0.037)	(0.017)	(0.016)	(0.013)	(0.012)
Constant	−0.177	−0.189	0.024	0.033	−0.038	−0.008
	(0.139)	(0.130)	(0.058)	(0.051)	(0.041)	(0.039)
Observations	244	244	244	244	244	244
R^2	0.095	0.056	0.084	0.047	0.094	0.057
Adjusted R^2	0.027	0.028	0.015	0.019	0.026	0.029
Residual Std. Error	0.113 (df = 226)	0.113 (df = 236)	0.056 (df = 226)	0.056 (df = 236)	0.043 (df = 226)	0.043 (df = 236)
F Statistic	1.392 (df = 17; 226)	1.998* (df = 7; 236)	1.224 (df = 17; 226)	1.672 (df = 7; 236)	1.387 (df = 17; 226)	2.044* (df = 7; 236)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6.2: Regression Results: Cross-Sectional Analysis of IPOs

6.2.4 Summary of Cross-Sectional Analysis

The cross-sectional regressions highlight significant associations between alpha and institutional ownership, as well as sectoral factors across different time horizons. PE-backing demonstrates a consistently positive and statistically significant correlation with alpha in all holding periods, indicating its association with superior performance. However, continued ownership of PE after the IPO shows a persistent negative correlation with alpha throughout all time horizons, suggesting a decline in performance when PE firms retain ownership.

For VC-backed IPOs, continued VC ownership is positively associated with alpha in the 6-month holding period but becomes negative at the 24-month mark, signaling weakened performance.

Sectoral variables become more influential in the long term, exhibiting significant positive correlations with alpha. Among firm-specific factors, only firm age has a significant positive correlation with alpha in the 12-month holding period, while other variables remain insignificant.

Firm age is positively correlated with alpha in the 12-month term, while other firm-specific factors do not show significant relationships. These results emphasize the varying importance of institutional, firm-specific, and sectoral factors over different post-IPO time horizons, highlighting associations rather than causality.

6.3 Comparison - CTP and Cross-Sectional Regression

6.3.1 Key Findings

The findings of the CTP and cross-sectional regressions provide complementary information on the performance dynamics of PE-backed and non-backed IPOs. The CTP analysis highlights that PE-backed IPOs exhibit some evidence of superior short-term performance, with a marginally significant positive alpha for the LS portfolio over the 12-month period. However, this advantage is not present in the two-year period, as the alphas of all portfolios become statistically insignificant. These results suggest that the initial performance boost associated with PE-backing does not persist over the longer term.

Cross-sectional regressions add granularity to these findings by identifying firm-specific and sector-specific drivers of IPO performance. PE-backing is significantly and positively correlated with alpha for the 6-month holding period, while being marginally significant and positive for the 12- and 24-month holding period. Including sectoral variables in the 24-month holding period, it correlates positive and significantly in the 24-month holding period. The continued ownership of PE after the IPO shows a positive association with alpha in all regressions.

These two methods complement each other by offering both macro- and micro-level

perspectives. The CTP analysis demonstrates the aggregate effects of PE-backing and manages to capture the systematic trends across time periods. The cross-sectional regressions manage to explore why these effects occur, highlighting the specific factors that drive the excess return post-IPO.

6.4 Post-2010 Subsample Analysis

The sample period for this study, 2000 to 2023, includes significant macroeconomic events, such as the financial crisis and the COVID-19 pandemic. These events have the potential to significantly influence the post-IPO performance of PE-backed securities, making it clear that this should be examined further.

Studying the graphs of cumulative returns in the section below, we can observe trends that vary between the 6-, 12- and 24-month return. To gain a better understanding of how these trends could impact our study and PE performance over a 6-, 12-, and 24-month holding period, we performed a CTP and cross-sectional regression on the post-2010 subsample. This resulted in findings that indicates a difference in PE-performance between the whole period of interest and the post-2010 subsample.

6.4.1 Analysis of Cumulative Returns

An analysis of the cumulative returns of the LS portfolios for the holding periods of 6, 12 and 24 months reveals tendencies in how the holding periods performed differently during and after the financial crisis. It also shows tendencies on how PE-backed IPOs and non-backed IPOs performed differently. The 6- and 12-month holding periods show flat cumulative returns during the financial crisis and its aftermath, caused by the absence of observations due to a decline in IPO activity during 2008-2010, as shown in Table 2.1. This reduction in IPO activity is a natural consequence of unfavorable market conditions during the crisis, resulting in the portfolio for these holding periods remaining unaffected by this period. The flat lines in the representative graphs, included in Figures A.4, A.5 and A.6, assume zero returns for these periods, reflecting the lack of activity in the IPO market.

In contrast, the 24-month holding period continues to include observations throughout the financial crisis and its aftermath. These observations reveal differing performance between

PE-backed and non-backed IPOs during this period. Although PE-backed IPOs tend to be negatively affected during this period, non-backed IPOs show relatively positive performance, as shown in Figure 6.1. This divergence results in a substantial negative return for the 24-month LS portfolio.

However, due to the absence of comparable observations for the 6- and 12-month holding periods during the same timeframe, it becomes harder to study whether the underperformance of the 24-month portfolio is a direct consequence of the financial crisis or due to other issues in PE-backed IPOs beyond the 12-month mark.

However, we would argue that the lack of observations is due to the timing of IPO dates, and therefore it would also be correct to consider this as a natural reason for how 6- and 12-month holding period IPOs would not be present and thereby underperform in such a period. This is therefore not considered bias, but rather as a potential explanation of the difference in performance.

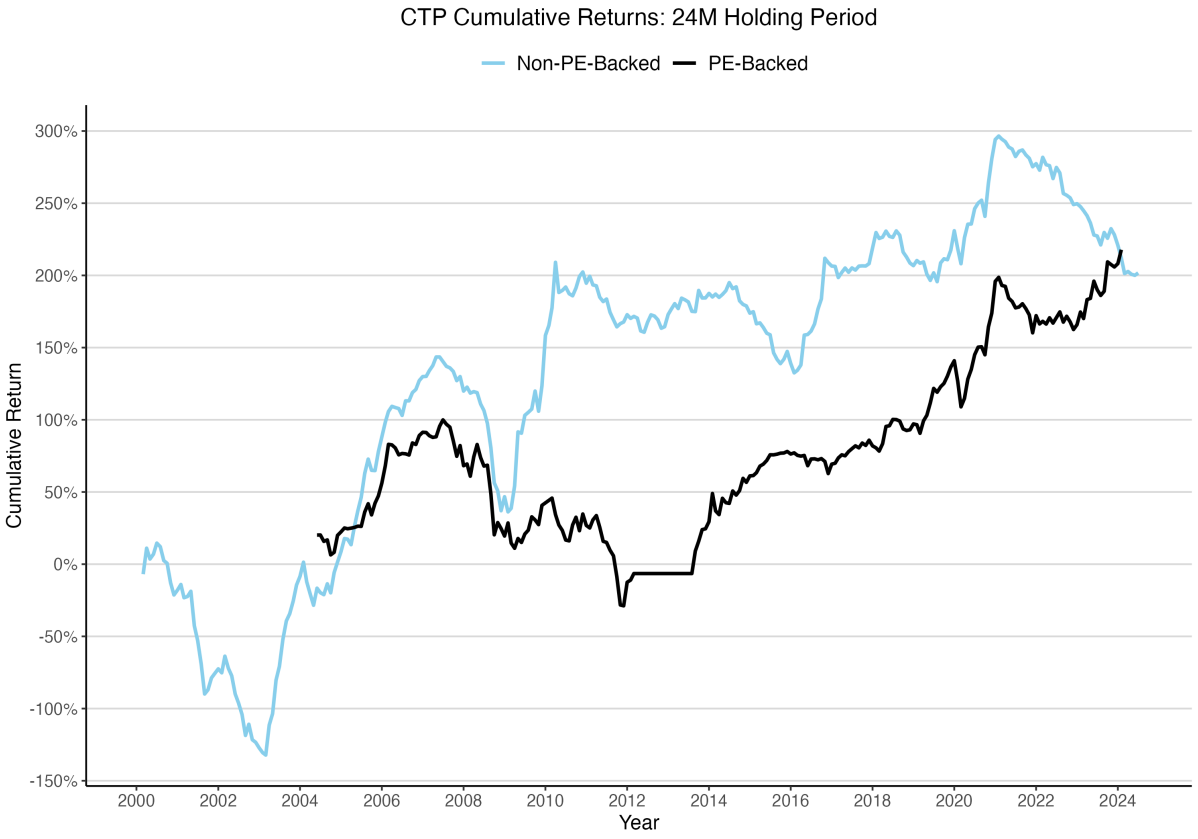

Figure 6.1: Cumulative Returns for Portfolios

Furthermore, comparing the cumulative return graphs for the three holding periods reveals

additional trends of interest. Before the financial crisis, all holding periods seemed to underperform. In addition, during the post-crisis years 2009-2012, the 24-month portfolio drastically underperformed, where the other holding periods were flat due to no recent IPOs. However, looking at all holding periods' performance after the financial crisis, beginning in 2011, all LS portfolios seem to have a much stronger performance relative to before the financial crisis.

