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The Six-Month Performance of Initial Public Offerings in the Norwegian Stock Market.

An Empirical Study on Investors' Ability to Generate Excess Returns by Investing in Initial Public Offerings.

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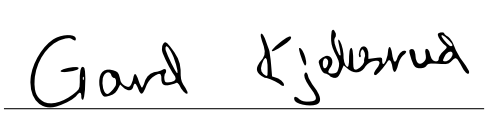

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Abstract

This thesis studies the six-month performance of 357 Norwegian initial public offerings (IPOs) from 1997 to 2021. To examine if IPOs underperform the market, we compute cumulative adjusted returns for equally-weighted portfolios, cumulative average adjusted returns, and buy-and-hold returns. We conclude that IPOs in the Norwegian market have an average initial return of 8.53% and that aftermarket underperformance is not only a long-run phenomenon but also occurs in the shorter time frame of six months. We find evidence that the IPOs underperform relevant market indices when measuring aftermarket performance from the first closing price to six months later. However, the returns are considerably higher when measuring from the offering price, indicating that cornerstone investors on average are better off investing in IPOs than retail investors. We document substantial variation in the IPO performance across sectors and year-to-year, with high-volume periods performing the best. Finally, our findings indicate that these patterns are caused by firms taking advantage of fads and investor overoptimism.

Keywords – IPO Performance, Investment decisions, Six-month returns

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1 Introduction

Several studies have documented anomalies related to the pricing of initial public offerings (IPOs) of common stock, with particular emphasis on the following phenomena: (1) short-run underpricing, (2) long-run underperformance, and (3) "hot issue" markets.[1] Most academic and professional literature considers IPO long-run underperformance as holding periods of three years or more.[2] There is, however, far less research done on shorter holding periods. In this thesis, we study the six-month performance of 357 IPOs on the Norwegian stock market between 1997 and 2021. The thesis presents an empirical investigation on whether active trading strategies can be applied to achieve higher returns than the market in six months and compares the results with existing literature on long-term performance. Further, we provide explanations for the IPO performance to examine if investors can predict the returns.

2020 and 2021 are record-breaking years for the Norwegian stock market with over 100 offerings, more than the period from 2010 to 2019 combined. In relation to this, the IPO underpricing, aftermarket performance, and hot market events are interesting for various reasons. First, if IPO-related price patterns exist, the knowledge of such patterns may present an opportunity for investors to achieve higher returns than the market based on an active trading strategy. Second, proponents of efficient markets would argue that once shares in an IPO are publicly traded, the price should reflect the shares' intrinsic value like any other stock in the market. Consequently, after going public, firms' risk-adjusted stock prices should not be predictable. If there are cross-sectional similarities between IPO performances, it is difficult to argue for market efficiency. The nonzero initial return (IR) events on the first public trading day support Shiller's (1990) hypothesis that the securities markets are subject to informational asymmetry that influences the prices. Third, if IPOs tend to underperform in the aftermarket during high volume periods, firms are timing new issues successfully by taking advantage of "windows of opportunity". Günther and Rummer (2006) suggest that these hot markets play an important role in explaining the

[1] For instance, Ritter and Welch (2002) and Ljungqvist (2007) review IPO underpricing, Loughran and Ritter (1995) document the underperformance, and Ibbotson and Jaffe (1975) discuss hot issue markets.

[2] IPO long-run underperformance is reported in various countries, for instance Aggarwal et al. (1993) in Brazil, Chile, and Mexico, Levis (1995) in the UK, Dimovski and Brooks (2004) in Australia, Agarwal et al. (2008) on Hong Kong and Jewartowski and Lizińska (2012) in Poland.

source of aftermarket IPO underperformance.

In his article, Ritter (1991) describes the long-run performance of initial public offerings and finds that IPOs appear to be overpriced. In the three years after a sample of 1,526 IPOs went public in the U.S between 1975 and 1984, Ritter finds that the companies significantly underperform comparable companies similar by size and industry. Arising from these findings, high academic and professional interest in IPO aftermarket performance has continued. Potential reasons for the long-run IPO underperformance are (1) risk mismeasurement, (2) bad luck, or (3) fads and overoptimism.

This thesis examines the topic empirically and uses a similar approach as Ritter (1991). Our hypothesis is stated as follows:

H0: Norwegian IPOs underperform the market in a six-month period
HA: Norwegian IPOs do not underperform the market in a six-month period

To answer the hypothesis, we compute cumulative average adjusted returns for an equally-weighted portfolio with daily rebalancing and buy-and-hold returns. Further, we add a strategy investing in all IPOs from 1997 to 2021 and holding for six months. We use benchmarks to ascertain if risk mismeasurements can explain the IPO underperformance and document several time-series and cross-sectional patterns to distinguish between explanations of bad luck or fads and overoptimism as determinants for IPO performance. As proxies for the market, we use the OSEBX and OSESX indices.

Consistent with most literature, we document that 357 IPOs on the Norwegian stock market have an positive average initial return of 8.53%. We find that the aftermarket underperformance is not only a long-run phenomenon but also occurs in the shorter time frame of six months. However, the findings highlight that returns from IPO investing strategies are sensitive to the holding period length and whether investors can buy at the offering price or the first trading day closing price. Cornerstone investors can in some cases outperform the market because they are able to invest at the IPO offering price, while retail investors are better off investing in market indices. We argue that the IPO underperformance is not merely due to bad luck or risk mismeasurement but the tendency for firms to go public in times of fads and overoptimism and subsequently experience low returns. However, some periods of overoptimism last longer than six months and we argue

that this, at least partially, explains why firms going public in high-volume periods can perform well in the aftermarket.

We add to the existing literature by examining if similar U.S. IPO patterns are present in the Norwegian stock market in a shorter time perspective. We use a shorter holding period of six months instead of three years (Ritter, 1991) or five years (Loughran and Ritter, 1995) to see if this will affect the performance significantly. The IPO data is expanded and contains information from the latest 25 years. Additionally, we compute portfolios with different holding periods to study how sensitive the IPO performance is to the number of days holding the IPOs. By evaluating IPO performances in a historical view and adding the extraordinary years of 2020 and 2021, we provide updated results and knowledge for investors, firms, and academics.