The entire sample period analyzed contains a time of growth of PE in Norway, the financial crisis, and the pandemic. The financial crisis impact caused a market drop that affected the PE-backed IPOs's return for that period. Despite controlling for market factors and using the LS portfolio strategy to make the performance relative to other IPOs, differences in how such macroeconomic events impact backed versus non-backed IPOs could differ. Eckbo et al. (2023) describes how the financial crisis has caused a near-zero interest rate, creating a trend of increased capital allocation to PE in recent years. As described in Section 2.2, leverage is considered one of the tools used by PE to drive value creation.

In light of the trends and periods described, studying the various holding periods limited to the post-2010 subsample could provide insight into how these periods might differ from the full sample period. The following sections examine the performance of the IPOs for the post-2010 subsample, isolating the period following the financial crisis. The analysis includes both CTP regressions and cross-sectional regressions across the relevant holding periods.

6.4.2 CTP Analysis

The post-2010 subsample analysis reveals a stronger performance for the 12- and 24-month LS portfolios, with positive and statistically significant alphas, as shown in Table 6.3. At the 12-month horizon, the alpha of the LS portfolio is significant at the 5% level, suggesting that PE-backed IPOs outperform non-backed IPOs by 2.4%. This performance persists at the 24-month horizon, where the alpha remains significant, indicating sustained excess returns of 1.9%.

In addition to the LS portfolio results, other changes are observed compared to the full sample analysis. The market premium remains consistently significant across all horizons, underscoring the influence of broader market movements on IPO performance. The SMB

factor shows significance in the post-2010 subsample, particularly at the 12- and 24-month horizons, indicating a stronger relationship between smaller firms and returns during this period. In contrast, the HML and MOM factors remain largely insignificant, consistent with the findings of the entire sample.

	6-Month			12-Month			24-Month		
	Dependent variable: Excess Return			*Dependent variable: Excess Return*			*Dependent variable: Excess Return*		
	Backed	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**
market_premium	0.869***	0.986***	−0.639	0.481**	0.959***	−0.707***	0.728***	0.938***	−0.372**
	(0.236)	(0.261)	(0.416)	(0.244)	(0.166)	(0.230)	(0.162)	(0.141)	(0.183)
smb	0.219	0.151	0.155	0.150	0.479***	−0.279	0.070	0.377***	−0.259
	(0.289)	(0.158)	(0.316)	(0.229)	(0.153)	(0.213)	(0.185)	(0.137)	(0.167)
hml	−0.132	−0.026	−0.024	−0.193	0.036	−0.199	−0.161	−0.043	−0.073
	(0.212)	(0.125)	(0.217)	(0.163)	(0.108)	(0.133)	(0.108)	(0.079)	(0.097)
mom	0.139	0.077	−0.057	0.009	0.056	−0.102	0.077	0.039	−0.012
	(0.168)	(0.114)	(0.192)	(0.108)	(0.103)	(0.118)	(0.069)	(0.081)	(0.088)
Constant	0.010	−0.007	0.017	0.008	−0.014***	0.024**	0.008	−0.009**	0.019**
	(0.013)	(0.007)	(0.017)	(0.008)	(0.005)	(0.010)	(0.006)	(0.004)	(0.008)
Observations	92	141	87	110	154	110	125	154	125
R^2	0.086	0.201	0.034	0.094	0.282	0.128	0.172	0.326	0.053
Adjusted R^2	0.044	0.177	−0.014	0.060	0.263	0.095	0.144	0.308	0.022
Residual Std. Error	0.103 (df = 87)	0.098 (df = 136)	0.131 (df = 82)	0.087 (df = 105)	0.102 (df = 149)	0.121 (df = 105)	0.071 (df = 120)	0.084 (df = 149)	0.113 (df = 120)
F Statistic	2.038** (df = 4; 87)	3.278*** (df = 4; 136)	0.732 (df = 4; 82)	3.334*** (df = 4; 105)	8.934*** (df = 4; 149)	2.576** (df = 4; 105)	6.258*** (df = 4; 120)	12.856*** (df = 4; 149)	1.043 (df = 4; 120)
Note:									*p<0.1; **p<0.05; ***p<0.01

Table 6.3: Regression Results: Post-2010 Equal-Weighted Portfolios Excess Returns

6.4.3 Cross-Sectional Analysis

The post-2010 subsample analysis of cross-sectional regressions, shown in Table 6.4, reveal notable changes in the drivers of firm-level alphas over time periods. For PE-backed IPOs, the coefficients for *pe_backed* are nonsignificant, different from the full sample. The *pe_post_ipo* variable is now negative and marginally significant for the 6-month holding period, and is not significant for the 12- and 24-month holding period. In the full sample, it was significant and negative for the 24-month hold period.

The *vc_backed* variable is negative and significant for the 6-month holding period when controlling for sectors. Without controlling for sectors, the variable is insignificant, in contrast to the full sample results. Continued VC involvement (*vc_post_ipo*) turns positive at 6 months but loses its significance over longer horizons. These results suggest that VC-backed IPOs underperform early on and that the short-term positive effects of continued VC ownership do not persist into the long term.

More sectors have significance for the post-2010 subsample for the 24-month regressions than for the full sample. This might indicate a stronger sectoral performance compared to the pre-crisis period. The firm-specific variable firm age (*log_firmage*), emerge as significant for the 12-month mark, suggesting that older firms are associated with better performance over 12 months in the subsample.

	6-Month		12-Month		24-Month	
	With Sectors	**Without Sectors**	**With Sectors**	**Without Sectors**	**With Sectors**	**Without Sectors**
log(market_cap)	0.009	0.011	−0.004	−0.005	0.003	0.002
	(0.011)	(0.010)	(0.004)	(0.004)	(0.003)	(0.003)
leverageratio	0.001	0.002	0.0003	0.0004	−0.0001	−0.0001
	(0.001)	(0.001)	(0.001)	(0.0004)	(0.001)	(0.0005)
log_firmage	−0.006	−0.003	0.009**	0.010**	0.005	0.004
	(0.011)	(0.010)	(0.004)	(0.005)	(0.004)	(0.004)
sectorConsumer Discretionary	0.023		0.029		0.022	
	(0.052)		(0.029)		(0.017)	
sectorConsumer Staples	−0.047		0.012		0.031**	
	(0.046)		(0.028)		(0.015)	
sectorEnergy	−0.076		−0.001		0.031*	
	(0.062)		(0.033)		(0.018)	
sectorFinancials	0.0004		0.013		0.031***	
	(0.046)		(0.027)		(0.010)	
sectorHealth Care	−0.041		−0.004		0.030	
	(0.063)		(0.041)		(0.024)	
sectorIndustrials	−0.025		0.013		0.023**	
	(0.047)		(0.027)		(0.010)	
sectorReal Estate	−0.037		0.009		0.024**	
	(0.043)		(0.025)		(0.009)	
sectorTechnology	−0.002		0.024		0.032**	
	(0.055)		(0.027)		(0.014)	
sectorTelecommunications	0.065		0.071		0.063**	
	(0.053)		(0.051)		(0.025)	
sectorUtilities	0.010		0.007		0.014	
	(0.057)		(0.030)		(0.018)	
pe_backed	0.020	0.022	0.008	0.013	0.017	0.017
	(0.034)	(0.032)	(0.018)	(0.018)	(0.012)	(0.011)
pe_post_ipo	−0.073*	−0.068*	−0.021	−0.019	−0.011	−0.007
	(0.043)	(0.041)	(0.020)	(0.020)	(0.013)	(0.012)
vc_backed	−0.081**	−0.058	−0.023	−0.014	0.002	0.003
	(0.037)	(0.036)	(0.016)	(0.015)	(0.009)	(0.009)
vc_post_ipo	0.098**	0.087**	0.015	0.009	−0.020	−0.019
	(0.042)	(0.042)	(0.019)	(0.017)	(0.015)	(0.013)
Constant	−0.158	−0.224	0.046	0.064	−0.114*	−0.055
	(0.230)	(0.212)	(0.087)	(0.079)	(0.062)	(0.054)
Observations	148	148	148	148	148	148
R^2	0.131	0.064	0.111	0.055	0.107	0.053
Adjusted R^2	0.018	0.017	−0.006	0.008	−0.010	0.005
Residual Std. Error	0.123 (df = 130)	0.123 (df = 140)	0.060 (df = 130)	0.060 (df = 140)	0.044 (df = 130)	0.044 (df = 140)
F Statistic	1.155 (df = 17; 130)	1.370 (df = 7; 140)	0.952 (df = 17; 130)	1.165 (df = 7; 140)	0.913 (df = 17; 130)	1.114 (df = 7; 140)
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 6.4: Regression Results: Cross-Sectional Analysis for IPOs Post-2010