The thesis structure will be as follows: Section 2 describes the background and literature. Section 3 explains our methodology and empirical methods, followed by Section 4 which describes the data sources and sample selection. In Section 5, we present and discuss the findings of our analyses. Section 6 comprises the conclusion, with limitations and suggestions for further work.

2 Theory and Background

This section presents the relevant background and existing literature for this thesis. We start by providing the fundamental background of IPOs and a few key traits of going public. Further, we review existing academic and professional literature, with particular emphasis on the research on underpricing and aftermarket performance.

2.1 Why Firms Conduct IPOs

There are various reasons why firms conduct initial public offerings. IPOs are one of the most common methods of raising funds for companies seeking capital increases and means that the firm will be traded publicly in the stock market. Ritter and Welch (2002) suggest that market conditions are the most important factors when firms consider going public or not. The second most important aspect seems to be which life cycle stage the firms currently find themselves in. IPOs are usually the preferred funding source left for private companies seeking to raise capital if internal sources of funds like retained earnings are insufficient, or external sources such as private equity or bank loans are unavailable (Khurshed, 2019). Going public may also be a preferred exit opportunity for old investors, for instance private equity firms seeking a suitable time to reduce their positions and capitalize on their investments. A common perception is that many IPOs face short-run underpricing, which potentially generates high returns for investors in a short period of time. Additionally, IPOs often appeal to investors since they allow for equity ownership in exciting new companies.

IPOs can help firms in many ways. For example, the capital raised can finance future growth or pay off debt and other capital requirements. Moreover, the firm can expect enhanced borrowing terms in the market due to the increased transparency related to the firm's business and financial statements. Another reason to go public can be linked to employee ownership and the alignment of incentives by offering a formal stake in the company in the form of shares with a market price that is easily traded. Pukthuanthong et al. (2007) find that new public firms perform better when managers are offered equity ownership and stock options.

2.2 The Norwegian Market

There are three different Norwegian stock exchanges: Oslo Stock Exchange (OSE), Oslo Euronext Expand, and Oslo Euronext Growth. There are systematic differences between the companies listed on each stock exchange due to the different criteria for initial public offerings. Oslo Euronext Growth has fewer legal requirements and more favorable taxation for firms with less on their balance sheets, which makes it attractive for small firms that need swift capital (Abrahamsen and Sveen, 2021). Private placements are the most common listing mechanism on Euronext Growth. Oslo Euronext Expand has fewer criteria than OSE but is more demanding than Euronext Growth.

The U.S. market has a higher average IPO volume than the Norwegian market. Hence, it is more difficult to impose minimum requirements on Norwegian offerings, because the sample must be big enough to allow for statistical significance. We obtain the biggest possible sample to study our research question by disregarding minimum offering requirements. Thus, we have included all IPOs that fulfill the minimum requirements described in section methodology.

2.3 Cornerstone vs. Retail Investor IPO Participation

Throughout the thesis, we devote attention to potential investment strategies for cornerstone investors compared to retail investors. We identify cornerstone investors as financial institutions and/or wealthy individuals. To separate the two investor types, we focus on the ability to participate in the offerings. It is typical for issuing firms to allocate shares to cornerstone investors to provide price support once they have gone public. Chen and Wilhelm (2008) explain that price support can be useful to ease the transition to public markets. Bodnaruk et al. (2008) review all Swedish IPOs between 1995 and 2001 and show that firms with more concentrated ownership are more likely to go public, have higher underpricing, and the controlling shareholders are more inclined to accept lower IPO share prices. These factors will arguably affect the return on investment for strategies that buy shares at the IPO offering price.

On the other hand, retail investors generally have more participation constraints than cornerstone investors, especially in private placements, although several IPOs allow for

retail capital as well. For simplicity reasons, we classify retail investors' IPO holding period return as buying the share at the closing price first day of public trading and holding for 127 trading days (equivalent to six months). For cornerstone investors, we classify the IPO holding period return as buying the IPO at the offering price and holding for 127 trading days. That is, cornerstone investors get the effects of initial return and aftermarket performance while retail investors only rely on aftermarket performance after the initial return period.

2.4 Literature Review

Jay Ritter's article on the long-term performance of initial public offerings in 1991 has a great influence on the perception of the performance of IPOs, and a vast amount of research has been conducted in later years to explain the same aspects. Reviewing new and old literature on IPO underpricing and aftermarket performance gives a solid foundation for examining the six-month performance of Norwegian initial public offerings.

2.4.1 Underpricing

IPO underpricing has been a well-documented phenomenon for many years. An IPO is considered underpriced when the stock price closes the first trading day at a price above the set IPO price. According to Ibbotson et al. (1988), US IPOs in 1988 yielded an average initial return of approximately 16.4% when measuring from the offering price to the closing price on the first day of public trading. Measured from 1960 to 2021, the average initial return in the U.S is 17.5% (Loughran et al., 2022). In Norway, the average initial return is 10.3% between 1984 and 2021. Underpricing is characterized as a cyclical phenomenon with some periods and industries having significantly higher initial returns than others. Lowry et al. (2010) document that monthly IPO initial returns volatility is substantially larger during hot IPO markets and fluctuates severely over time.

There are different opinions on why underwriters allocate underpriced shares to certain investors. The quid pro quo view (Ljungqvist and Wilhelm, 2003; Loughran and Ritter, 2002) argues that underwriters compensate institutional investors to maintain business relations. From the bookbuilding view (Benveniste and Spindt, 1989; Sherman and Titman, 2002), underpricing occurs to reward investors for their information. Both views

are based on the short-term underpricing phenomenon, while Boehmer et al. (2006) argue that there are systematic differences both initially and up to a one-year holding period. They further suggest there are systematic differences in the allocation between retail and institutional investors. In private offerings, shares are sold to a selected group of investors, while public offerings are also available to retail investors. Fjesme (2016) argue that the choice between the type of offering is based on the personal benefits of controlling the companies. Hence, private placements are often chosen by firms with concentrated ownership. Considering these findings, we provide an analysis of returns, both excluding and including initial returns. This is to capture the situation of retail investors, as many of the IPOs are solely based on institutional capital. By excluding initial returns, hence focusing exclusively on aftermarket performance, all retail investors can buy shares as they are already offered and publicly traded.