6.4.4 Summary of Post-2010 Results

The post-2010 subsample analysis reveals similarities with the full sample CTP and cross-sectional regressions, but differs in several areas. We find that the LS CTP regression still indicates an outperformance by PE-backed IPOs, but now with a statistically significant constant for the 12 and 24-month holding period, compared to only marginally significant for the 12-month period. In addition, the non-backed portfolio is now also significant and negative for the 24-month holding period.

Furthermore, cross-sectional regressions show a reduced significance of PE-related variables. The variable *pe_ backed* is not significant in any year, while the variable of continued ownership for PE and VC does not show significance for the 12- and 24-month period. This differs somewhat from the full sample results, where continued ownership of VC is significant and negative for the 24-month holding period.

The findings of the post-2010 analysis are of interest for further research, where the difference from the post-2010 and full sample results can be further studied. In particular, the positive and more significant return of the 12- and 24-month holding period in the post-2010 period could be interesting to study in comparison to the full sample period.

6.5 Robustness

6.5.1 Sample Size

Figure 5.1 illustrates the distribution of IPO observations in our dataset, highlighting a pattern of IPO activity occurring in waves. Notably, PE-backed IPOs consistently represent only a small fraction of the total number of IPOs, and in some years, there are no PE-backed IPOs at all. This uneven distribution introduces challenges for the robustness of the results in two ways.

Firstly, in Section 6.4.1 we discussed how the full sample periods lack observations for certain holding periods and how that might cause bias. However, in the section, we argue that the missing observations for certain periods are due to the timing of IPOs, and that it therefore correctly should not be observations for certain periods throughout the sample period for certain holding periods. We therefore do not consider this a major bias in our study.

Secondly, in years where PE-backed IPOs are present, the small number of observations can disproportionally influence the results. For example, in a year with only two PE-backed IPOs, their performance may gain larger explanatory power on the overall analysis. This can provide results for certain months that are unrepresentative for PE-backed IPOs performance, in general.

The limited sample size affects the statistical power of the analysis, making it harder to detect significant relationships or differences between PE-backed and non-backed IPOs. This increases the risk of Type II errors, where meaningful effects may be undetected due to insufficient data. The variability in the sample size over years further complicates the interpretation of the statistical results. These considerations highlight the importance of being cautious when interpreting our findings in light of the limitations of the data set.

6.5.2 Regression Diagnostics

When it comes to the interpretation of the results of the regression analysis, it is important to be aware that these assume that the ordinary least squares (OLS) assumptions hold. Violations of these assumptions, such as heteroskedasticity, autocorrelation, and multicollinearity, can affect the accuracy and reliability of the estimated coefficients in our analysis.

Heteroskedasticity occurs when the variance of the residuals is not constant at all levels of the independent variables. This issue can lead to inefficient estimates and unreliable standard errors, which can cause bias in statistical inference (Frost, 2023). To address this issue, Newey-West standard errors were used in the CTP regressions. This adjustment was made to account for potential autocorrelation and heteroskedasticity and to ensure that inference is robust to such violations of the OLS assumptions. Such violations are commonly observed in financial time-series data.

For cross-sectional analysis, a Breusch-Pagan test was used to formally assess the presence of heteroskedasticity. The results of this test, presented in Table B.6 in the Appendix, indicated that there is no evidence of heteroskedasticity in our observations. Despite this, we applied robust standard errors as a precaution to ensure the reliability of our findings.

Autocorrelation, or the correlation of residuals of across observations, is another critical challenge, especially in the context of time-series data. If present, autocorrelation can underestimate the standard errors, inflating the significance of our regression coefficients. To evaluate this issue, a Durbin-Watson test was performed on the residuals of the second-stage cross-sectional regressions. The results, shown in Table B.5 in the Appendix, showed some evidence of autocorrelation in the 6-month PE-backed model. To mitigate the potential effects of this issue, Newey-West standard errors were also used in the cross-sectional analysis. This was done to ensure that our models and the resulting conclusions remain robust to potential violations of the OLS independence assumption.

Multicollinearity was assessed for cross-sectional analysis to ensure that regression estimates were reliable, using Variance Inflation Factors (VIF). The results, presented in Table B.7 in the Appendix, show that the adjusted VIF values for all included variables are within the accepted limits. This indicates that multicollinearity is not a concern in

our analysis. This provides confidence in the validity of the regression coefficients in the model.

The regression diagnostics confirm that the models are robust, with no significant issues of heteroskedasticity or multicollinearity. Although some autocorrelation was detected, the use of robust standard errors ensured reliable estimates, supporting the validity of the results.

7 Discussion

7.1 Overview

The findings reveal some evidence that PE-backed IPOs tend to outperform non-backed IPOs within the 12-month holding period after IPO. On a 10% significance level, this rejects our null hypothesis for our 12-month holding period, where our alternative hypothesis suggests that PE-backed IPOs outperform non-backed IPOs. The cross-sectional regression has tried to explain what might cause differences in IPO performance, where continued ownership seems to be the most significant firm-specific variable for the IPOs' alpha. In this section, we will discuss our findings and how they align with previous research and theoretical frameworks, the limitations and challenges tied to our findings and methods, and how further research could provide further insight into why PE-backed IPOs' performance differs from other IPOs. The findings from the post-2010 subsample will also be discussed, with an emphasis on how the findings are interesting for further research.

7.2 Comparison with Previous Research

The results of our analysis appear to align with previous studies and theoretical frameworks on various points. Levis (2011) observed that PE-backed IPOs on the London Stock Exchange performed better than non-backed and VC-backed IPOs, particularly during the first 12 months, as discussed in Section 2.2. Furthermore, as discussed in 2.3.1, Ritter (1991) concluded that IPOs generally underperform relative to the market during the first three years post-IPO in the American market. This empirical finding serves as the foundation for his theory of the winner's curse. The theory explains how investors who are the most optimistic about an IPOs forecast tend to be the ones that underwrite the most, giving an overestimated value of the IPO price. This overpricing is later revealed in the long-term performance of the company. These findings are similar to our findings on OSE from the CTP regressions, where PE-backed IPOs demonstrate a stronger 12-month term performance compared to non-backed IPOs which tend to underperform.

As Jensen (1986) mentions, the operational efficiency achieved by closer monitoring,

management expertise, and financial discipline are the key value drivers for PE portfolio companies. However, these mechanisms may lose their effects over time, especially if governance structures are weakened post-IPO. This research supports our findings from the CTP regression of better post-IPO performance the following 12 months after the IPO, while being reduced on a longer time horizon. Despite the theory of maintained operational efficiency that fits our results well, it is important to underline the possibility of additional factors that cause this periodical overperformance from PE.

Levis (2011) emphasizes in his findings how PE-backed IPOs often experience a more modest first-day return compared to other IPOs due to the widespread market perception of aggressive pricing from PE sponsors and the high debt ratios. This finding also aligns with the information asymmetry theory (Section 2.3.3) which states that buyers, unable to distinguish between high-quality and low-quality IPOs due to information asymmetry, can crowd out high-quality IPOs. This could partially explain how backed IPOs then would be able to gain a better return from one month post-IPO and forwards. Levis (2011) further describes how the market gradually realizes the robust operating performance of the company and the reduction in debt causes a positive aftermarket performance.

By studying the cross-sectional regression, our null hypothesis that post-IPO ownership is insignificant is rejected at the 5% level for the 6-month holding period. This suggests that continued ownership after the IPO has a significant correlation with the 6-month performance. For VC-backed IPOs, the null hypothesis is rejected for both the 6 and 24 month holding periods, where continued ownership after IPO is positively correlated with a 6-month holding period alpha and negatively for the 24-month holding period alpha.