2.4.2 Aftermarket Performance

There are different views on how to explain the sources of long-run IPO underperformance. Stoll and Curley (1970) examine 205 small issues from 1957 to 1963 and compare the long-run rates of return to the Standard and Poor's Industrial Average index portfolio consisting of large-cap stocks. The findings presented lower long-run rates of return for small new firms compared to investing in the index. However, the short-term price appreciation was considerably higher for the 205 sample firms. According to Stoll and Curley, these findings imply that investors are not reluctant to commit capital to new small firms even when other investment opportunities exist. They further raise questions about newly issued firms' seemingly systematic price appreciation and emphasize the lack of suitable explanations for the phenomenon. Stern and Bornstein (1985) also report that new issues in the period from January 1975 to the end of June 1985 have underperformed the Standard Poor's 500 stock index by 22%. Consistent with these results, Yi (2001) conducts a study that confirms the long-run underperformance of IPO firms over a 3-year period from the date of going public compared with the NASDAQ index. The study suggests that investors are overly optimistic about future returns of IPOs.

Ibbotson and Jaffe (1975) finds that "results generally confirm that there are no departures from market efficiency in the aftermarket" (p. 265). Ibbotson's result is based on IPO excess returns over a period of 10 years from 1960 to 1969, with a sample that included

one offering per month and a minimum IPO price of $3.00 per share. Still, he reports that post-offering IPO performance generally is positive during the first year, negative in years 2-4, and positive again during the fifth and last measured year. It is, however, essential to be aware of high standard errors related to the estimates, which makes it problematic to reject the hypothesis of market efficiency. In addition, the work of Buser and Chan (1987) is interesting as they present findings that do not indicate long-term IPO underperformance. They evaluate over 1,078 NASDAQ/National Market System-eligible IPOs in 1981-1985 and find that the initial IPO return is 6.2%. The two-year mean market-adjusted return for the same period is 11.2% when using the NASDAQ Composite Index as a benchmark (initial return excluded).

Ritter and Welch (2002) argue that, in their view, one of the few semi-rational explanations of IPO long-run underperformance is based on Miller's (1977) assumptions that IPOs are subject to shorting constraints and investors have heterogeneous firm valuation expectations. Consequently, the most optimistic investors buy the IPO. As the variance of beliefs decreases over time, stock prices will fall because the marginal investor's expectations of firm value will converge toward the mean. This view is consistent with stocks experiencing a drop in price at the end of lock-up periods, as Field and Hanka (2001) and Brau et al. (2004) document.

Several studies have also focused on the aspect of overoptimistic managers. Teoh et al. (1998) attribute parts of the underperformance to excessively optimistic accounting when the IPO is conducted. Since the market has difficulties valuating a new firm with limited historical information available, some of the underperformance may stem from a market that is too optimistic about future forecasts. This is consistent with Ljundqvist's (2007) argument about the shortcomings of IPO firm's information. Purnanandam and Swaminathan (2004) suggest that IPOs with high valuations compared to public market comparable companies tend to underperform in the long run, even though first-day returns are higher.

2.4.2.1 Small vs Large Firms

Several studies examine the aftermarket performance of small firms compared to large firms. Ritter (1991) and Loughran and Ritter (1995) find that small firms experience

worse stock price performance following the offering compared to large firms, indicating that smaller offerings represent more speculative firms. More than a decade later, Goergen et al. (2007) find that small firms have worse long-run performance than larger firms after going public. Similarly, Gregory et al. (2010) examine 2,499 UK IPOs between 1975 and 2004 and report that smaller firms underperform more frequently. Additionally, Gao et al. (2013) study the performance of small firm IPOs between 1980 to 2009 and conclude that these firms have become less profitable over the years. Researchers have argued that small firms going public underperform for different reasons. Smaller firms may have a harder time recovering from economic shocks due to fewer financial resources, thus resulting in a greater sensitivity to external economic factors. Also, one can argue that small firms underperform due to overly optimistic IPO valuations, as Purnanandam and Swaminathan (2004) describe, because of asymmetric information.

2.4.2.2 Hot Markets and Windows of Opportunity

The notion of hot issue markets refers to events when the stock prices of newly issued firms rise to higher than average aftermarket premia, measured from the offering price (Ibbotson and Jaffe, 1975). High-volume periods in the IPO market are characterized by a substantial increase in the number of IPOs and may also come with a higher underpricing. Dark and Carter (1993) find evidence that issuing firms are more likely to experience an overestimated market value in the immediate aftermarket during hot conditions. Brau and Fawcett (2006) survey 336 CFOs and report that CFOs define windows of opportunity based on the overall stock market condition and seek to go public at times that portend a high stock price. Firms prefer to go public in high-volume periods because they can exploit market sentiment and raise more money by setting offer prices higher.

Historically, we have seen differences in IPO activity across the years. For instance, the number of offerings was low in the years following the dot-com bubble but picked up closer to the financial crisis. Similarly, the number of IPOs closely after the financial crisis was low. Since 2017, there have been more than 10 public listings in the Norwegian stock market every year, but 2020 and 2021 stand out with more than 100 firms going public combined. These observations show some cyclicality and suggest that the decision to go public, at least partially, is influenced by external economic factors.

3 Methodology

The following chapter describes our methodology and empirical methods used throughout the thesis. We describe the process of measuring the cumulative benchmark-adjusted aftermarket performance and buy-and-hold measures.

3.1 Empirical Methods

We are inspired by Ritter's, (1991) work and calculation methods. Returns are calculated for (1) the initial return period, defined as the offering price to the first trading day closing price, and (2) the aftermarket period characterized as the period between the closing price of the first public trading day and the closing price six months later, equivalent to 127 trading days. The initial return period is referred to as month 0, while the aftermarket period corresponds to the following six months after the offering date. One month is defined as 21 trading days. Hence, the first month contains event days 2-22, the second month contains event days 23-43, and so on. We choose a holding period of six months due to IPO lock-up periods usually lasting for 180 days (Sletten, 2018).

IPOs from OSE, Oslo Euronext Expand, and Oslo Euronext Growth are used and compared to the return of suitable benchmarks. As proxies for the market, we use the Oslo Stock Exchange Benchmark (OSEBX) and Oslo Stock Exchange Small Cap Index (OSESX).[3] OSEBX represents the most traded and largest stocks on OSE and is a suitable benchmark because it covers the broad market. OSESX consists of the 10% lowest capitalized shares on OSE. IPOs are often smaller firms than those established in the stock market, so OSESX is an appropriate benchmark for companies in the small-to-mid cap range. Both indices are free float adjusted.