The cross-sectional analysis reveals that post-IPO PE ownership negatively impacts alpha over a 6-month holding period. This contradicts our initial alternative hypothesis stating that continued involvement facilitates better operating performance, and thereby superior aftermarket performance.

Instead, our results can support another suggested hypothesis: ongoing PE ownership post-IPO can signal unresolved challenges in the portfolio company. It suggests that the sponsor may have been unable to exit as wanted due to the company not reaching its anticipated goals. As a result, the PE firm might keep their stake to impose further improvements or to make the deal more appealing to investors. As a result, the PE

firm might keep their stake to impose further improvements or to make the deal more appealing to investors. This continued involvement could indicate underperformance, which could also correlate with continued underperformance post-IPO which is reflected in the 24-month holding period return. This would be despite maintaining the benefits of being PE-backed.

In the cross-sectional regression, we also studied how VC-backing and continued ownership from VC correlates with post-IPO performance. The *vc_ backed* variable has a negative and marginally significant coefficient for the 6-month holding period for the non-backed portfolio. This suggests that being a VC-backed IPO has a negative correlation with post-IPO return. According to Levis (2011), research results on the impact of VCs on post-IPO performance are mixed outside the US, while in the US VC-backed IPOs outperform non-backed firms. The overperformance in the US has been attributed to the effect of better management and corporate governance structures.

Furthermore, the regression shows that VC ownership after the IPO is significant and positively correlates with an improved holding period return after 6 months. This finding is consistent with Jensen (1986) research which suggests that the mechanisms provided by VC ownership may weaken over time. Therefore, continued ownership of VC could further facilitate operational efficiency and continuation of the benefits of being VC owned. However, for the 24-month holding period, continued ownership by VC has a negative and significant coefficient. Our hypothesis for the indicated effect of VC-backing after the IPO is the same as for continued ownership by PE after the IPO. We hypothesize that not exiting should be interpreted as a signal of underperformance, which further correlates with a continued underperformance long term.

For the VC-backed IPOs in general, we hypothesize that VC firms' IPOs are more heavily valued based on a forecast with substantial expected growth, which often turns out to be overvalued at IPO, causing a negative short-term return. However, these hypotheses have yet to be proven, particularly considering that VC firms represent a small part of our dataset.

The post-2010 subsample analysis gives interesting additional findings to the paper. The findings are not fully identical to the full sample findings and could be of interest for further research. The reasoning used to discuss the full sample results is still applicable

when discussing the post-2010 results. The performance of the 12- and 24-month holding period could still be argued to be explained by the mechanisms provided by PE, but in this instance the mechanisms might not be as short-lasting as previously argued.

Furthermore, looking at the post-2010 subsample, it can still be argued that continued ownership after an IPO is often a result of underperformance, which correlates with continued underperformance post-IPO. This would be a correlation which is not priced in at the IPO and, therefore, will be reflected in the post-IPO return. In the post-2010 sample, such a continued underperformance is reflected in the 6-month holding period, and not in the 24-month holding period, as observed in the full sample.

In the subsample it can be observed that the alpha of the 12- and 24-month holding period of the CTP LS portfolio is statistically significant and positive, while in the cross-sectional regression the *pe_backed* variable is not statistically significant in any period. However, looking at the CTP regression of the non-backed portfolio for the 12- and 24-month holding period, we can observe that it is significant and negative. This could be a potential explanation for why the LS portfolio gains a significant alpha when the *pe_backed* variable is insignificant in the cross-sectional regression.

We hypothesize that this could be due to the PE-backed CTP portfolio performing as well as the market, providing an alpha that is insignificant different from zero, as according to the null hypothesis, while the non-backed CTP portfolio underperforms the market. An underperformance of the IPOs would be in accordance with the empirical study on the performance of the IPOs described in Section 2.3.5. This would cause a positive return for our CTP LS portfolio which shorts the non-backed portfolio, while going long in the PE-backed portfolio. However, Eckbo explains that when a liquidity factor is included, this underperformance disappears.

There may be external factors influencing the performance of PE-backed IPOs after 2010. External factors that could have, directly or indirectly, impacted the performance of PE-backed IPOs after 2010 are the low policy rate that has been since Q2 2009 until post-covid and the growth of PE in Norway (Norges Bank, 2024). As discussed in Section 6.4.1, Eckbo highlights how near-zero interest rates have impacted the PE industry since the financial crisis, fostering conditions that may have influenced the timing and outcomes of PE-backed IPOs. He also describes countercyclical patterns in PE returns, particularly

for funds with vintage years during recessions. It could be interesting to study whether this countercyclical pattern would also correlate with post-IPO performance and whether it is priced into the IPO by the market.

Looking at Figure 5.1 we can see how the PE-backed IPOs post-2010 seem to negatively correlate with the timing of non-backed IPOs. PE funds have a typical investment horizon in their portfolio companies of five years and for their portfolio ten years, which is also described as the *J-curve* by Eckbo et al. (2023). Having this in mind, PE funds with a vintage year after the financial crisis would seem to somewhat match the timing of the PE-backed IPOs in the post-2010 sample. It can be seen how relatively many PE-backed IPOs occurred in the time frame 2013-2017 compared to the non-backed IPOs.

7.3 Challenges and Limitations

There are several factors that can influence the results of our study and must be considered when interpreting the results. One of the primary challenges is the mismatch in sample size and the uneven distribution of IPOs between PE-backed and non-backed groups.

The rapid growth of the PE industry in recent years has also had a notable impact. As discussed in Section 2.2.1, the activity of PE firms increased significantly in the 2000s, resulting in more IPO observations after 2010. Although these provide a clearer picture of performance in recent years, the lack of observations historically limits the validity of our findings.

Furthermore, the results of the cross-sectional regression challenge the initial hypothesis regarding the continuous ownership of PE. Agency theory, as discussed in Section 2.3.4, hypothesizes that continued participation in PE improves governance and operational efficiency. However, our results suggest that continued PE ownership is more correlated with unresolved issues, outweighing the benefit of continued PE ownership.

Lastly, it is also worth considering the sectoral biases. The strong performance of PE-backed IPOs in the telecommunications and technology sectors, as highlighted in Section 6.2, suggests a focus on high-growth industries by PE firms. This is informative but raises the question whether the observed outperformance is due to PE involvement or inherent advantages or cycles in these sectors. Furthermore, the number of observations in each

sector limits the possibility of drawing any conclusions on the sectoral factor.

7.4 Further Research Recommendations

Future research could investigate how the market timing of PE-backed IPOs differs from that of non-backed IPOs. Considering our study on the post-2010 subsample, this could be of particular interest to gain a deeper understanding of PE-backed IPO performance. These differences may arise from varying incentives to go public, potentially influencing market timing decisions. As discussed in Section 2.3.2, the theory of market timing suggests that companies often issue equity during periods of high market valuations. Observations of IPO clustering during "hot markets" in this study underscore the relevance of timing. Conducting research on how PE-backed companies approach IPO timing compared to others could provide deeper insights into the drivers of post-IPO performance differences.

The operational measures implemented by PE firms on their target companies may also provide important explanatory power for the relative performance of PE-backed IPOs. Although these interventions, such as improving operational efficiency or restructuring management, are challenging to quantify due to their variability between companies, they likely play a significant role in post-IPO outcomes. Exploring these measures in greater detail could shed light on what makes certain target companies more attractive and how these actions contribute to value creation after the IPO.

An interesting exploration path could focus on the synergies between the theory of market timing and the operational measures implemented by the PE firms. It remains unclear whether PE firms strategically align their operational changes with favorable market conditions to optimize their IPO success. For instance, to investigate whether firms that do aggressive cost-cutting or restructuring, time their IPOs differently from others, and how this affects investor sentiment and subsequent performance. Researching the synergies behind such internal and external factors could offer a better understanding of how it drives value creation in PE-backed IPOs.

Broadening the geographical and time scope of the analysis offers another promising approach. The focus of this study is on the Norwegian market, which can limit the generalizability of its findings. Including data from other Nordic countries such as Sweden and Denmark could provide a comparative perspective or enable the creation of a larger,

merged dataset. Such an approach could improve the robustness of the conclusions and mitigate potential biases related to specific characteristics of the Norwegian market. In addition, studying the performance of the IPO before and after significant events such as the financial crisis may reveal additional trends, as differences in performance during these periods suggest the influence of factors beyond those included in this investigation.

Momentum effects, particularly for large-cap PE-backed IPOs, emerged as a noteworthy factor in this study. These companies displayed higher momentum coefficients, potentially influenced by factors such as increased investor attention. Further research could investigate the mechanisms driving this momentum, offering a more nuanced understanding of its impact on post-IPO performance.

As discussed previously, the post-2010 subsample could be of great interest for further research. The post-financial crisis period with its low interest rate seems to have been beneficial for the PE funds' returns, but also for the PE industry's growth. More comprehensive research on this period's performance might provide results that provide additional insight into the performance of PE-backed IPOs.

8 Conclusion

The results show that over a 12-month period, PE-backed IPOs tend to outperform non-backed IPOs. This rejects our null hypothesis of PE-backed and non-backed IPOs having an equal post-IPO performance over a 12-month holding period after the IPO. The positive monthly alpha for the LS portfolio shows that going long in the PE-backed IPOs and shorting non-backed IPOs yield positive returns for our sample period. This aligns with the reasoning of PE mechanisms improving a company's operation but while being underestimated by investors at the IPO and in a short period after the IPO.

In our cross-sectional analysis, we examined characteristics associated with post-IPO alphas, aiming to provide a comprehensive understanding of post-IPO performance. Our results reject the null hypothesis for post-IPO ownership for the 6-month holding period for both VC and PE. The results indicate that continued ownership of PE after the IPO is negatively associated with performance at 6 months, while positive for VC.

Our initial hypothesis for continued PE ownership was that it should strengthen operations through continued ownership and thus exceed market expectations. A potential explanation for continued PE ownership being negatively correlated could be that they do not maintain ownership as a strategic decision, but as a response to underperformance. Such underperformance may compel investors to require ongoing PE participation to align incentives and drive future performance. We hypothesize that this underperformance, necessitating continued ownership, is associated with sustained underperformance post-IPO, which is not adequately priced into the initial offering. This continued underperformance after the IPO is then reflected in the post-IPO return.

Other firm-specific characteristics showed limited explanatory power in explaining post-IPO performance, whereas sector-specific effects emerged as more significant for the 24-month holding period. This underscores the critical role of market and industry dynamics in shaping IPO outcomes, often outweighing the significance of firm-specific factors.

The post-2010 subsample analysis and discussion opens up for further research on how macroeconomic trends and cycles could impact PE-backed IPO performance relative to other IPOs. The period differs from the full sample LS CTP results, where PE-backed

IPOs' with a 12- and 24-month holding period alpha were positive and significant, versus the full sample CTP regression results, which displayed a marginally significant and positive 12-month holding period alpha.

The findings of this thesis have practical and theoretical implications. Practical implications of our findings include that PE-backed IPOs are more often underestimated by the market and that other IPOs are overestimated, and following this logic gives an inefficient market. For investors, assuming our findings are applicable in the future, PE-backed IPOs offer an interesting opportunity for short-term gains, as shown by the LS portfolios with a positive alpha. Investors may use this pattern to optimize their returns by focusing on PE-backed IPOs during their first months of trading and to understand what characterizes these returns.

Theoretical implications of our findings confirm that similar research on other markets is also applicable to the Norwegian IPO market and suggests that several theoretical frameworks could be relevant in explaining what impacts IPO pricing and performance. In particular, the information asymmetry framework is found to be a framework that contributes to explaining a lower price setting for PE-backed IPOs caused by a biased underestimation of PE-backed IPOs. This framework and our results also align with Levis (2011) research on PE-backed IPOs on the London Stock Exchange. Our findings could be considered as a foundation for further research on PE-backed IPOs in the Norwegian market.

The outperformance of PE-backed IPOs highlights the market's potential inefficiencies in pricing these offerings. Our findings emphasize the importance of understanding firm-specific and sector-specific dynamics, as well as the role of continued PE ownership after IPO, which appears to correlate with weaker long-term performance. Although our study aligns with existing research from other markets, it also underscores the need for further research on the Norwegian market, particularly given the limitations imposed by sample size and the impact of economic shocks such as the financial crisis and the COVID-19 pandemic. The findings of our thesis provide a foundation for further research on the performance of PE-backed IPOs.

9 AI Declaration

Declaration on the use of AI tools in the work on this master's thesis:

Name of the AI tool: ChatGPT 4o

Purpose of using the tool: Generating ideas, organizing data, and rewriting sentences for clarity and improved readability.

We are aware that we are responsible for all content of this master's thesis, including the parts where AI tools are used. We are responsible for ensuring that the thesis complies with ethical rules for privacy and publication.