Further, we use three measures to assess the performance: (1) adjusted cumulative returns for a portfolio reinvesting in all IPOs from 1997 to 2021, rebalancing monthly, upon new issues, after holding an IPO for 127 days, and in the case of delistings. (2) Cumulative average adjusted returns (CAR), where the adjusted returns are calculated based on the benchmarks with a daily rebalancing of the portfolio. And (3) six-month holding period

[3]Oslo Stock Exchange All Share Index (OSEAX) and Oslo Stock Exchange Fund Index (OSEFX) give similar results as OSEBX and are therefore not included in the analyses.

return for both the IPOs and the benchmarks. The holding period for IPOs delisted before six months of trading is truncated according to the last listing date. There were no firms transferred to another stock exchange within the return period.

3.1.1 Cumulative Benchmark-Adjusted Aftermarket Performance

The daily benchmark-adjusted returns are calculated by the daily raw return of stock i, subtracting the benchmark return over the corresponding one-day period. We use OSEBX and OSESX as benchmarks. The adjusted return for stock i in event day t is defined as

$$ar_{it} = r_{it} - r_{mt} \tag{3.1}$$

It follows that the average benchmark adjusted return of a portfolio consisting of n stocks for day t will be the arithmetic average of the equally-weighted benchmark-adjusted returns:

$$AR_t = \frac{1}{n}\sum_{i=1}^{n} ar_{it} \tag{3.2}$$

Summing the adjusted returns for a specific period gives the cumulative benchmark-adjusted returns for the period.

$$CAR_{q,s} = \sum_{t=q}^{s} AR_t \tag{3.3}$$

s and q are two separate periods of events. When a firm is delisted before six months, the proceeds are distributed equally to the remaining portfolio firms. Therefore, the cumulative market-adjusted portfolio return is based on an equally-weighted average of the remaining firms.

3.1.2 Cumulative Returns for Rebalancing Portfolios Investing from 1997 to 2021

Additionally, to test whether this strategy is profitable in practice, a portfolio investing in all 357 IPOs from 1997 to 2021 is computed. The portfolio is rebalanced to maintain an equal weight at the following events: (1) a new month, (2) a newly listed firm included in the portfolio, (3) at the end of a firm's 127th trading day, and (4) when a firm is delisted.

OSEBX and OSESX are used as benchmarks to see if the strategy generates higher returns. For a strategy investing NOK 1 in 1997, the cumulative return is calculated as:

$$CR_t = CR_{t-1} \times (1 + AR_t) \tag{3.4}$$

To test the sensitivity towards the number of holding period days, the same portfolio construction is used by varying the holding periods.

3.1.3 Wealth Relatives

A buy and hold strategy for six months is also considered. The holding period returns R_i are calculated by:

$$R_i = \prod_{t=1}^{6} (1 + r_{it}) \tag{3.5}$$

Here, r_{it} is the raw return of firm i in period t. This strategy shows the total return from buying and holding the stock over six months or until delisting. To better visualize the performance, a ratio between the performance of the IPOs and the return of benchmarks is used. This ratio is defined as a wealth relative (WR) and is calculated as:

$$WR = \frac{1 + \text{ average 6-month total return on IPOs}}{1 + \text{ average 6-month total return of a benchmark}} \tag{3.6}$$

WR>1 means that the IPOs outperformed the benchmark and WR<1 means that IPOs underperformed. To test our hypothesis, the wealth relatives will measure the performance when sorting the firms based on the following factors: (1) gross proceeds, (2) initial return, (3) market value, (4) sector, (5) issuing year, and (6) age.

4 Data

This section describes our data sources and sample selection process. We show an overview of the sample by characterizing the distribution of initial public offerings by year.

4.1 Data Sources and Sample Selection

We utilize data from a total of four different providers, supplemented with company IPO prospectuses. Oslo Stock Exchange (OSE) and Euronext, including Newsweb, are the primary sources of information. In cases of insufficient information, we fill in the remaining data using Refinitiv Eikon and Yahoo Finance.

First, we find firms publicly listed in the period from 01/01/1997 to 20/10/2021 on OSE (now Euronext Oslo), Merkur Market (now Euronext Growth), and Oslo Access (now Euronext Expand). This period gives a comprehensive overview of IPOs during 25 years of different economic times with various levels of IPO activity. Thus, this time period is suitable for assessing time-series and cross-sectional patterns in IPO performance.

Second, we identify the firms qualifying as an initial public offering. As an initial public offering (IPO), we classify the event when a firm issues shares of common stock to the public for the first time. We observe that literature and stock exchanges use the IPO term broadly. Hence, we choose to include both public offerings and private placements in the IPO category. Direct listings are not considered an IPO as no new shares are offered. The process of an IPO is commonly referred to as going public or being listed, which are terms we will use interchangeably throughout the thesis. The IPO firms are found in the OSE datasets containing listing changes and issues, and we exclude all other listings or issues not qualifying as an IPO.[4] We emphasize the importance of these exclusions to have the correct data. Firms without available issue prices are excluded from the sample. As a result, our sample comprises 357 IPOs from 1997 to 2021 in the Norwegian market.

Finally, we gather financial data for all IPO firms. This information includes ticker, nominal value, listing date, IPO offering price, closing prices, gross proceeds, market value, sector classification (GICS), and age for all stocks. Daily closing prices for OSE

[4]Direct listings, exchange transfers, secondary listings, public issues, employee issues, repair issues, and listings with insufficient data are excluded.

and Euronext Expand are retrieved from the Oslo Børs Information (OBI) database for 1997 to June 2020. We find the remaining data from July 2020 to April 2022 through Euronext, Refinitiv Eikon, and Yahoo Finance. Issue prices are retrieved from OSE issues data, Newsweb, Euronext, and company prospectuses. Daily closing prices for Euronext Growth are retrieved from Refinitiv Eikon and Yahoo Finance, while the issue prices are from Euronext, Newsweb, and company prospectuses.

Two of the companies were delisted within six months after their offering date. Our data set includes both stocks currently listed and delisted. Consequently, we are confident that the sample is not subject to a survivorship bias in the sense that poor-performing companies would be excluded from the sample. In the case of an IPO being a spinoff, like Aker Carbon Capture, the date of founding is set to be the date of the spinoff. Compared to other young firms, the spinoffs will benefit from experience and resources developed through years of operation and may not give an entirely correct basis for comparison. However, we deem it less correct to list the parent company's founding date and do not believe this issue will affect the analyses significantly. In the event of a stock split within six months after the offering date, prices are corrected. Benchmark returns are retrieved from Euronext.

We acknowledge that we do not include all Norwegian IPOs between 1997 and 2021 due to insufficient data and emphasize the difficulties of finding correct information 25 years ago. However, based on a systematic selection, we deem our dataset comprehensive compared to other samples we have seen. To our knowledge, we have not found other literature comprising this amount of IPO-related data on the Norwegian market. We recognize that stock exchange information systems have developed over the years and find it necessary to conduct extensive research to construct the most accurate sample possible. Fortunately, we utilize a variety of high-quality data sources and are satisfied with the current IPO sample. We also recognize substantial outliers in terms of firm market values and gross proceeds due to the relatively low volume of Norwegian IPOs compared to the U.S. This makes the sample sensitive to large values. For instance, Telenor raised NOK 15.63 billion in 2000 (not price-adjusted), representing 79.66% of total gross proceeds in 2000.

Table 4.1: Initial Public Offerings Distribution by Year and Stock Exchange, 1997-2021

Table 4.1 presents the distribution of initial public offerings during the years 1997-2021 and across the three Norwegian stock exchanges Oslo Stock Exchange, Euronext Expand Oslo, and Euronext Growth Oslo. The number of IPOs is based on Oslo Stock Exchange (OSE) issues and listings data for all three stock exchanges. Refinitiv Eikon, Yahoo Finance, and Newsweb supplement insufficient OSE data. Aggregate gross proceeds represent the capital raised for all firms each year. Gross proceeds from overallotment options, if exercised, are included. This table does not include any price level adjustments.

	Total included		Oslo Stock Exchange		Euronext Expand Oslo		Euronext Growth Oslo	
Year	No. of IPOs	Aggregate gross proceeds, NOK millions	No. of IPOs	Aggregate gross proceeds, NOK millions	No. of IPOs	Aggregate gross proceeds, NOK millions	No. of IPOs	Aggregate gross proceeds, NOK millions
1997	12	3 926.9	12	3 926.9				
1998	10	1 616.7	10	1 616.7				
1999	3	544.5	3	544.5				
2000	8	19 621.0	8	19 621.0				
2001	6	14 195.9	6	14 195.9				
2002	2	354.3	2	354.3				
2003	2	125.3	2	125.3				
2004	4	2 302.5	4	2 302.5				
2005	32	10 255.4	32	10 255.4				
2006	18	4 493.5	18	4 493.5				
2007	34	10 223.8	17	7 178.7	17	3 045.0		
2008	11	531.2	3	25.4	8	505.8		
2009	2	783.4	0	0	2	783.4		
2010	16	22 707.3	9	21 726.1	7	981.2		
2011	9	8 484.3	3	4 299.4	6	4 184.9		
2012	3	2 217.7	2	2 201.6	1	16.1		
2013	12	6 577.1	8	6 351.1	4	226.0		
2014	15	7 167.1	10	6 733.0	5	434.1		
2015	7	6 331.1	5	5 996.1	2	335.0		
2016	6	1 893.0	2	1 425.0	1	110.1	3	357.8
2017	16	11 114.5	10	8 610.0	2	2 094.5	4	410.0
2018	11	10 067.9	6	9 050.6	0	0	5	1 017.3
2019	11	8 779.4	6	6 987.3	4	1 672.2	1	120.0
2020	49	24 848.8	4	5 598.9	0	0	45	19 249.9
2021	58	32 408.2	5	6 098.6	0	0	53	26 309.6
Total	357	211 570.6	187	149 717.6	59	14 388.3	111	47 464.7

Table 4.1 presents the sample distribution for each stock exchange's number of offerings and gross proceeds each year.[5] The table shows that the number of IPOs and gross proceeds are not distributed equally over the sample period. There are differences both in terms of years and stock exchanges. The years 2000-2001, 2005, 2007, 2010, 2017-2018, and 2020-2021 stand out as years with aggregate gross proceeds above NOK 10 billion. Specifically, the four years with the largest aggregate gross proceeds combined (out of 25 years) account for 47% of total gross proceeds. In terms of volume, the average number of IPOs per year is 14, but there are significant deviations from this number.

[5]In the event of overallotment options being exercised, the amount is included in gross proceeds.

5 Analysis

This chapter presents the findings and results of our analyses and discusses potential reasons and implications.

5.1 Equal-Weighted Cumulative Returns for IPO Aftermarket Performance

Figure 5.1 illustrates the economic significance of investing from the offering price compared to the first closing price. The cumulative return from top to bottom: (1) raw return including the initial return, (2) OSESX adjusted return including the initial return, (3) OSEBX adjusted return including the initial return, (4) raw return excluding the initial return, (5) OSESX adjusted return excluding the initial return, and (6) OSEBX adjusted return excluding the initial return.Considering the cumulative raw returns, investing from the first closing price and holding for 127 trading days leads to a loss of 93.42%, while the same strategy investing from the IPO offering price leads to a return of 174.82% over 25 years.[6] The raw return, excluding the initial return, never recovers from the early 2000s characterized by the dot-com bubble.[7] The portfolio slowly builds back up in the years before the financial crisis of 2008 but suffers during the subsequent recession. Including the initial return, the portfolio follows the same patterns but recovers to initial levels around 2018. Following an economic downturn in the start of the covid-19 pandemic in 2020, the portfolio experienced great returns, up 525% from the bottom of 2020. The cyclicality and volatility of IPO performance are evident in Figure 5.1 with standard deviations of approximately 45% for raw returns.