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Appendices

A Figures

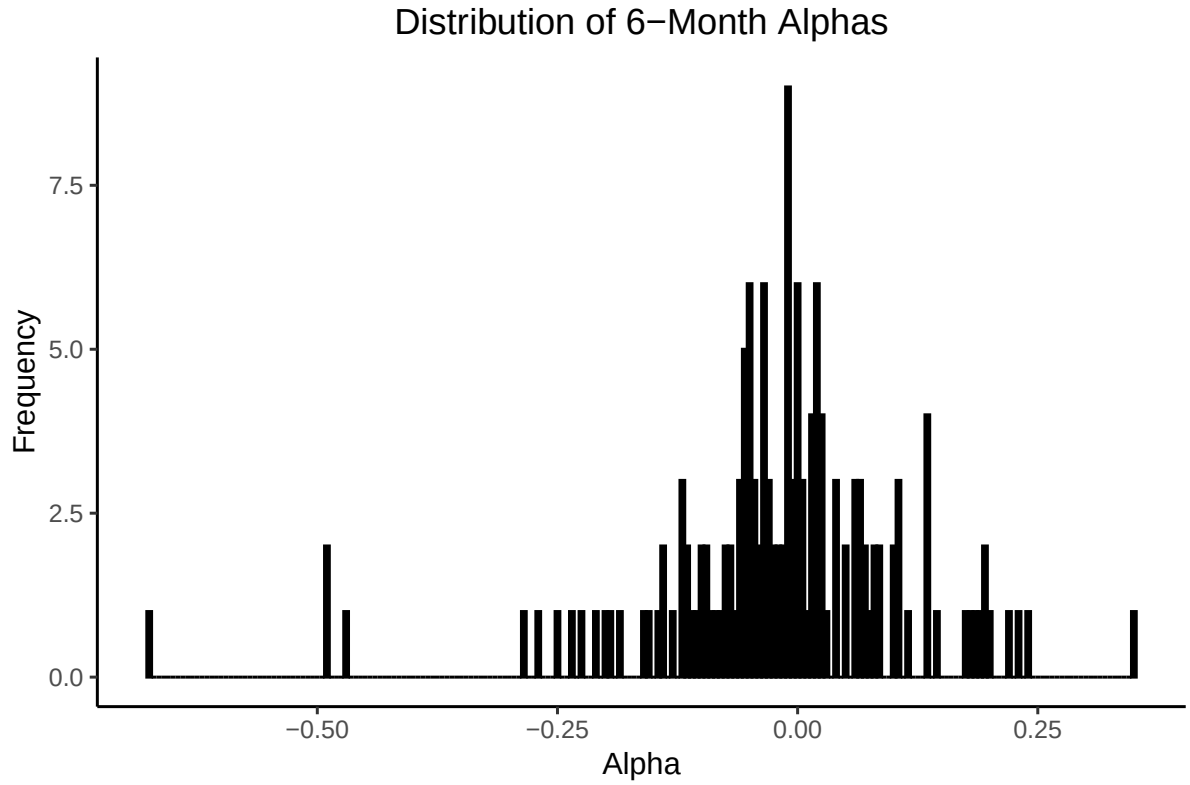

Figure A.1: Distribution of 6-Month Alpha

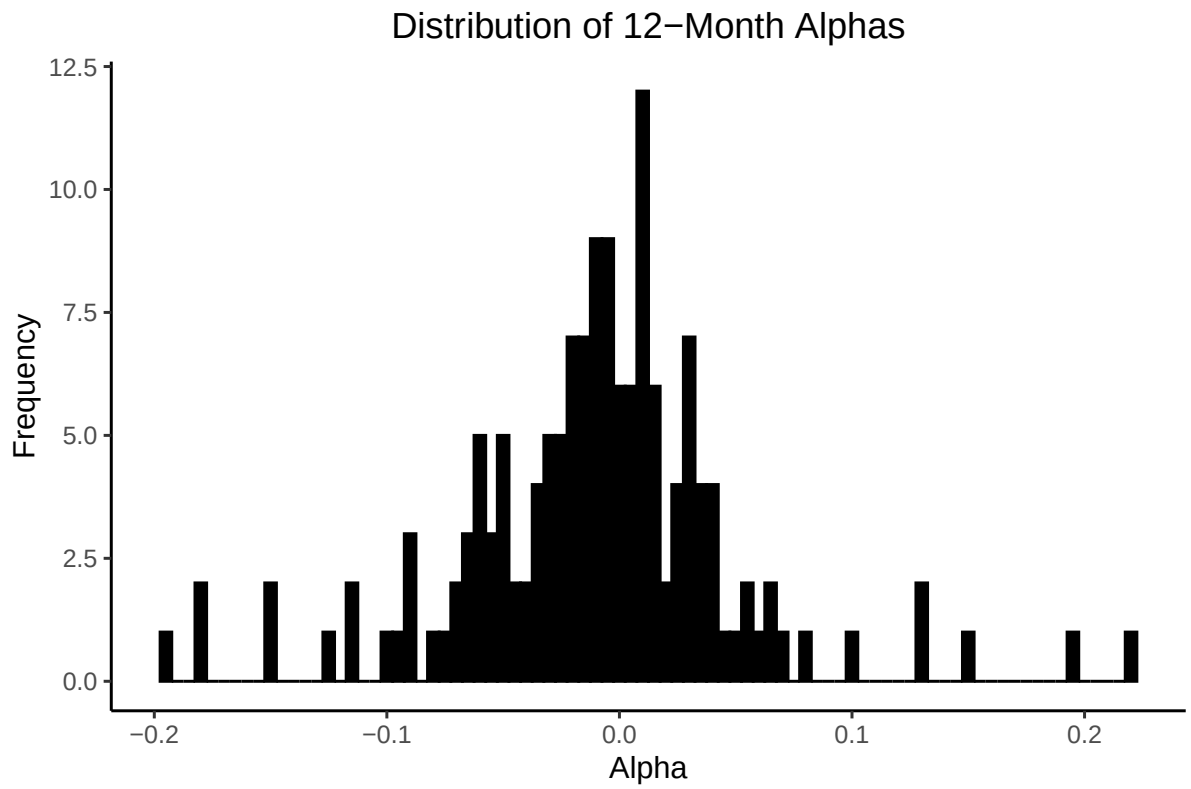

Figure A.2: Distribution of 12-Month Alpha

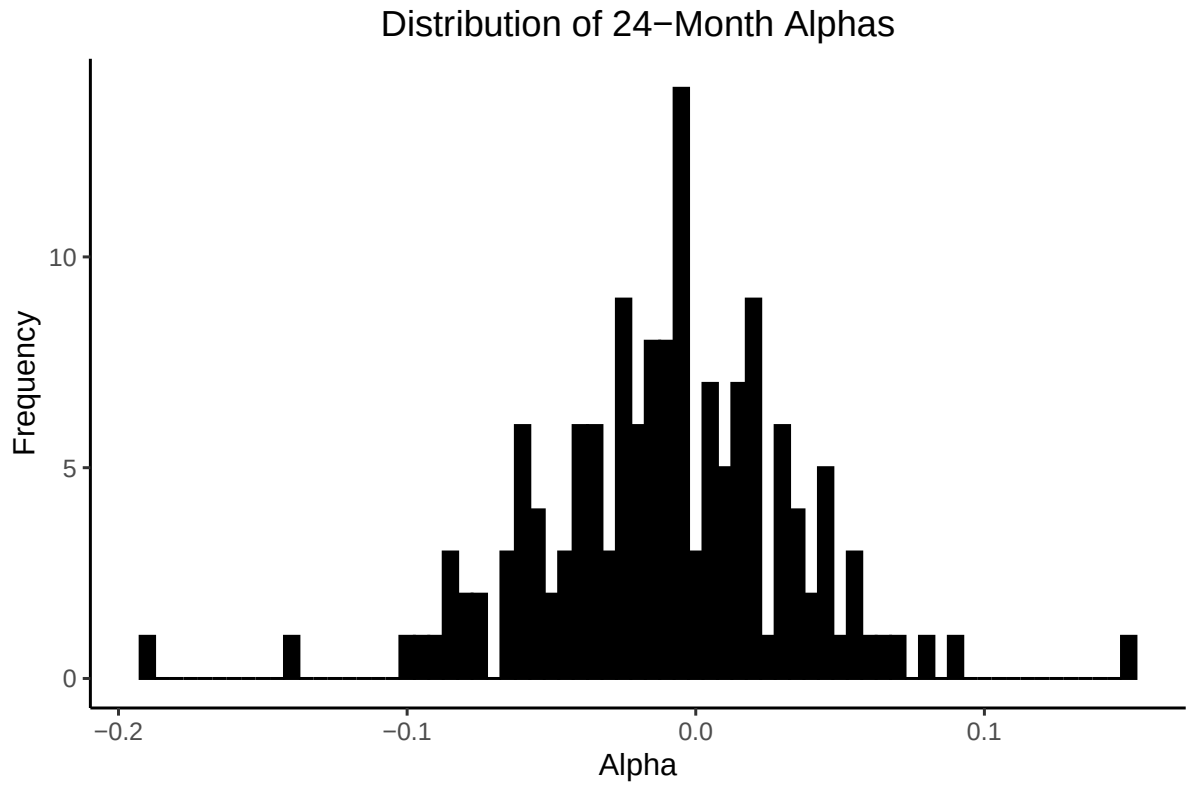

Figure A.3: Distribution of 24-Month Alpha

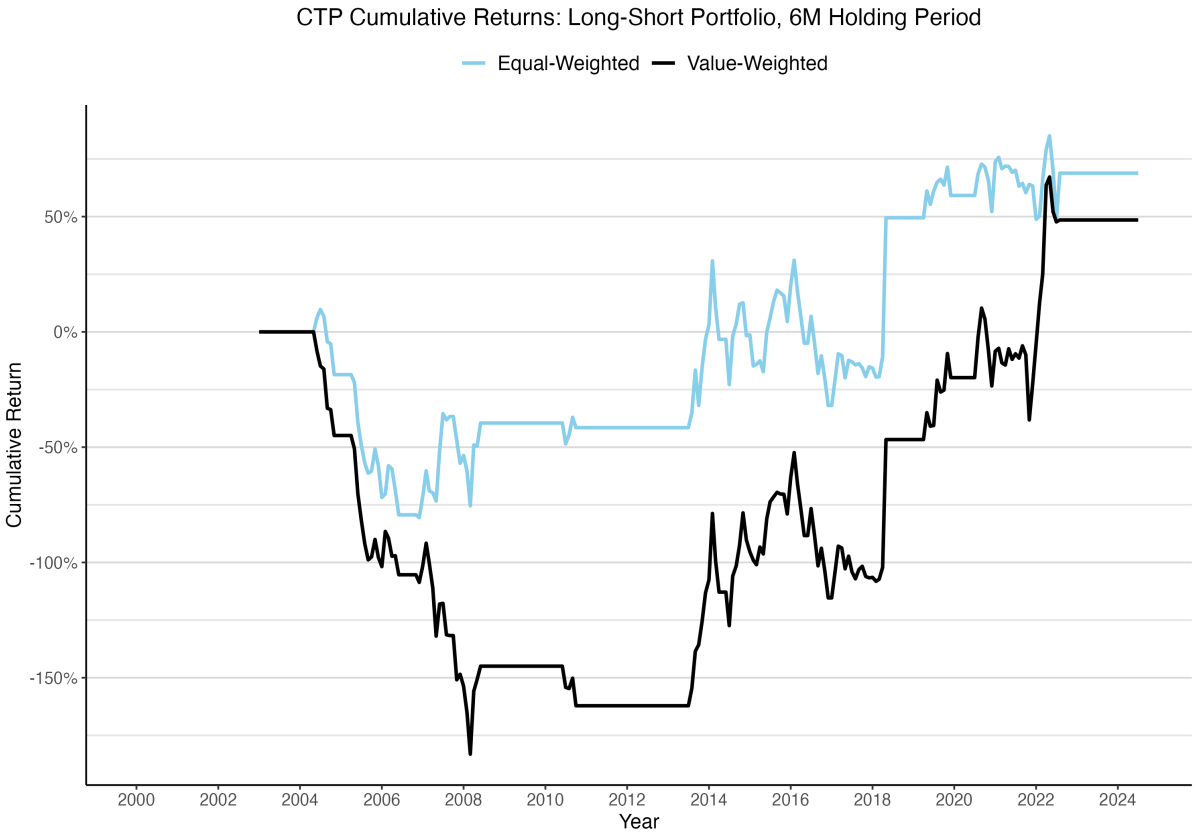

Figure A.4: CTP Cumulative Returns: Long-Short Portfolio, 6-Month Holding Period

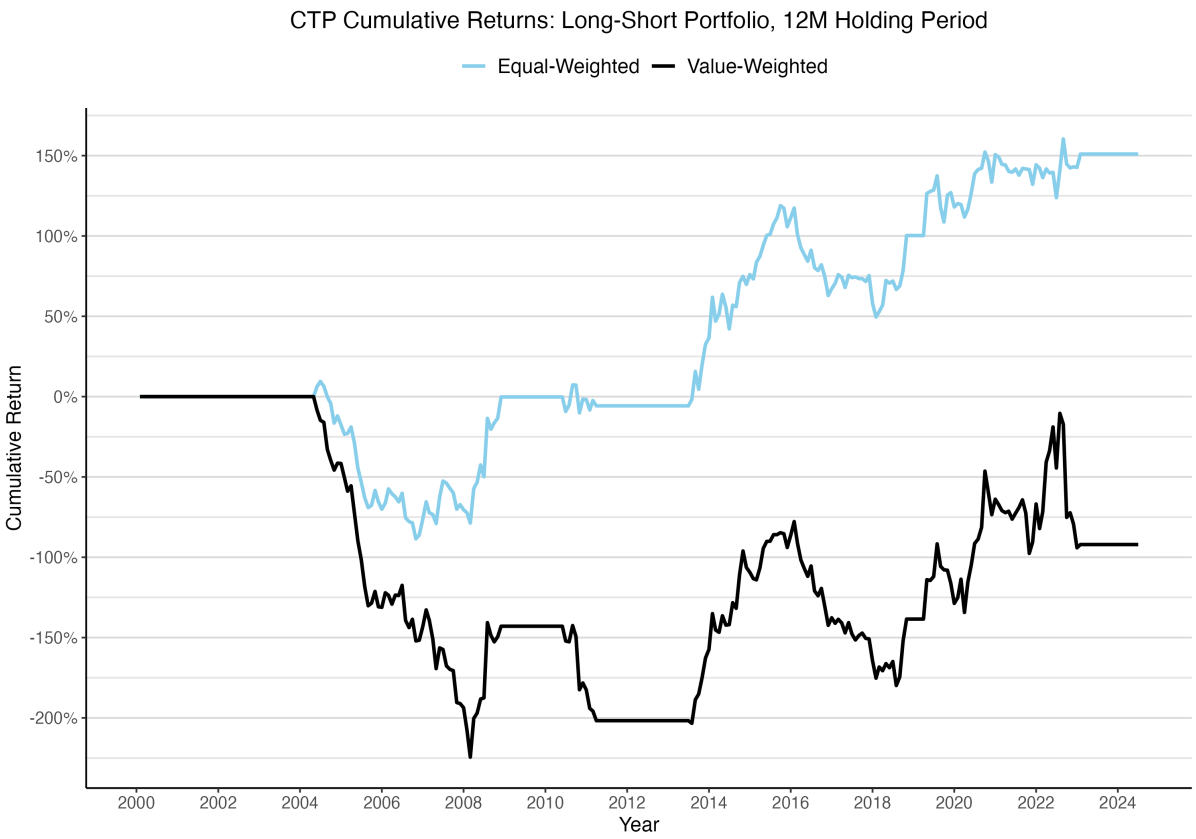

Figure A.5: CTP Cumulative Returns: Long-Short Portfolio, 12-Month Holding Period

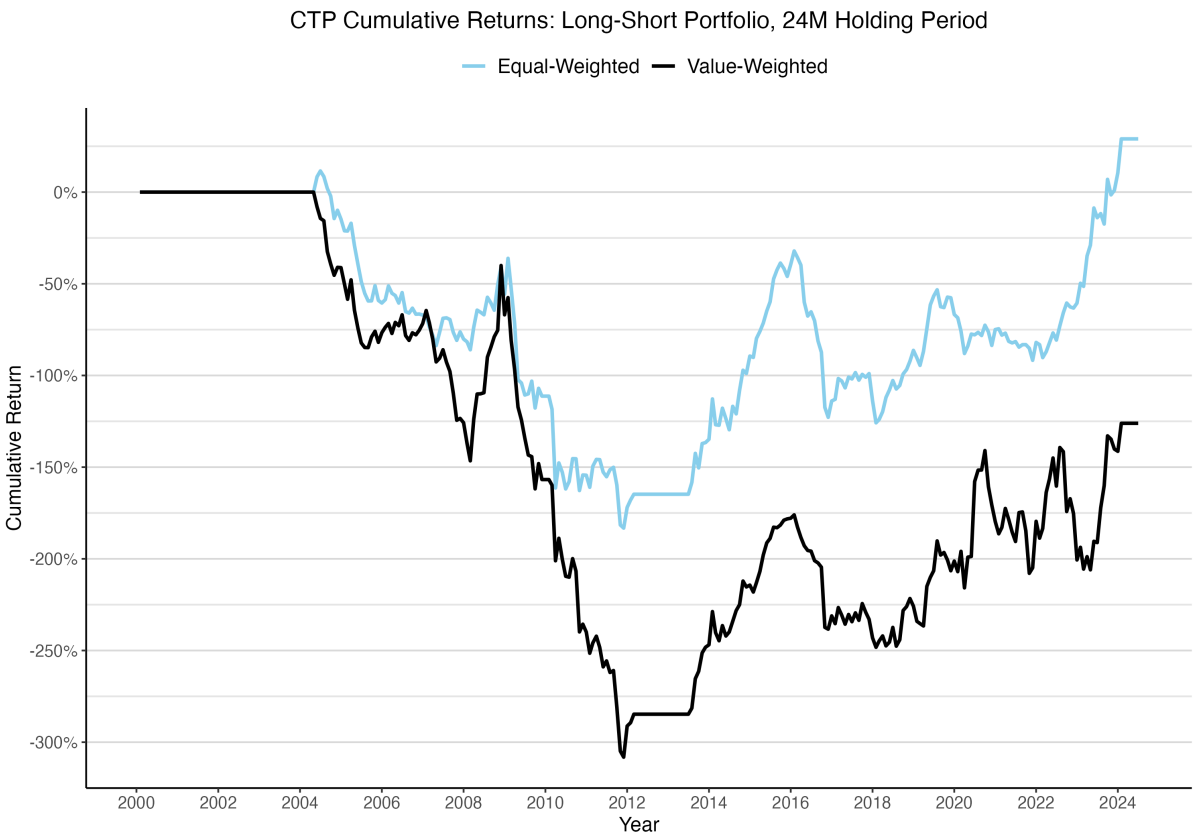

Figure A.6: CTP Cumulative Returns: Long-Short Portfolio, 24-Month Holding Period

B Tables

Variable	Explanation
`log(market_cap)`	The natural logarithm of the company's market capitalization at IPO.
`leverageratio`	The leverage ratio of the company, measured as the book value of total debt divided by total assets at IPO.
`log_firmage`	The natural logarithm of the firm's age at the time of IPO.
`sector`	A categorical variable indicating the ICB sector classification of the company.
`pe_backed`	A dummy variable equal to 1 if the company was backed by a Private Equity (PE) fund pre-IPO, and 0 otherwise.
`pe_post_ipo`	A dummy variable equal to 0 if the PE fund exited at IPO, and 1 otherwise.
`vc_backed`	A dummy variable equal to 1 if the company was backed by a Venture Capital (VC) fund pre-IPO, and 0 otherwise.
`vc_post_ipo`	A dummy variable equal to 0 if the VC fund exited at IPO, and 1 otherwise.