Figure 5.1 additionally plots the cumulative adjusted returns, which is the return of the rebalancing IPO portfolio adjusting for OSEBX and OSESX. The resulting cumulative return reveals different patterns due to the difference in performance of the two indices. Both indices outperform the IPO portfolios significantly. The IPO portfolio that excludes the initial returns, adjusted for the OSEBX index, results in a loss of 99.67%. Including

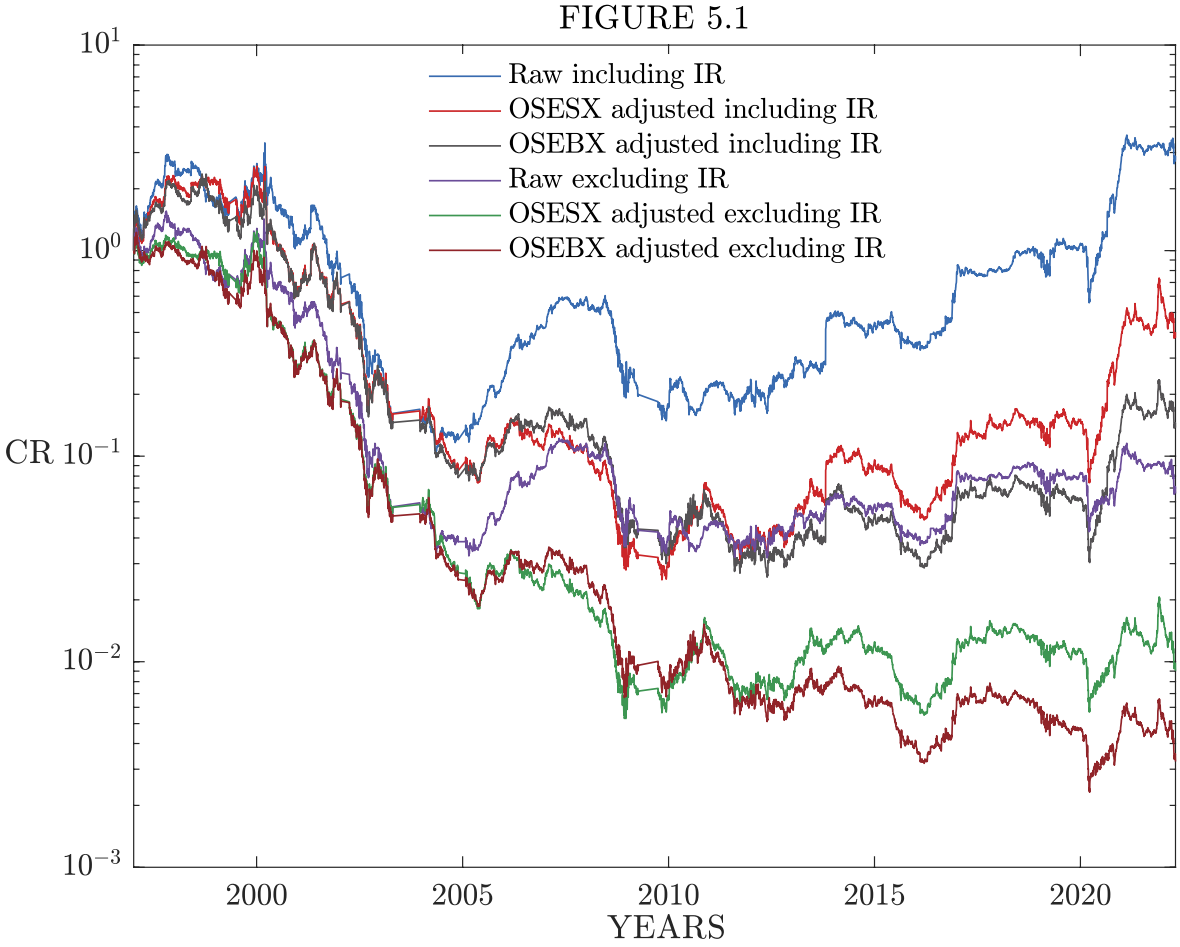
[6] Transaction costs are not accounted for in the cumulative return. Hence, the return would be lower for such a strategy.

[7] The rebalancing portfolio is sensitive to economic downturns. Periods with few issues result in few firms in the portfolio, leading to low diversification and exposure to firm-specific events.

Figure 5.1: Cumulative Returns for Rebalanced Equally-Weighted Portfolios with Six Months Holding Periods, Starting with NOK 1 and Reinvesting in 357 IPOs from 1997 to 2021.

The figure depicts the relationship between six-month cumulative returns when using different benchmarks and raw returns. The figure also shows the differences in cumulative returns when excluding and including initial returns. Six series are plotted: (1) raw return including the initial return, (2) OSESX-adjusted return including the initial return, (3) OSEBX-adjusted return including the initial return, (4) raw return excluding the initial return, (5) OSESX-adjusted return excluding the initial return, and (6) OSEBX-adjusted return excluding the initial return. The portfolios hold cash in periods with no new IPOs. Portfolios are rebalanced upon a new month, when a newly listed firm is included in the portfolio, at the end of a firm's 127th trading day, and when a firm is delisted. For firms delisted before six months have passed, returns are calculated until the day of delisting.

FIGURE 5.1



the initial return results in a loss of 86.26%. Adjusting for OSESX, the portfolio excluding initial returns results in a 99.10% loss. When including the initial return, the loss is 86.26%.

Due to the influence of the dot-com bubble on the IPO performance, we conduct the same strategy starting in 2003. We do this to test the feasibility of our study and whether the poor performance is due to bad timing. The portfolio including the initial return outperforms OSEBX with 46.21%. Excluding the initial return, the portfolio results in a loss of 37.42%. We observe the same trend when excluding the financial crisis and start computing the portfolio in 2010. Measuring from the offering price, the portfolio outperformed OSEBX and OSESX, while from the closing price the market indices outperform the portfolio. Hence, Figure 5.1 shows that investing in IPOs in times of great uncertainty comes with high risk, especially for retail investors.

The findings in Figure 5.1 indicate that the initial return is vital for investors seeking higher returns than the market. We highlight that those investors able to invest from offering prices and timing the market can outperform the market with this investment strategy. Investors buying at the first trading day closing price are not able to outperform the market and are better off investing in market indices, even when timing the market. Investing in all IPOs and holding them for six months, rebalancing monthly, in the event of new listings and delistings, would result in a loss measured against both OSEBX and OSESX. Hence, this strategy underperforms in the aftermarket.

5.1.1 Portfolios with Different Holding Periods

To further investigate a strategy investing in all IPOs, we change the holding period to see what could be characterized as a theoretical optimal holding period focusing only on raw returns. This is illustrated in Figure 5.2. The cumulative return from top to bottom: (1) one-day holding period, (2) two-day holding period, (3) three-day holding period, (4) five-day holding period, (5) ten-day holding period, (6) twenty-day holding period, and (7) fifty-day holding period.

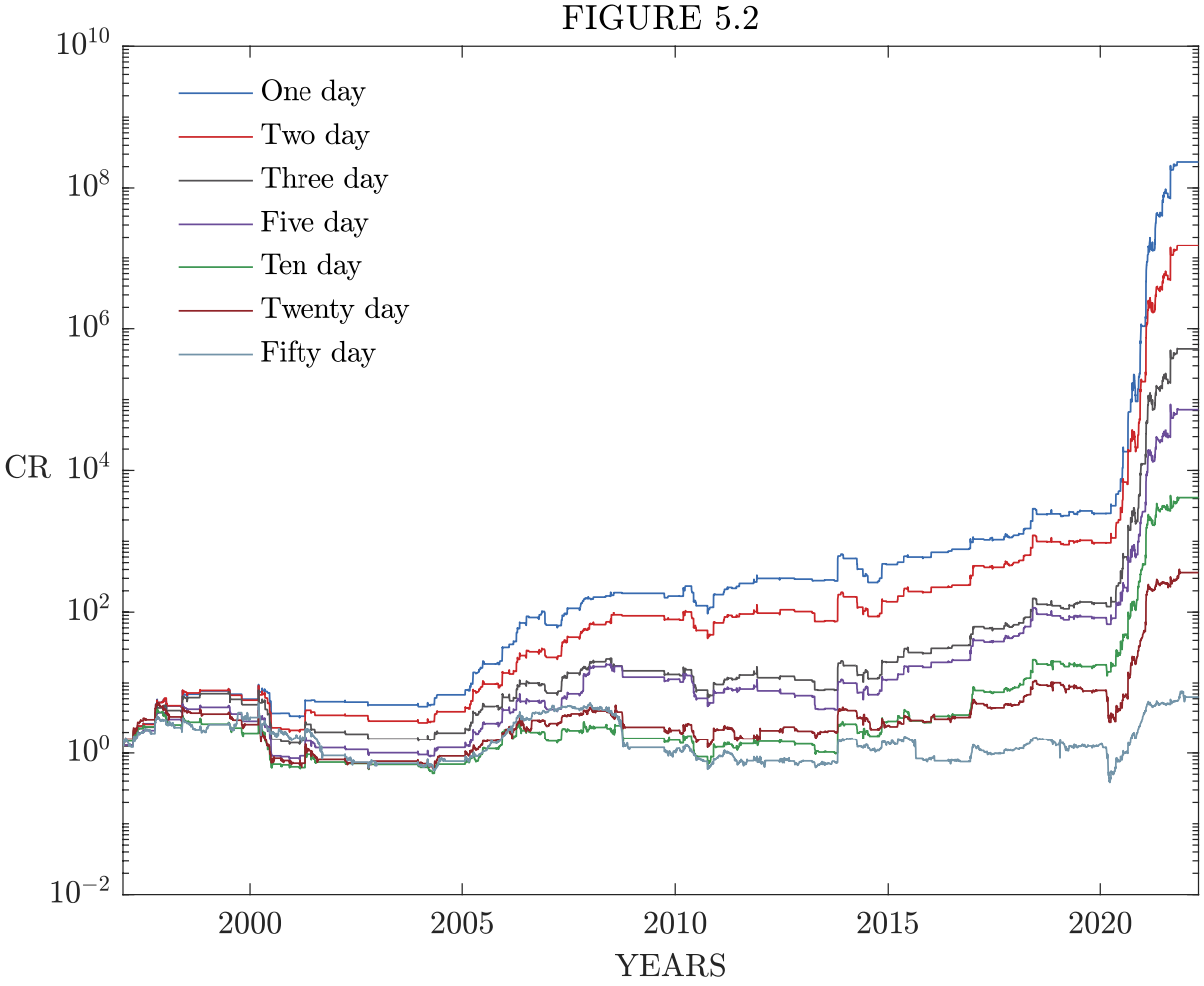
Changing the holding period to one day and investing NOK 1 in the first IPO in 1997 and reinvesting it in the remaining 356 offerings from 1997 to 2021 would lead to a return of NOK 232.521 million investing from the offering price. Buying from the first closing price leads to a return of NOK 0.12. We emphasize that this strategy is not practically feasible, but it illustrates the significance of the underpricing phenomenon.[8] Including

[8]There are usually lock-up periods on new issues to reduce early IPO flipping, often 180 days (Sletten, 2018).

Figure 5.2: Raw Cumulative Returns for Equally-Weighted Portfolios with Different Holding Periods, Starting with NOK 1 and Reinvesting at the Offering Price in 357 IPOs from 1997 to 2021.

This figure illustrates the effects of varying the holding periods. The portfolios include holding periods of: (1) one day, (2) two days, (3) three days, (4) five days, (5) ten days, (6) twenty days, and (7) fifty days. The portfolios hold cash in periods with no new IPOs. Portfolios are rebalanced upon a new month, when a newly listed firm is included in the portfolio, at the end of a firm's holding period, and when a firm is delisted.

FIGURE 5.2



the initial return gives an average return of 4.67% each day of holding assets in the portfolio. Excluding the initial return leads to an average return of 0.2%. This portfolio does not fully recover from the dot-com bubble burst until 2021, where it peaks at NOK 2.3 before suffering losses back to NOK 1.12. 2020 and 2021 play a significant role in these extraordinary returns and illustrate the Norwegian market's extreme market conditions during these years. For each day when holding assets in the portfolio, the average return

including initial returns for 152 days in 2020 and 2021 is 10.75%. This results in a move from NOK 2,441 to NOK 232,521,519 over 23 months.

Increasing the holding period results in relative losses measuring from both the offering and the first closing price. Excluding the initial return results in a loss of around 90% for all holding periods above one day. Holding IPOs for two days, investing at the offering price, leads to a profit of NOK 15.300 million, which is a relative loss of NOK 217.221 million compared to a holding period of one day. This trend continues as the holding period increases, and for a holding period of three days, a relative loss of 96.61% occurs. However, the results are still extraordinary, with a return of 518,944 times the invested amount. The losses decrease in relative magnitude as the holding period increases. From a holding period of twenty days to fifty days, the difference in profit is 35,435%.