Table B.1: Description of Variables in Cross-Sectional Regression

	6-Month			12-Month			24-Month		
	Dependent variable: Excess Return			*Dependent variable: Excess Return*			*Dependent variable: Excess Return*		
	Backed	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**
market_premium	0.700***	0.653***	−0.305	0.627***	0.888***	−0.367*	0.679***	0.855***	−0.337***
	(0.146)	(0.133)	(0.289)	(0.096)	(0.140)	(0.203)	(0.092)	(0.082)	(0.119)
smb	0.121	0.178*	−0.020	0.218*	0.218**	−0.039	0.169*	0.236**	−0.109
	(0.161)	(0.100)	(0.180)	(0.118)	(0.105)	(0.160)	(0.100)	(0.101)	(0.160)
hml	−0.095	−0.058	−0.051	−0.202***	−0.009	−0.147	−0.142**	−0.019	−0.074
	(0.114)	(0.079)	(0.139)	(0.073)	(0.086)	(0.123)	(0.068)	(0.079)	(0.111)
mom	0.188	0.123	−0.031	0.182*	0.008	0.113	0.230***	−0.006	0.292***
	(0.133)	(0.102)	(0.147)	(0.099)	(0.096)	(0.133)	(0.084)	(0.079)	(0.111)
Constant	0.009	0.004	0.010	0.001	0.004	−0.003	0.001	0.009*	−0.006
	(0.011)	(0.006)	(0.014)	(0.007)	(0.005)	(0.010)	(0.006)	(0.005)	(0.008)
Observations	138	240	129	179	269	175	217	286	217
R^2	0.096	0.127	0.015	0.177	0.238	0.046	0.194	0.280	0.066
Adjusted R^2	0.069	0.112	−0.017	0.158	0.226	0.024	0.179	0.269	0.049
Residual Std. Error	0.111 (df = 87)	0.094 (df = 136)	0.132 (df = 82)	0.102 (df = 105)	0.091 (df = 149)	0.118 (df = 105)	0.089 (df = 120)	0.088 (df = 149)	0.107 (df = 120)
F Statistic	1.456** (df = 4; 87)	3.223*** (df = 4; 136)	0.761 (df = 4; 82)	3.844*** (df = 4; 105)	9.442*** (df = 4; 149)	2.579** (df = 4; 105)	5.922*** (df = 4; 120)	11.901*** (df = 4; 149)	1.503 (df = 4; 120)
Note:									*p<0.1; **p<0.05; ***p<0.01

Table B.2: Regression Results: Value-Weighted CT Portfolios

	6-Month			12-Month			24-Month		
	Dependent variables: Weighted Excess Return			*Dependent variables: Weighted Excess Return*			*Dependent variables: Weighted Excess Return*		
	Backed	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**	**Backed**	**Non-Backed**	**Long-Short**
market_premium	0.760***	0.812**	−0.645	0.601***	1.166***	−0.991***	0.907***	0.920***	−0.343
	(0.256)	(0.348)	(0.433)	(0.215)	(0.284)	(0.343)	(0.179)	(0.253)	(0.259)
smb	0.006	0.276*	−0.225	0.190	0.573***	−0.320	−0.124	0.566***	−0.607***
	(0.259)	(0.142)	(0.260)	(0.216)	(0.179)	(0.264)	(0.133)	(0.170)	(0.220)
hml	−0.116	−0.069	0.043	−0.290**	0.043	−0.267	−0.254**	0.097	−0.309
	(0.207)	(0.135)	(0.286)	(0.127)	(0.177)	(0.238)	(0.120)	(0.117)	(0.193)
mom	0.262	0.089	0.002	0.228	0.004	0.134	0.446***	−0.052	0.425***
	(0.179)	(0.108)	(0.200)	(0.144)	(0.101)	(0.180)	(0.129)	(0.083)	(0.162)
Constant	0.023*	−0.002	0.035**	0.009	−0.003	0.020	0.011*	−0.002	0.016*
	(0.014)	(0.009)	(0.017)	(0.008)	(0.008)	(0.013)	(0.006)	(0.007)	(0.009)
Observations	92	141	87	110	154	110	125	154	125
R^2	0.055	0.115	0.032	0.130	0.248	0.154	0.200	0.269	0.157
Adjusted R^2	0.011	0.089	−0.015	0.097	0.228	0.122	0.174	0.249	0.129
Residual Std. Error	0.111 (df = 87)	0.094 (df = 136)	0.132 (df = 82)	0.102 (df = 105)	0.091 (df = 149)	0.118 (df = 105)	0.089 (df = 120)	0.088 (df = 149)	0.107 (df = 120)
F Statistic	1.456** (df = 4; 87)	3.223*** (df = 4; 136)	0.761 (df = 4; 82)	3.844*** (df = 4; 105)	9.442*** (df = 4; 149)	2.579** (df = 4; 105)	5.922*** (df = 4; 120)	11.901*** (df = 4; 149)	1.503 (df = 4; 120)
Note:									*p<0.1; **p<0.05; ***p<0.01

Table B.3: Regression Results: Post-2010 Value-Weighted CT Portfolios

	Dependent Variable: Excess Return		
	6-Month	**12-Month**	**24-Month**
MKT	0.893***	0.825***	0.839***
	(0.087)	(0.059)	(0.039)
SMB	0.349***	0.393***	0.400***
	(0.070)	(0.058)	(0.046)
HML	−0.126***	−0.081**	−0.070**
	(0.047)	(0.038)	(0.031)
MOM	0.048	−0.015	−0.051
	(0.067)	(0.050)	(0.038)
Constant	−0.006	−0.007**	−0.008***
	(0.004)	(0.003)	(0.002)
Observations	1,710	3,146	5,855
R^2	0.068	0.069	0.086
Adjusted R^2	0.066	0.068	0.086
Residual Std. Error	0.168	0.164	0.164
F Statistic	31.137***	58.298***	138.425***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table B.4: Regression Results: Alpha Estimates

Time Period	Model	DW Statistic	P-Value	Autocorrelation
6 Months	With Sectors	1.6706	0.0048	Yes
6 Months	Without Sectors	1.7139	0.012	Yes
12 Months	With Sectors	1.8786	0.1696	No
12 Months	Without Sectors	1.8747	0.1603	No
24 Months	With Sectors	1.9105	0.2403	No
24 Months	Without Sectors	1.9243	0.2731	No

Table B.5: Durbin-Watson Test Results for Regression Models

Time Period	Model	BP Statistic	P-Value	Heteroskedasticity
6 Months	With Sectors	19.7998	0.2846	No
6 Months	Without Sectors	5.8151	0.5615	No
12 Months	With Sectors	17.6024	0.4143	No
12 Months	Without Sectors	5.4434	0.606	No
24 Months	With Sectors	20.7044	0.2398	No
24 Months	Without Sectors	11.6399	0.113	No

Table B.6: Breusch-Pagan Test Results for Regression Models

Time Period	Model	Variable	Adjusted GVIF$^{1/(2 \cdot Df)}$
6 Months	With Sectors	log(market_cap)	1.0633
	With Sectors	leverageratio	1.0604
	With Sectors	log_firmage	1.0794
	With Sectors	sector	1.0286
	With Sectors	pe_backed	1.9133
	With Sectors	pe_post_ipo	1.9428
	With Sectors	vc_backed	1.6310
	With Sectors	vc_post_ipo	1.5446
6 Months	Without Sectors	log(market_cap)	1.0695
	Without Sectors	leverageratio	1.0974
	Without Sectors	log_firmage	1.0901
	Without Sectors	pe_backed	3.4632
	Without Sectors	pe_post_ipo	3.5815
	Without Sectors	vc_backed	2.3793
	Without Sectors	vc_post_ipo	2.3282
12 Months	With Sectors	log(market_cap)	1.0633
	With Sectors	leverageratio	1.0604
	With Sectors	log_firmage	1.0794
	With Sectors	sector	1.0286
	With Sectors	pe_backed	1.9133
	With Sectors	pe_post_ipo	1.9428
	With Sectors	vc_backed	1.6310
	With Sectors	vc_post_ipo	1.5446
12 Months	Without Sectors	log(market_cap)	1.0695
	Without Sectors	leverageratio	1.0974
	Without Sectors	log_firmage	1.0901
	Without Sectors	pe_backed	3.4632
	Without Sectors	pe_post_ipo	3.5815
	Without Sectors	vc_backed	2.3793
	Without Sectors	vc_post_ipo	2.3282
24 Months	With Sectors	log(market_cap)	1.0633
	With Sectors	leverageratio	1.0604
	With Sectors	log_firmage	1.0794
	With Sectors	sector	1.0286
	With Sectors	pe_backed	1.9133
	With Sectors	pe_post_ipo	1.9428
	With Sectors	vc_backed	1.6310
	With Sectors	vc_post_ipo	1.5446
24 Months	Without Sectors	log(market_cap)	1.0695
	Without Sectors	leverageratio	1.0974
	Without Sectors	log_firmage	1.0901
	Without Sectors	pe_backed	3.4632
	Without Sectors	pe_post_ipo	3.5815
	Without Sectors	vc_backed	2.3793
	Without Sectors	vc_post_ipo	2.3282

Note: Adjusted GVIF values account for the degrees of freedom in categorical variables. Values close to 1 indicate low multicollinearity, while values above 5 or 10 may suggest issues.

Table B.7: Results of VIF-Test - Cross-Sectional Regression