Figure 5.2 does well in illustrating the sensitivity towards the holding period. The aftermarket performance steadily decreases for each additional day added to the holding period. Kryzanowski et al. (2005) finds the same pattern for the Canadian stock market in the years between 1984 and 2002. The findings support the hot issue anomaly and firms going public in times of IPO overoptimism (Santos, 2017). Another explanation of the phenomenon is Miller (1977) arguments of IPO shorting constraints and heterogeneous firm valuation expectations. When the variance of beliefs decreases the stock price will converge to the mean, consistent with Field and Hanka (2001) and Brau et al. (2004) findings of IPOs experiencing a decline in price at the end of lock-up periods.

5.2 Cumulative Average Returns

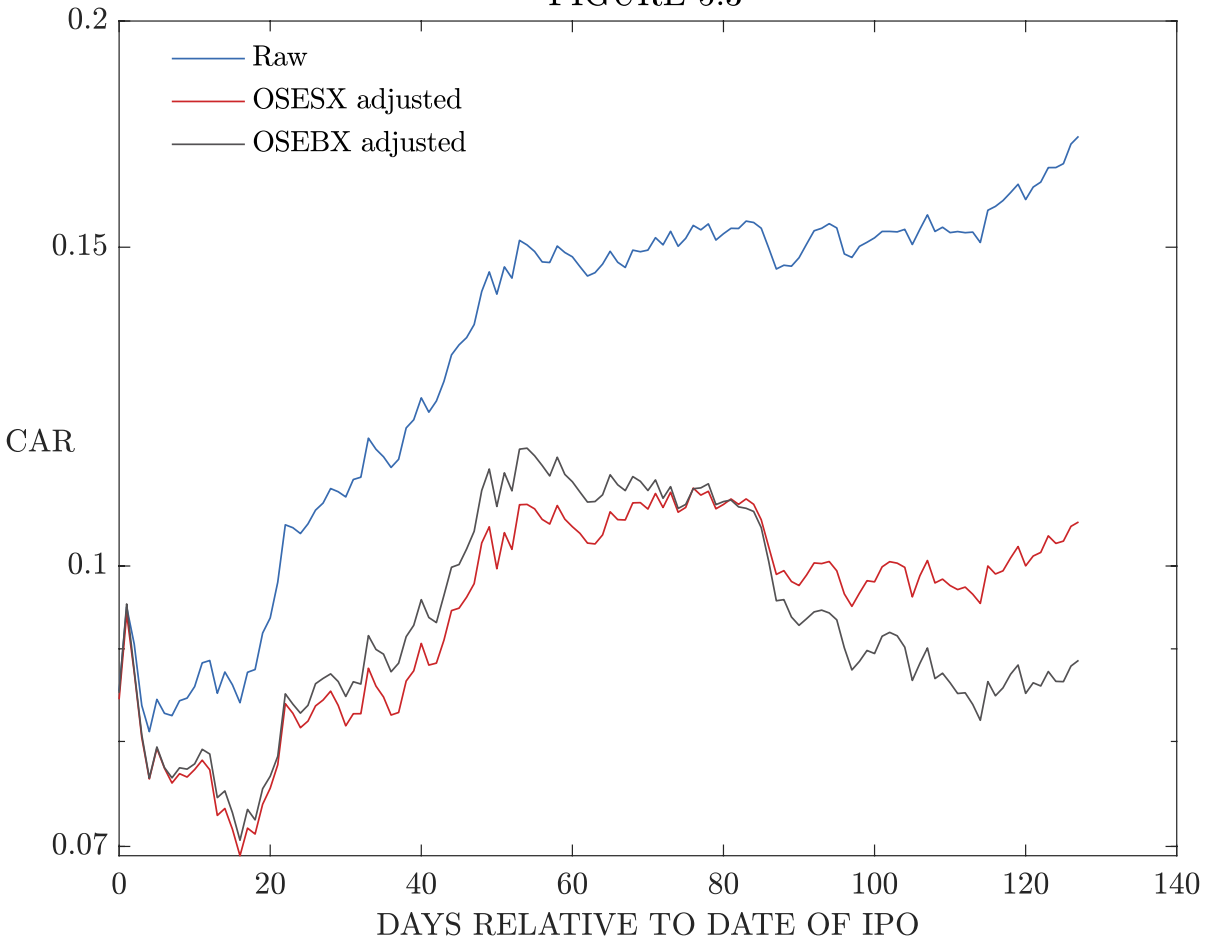
The cumulative average return series from top to bottom in Figure 5.3: (1) raw returns, (2) OSESX adjusted returns, and (3) OSEBX adjusted returns. The starting point for all return series is the average initial return of 8.53%. A positive initial return is consistent with most literature regarding the underpricing phenomenon of IPOs, for instance Ritter and Welch (2002) and Ljungqvist (2007). The average cumulative raw return reaches its highest level after six months with a return of 17.3%, with the average daily return varying from 0.9% to negative -0.6%.

Figure 5.3 also shows the cumulative raw returns adjusted for OSEBX and OSESX. The difference in displays is due to the performance of the two indices. Raw returns

Figure 5.3: Cumulative Average Returns, Raw and Adjusted, over Six Months from the Offering Price, for an Equally-Weighted Portfolio of 357 IPOs.

The figure illustrates the performance differences between raw and adjusted cumulative average returns. From the date of the IPO to six months later (127 trading days), three CAR series are plotted including initial returns: (1) raw, (2) OSESX-adjusted, and (3) OSEBX adjusted. Day zero represents the initial return.

FIGURE 5.3



adjusted for OSEBX end at NOK 0.004 more than the initial return, while the raw returns adjusted for OSESX increase by NOK 0.021. From the start of the graph, the same pattern can be observed for all three time- series, which is a steady incline until day 53. OSEBX-adjusted returns reach a maximum of 11.6% after 53 days, while OSESX peaks at 11% on day 76. Consistent with the results of Ritter (1991), we find that the IPOs outperform the two benchmark indices in a six-month perspective. Ritter points to most of the underperformance being materialized after the 24th month, which leads to underperformance over three years. Similarly, Buser and Chan (1987) find that IPOs

outperform in the two-year aftermarket period. Hence, Figure 5.3 illustrates that investors can achieve returns higher than the market when buying at the offering price.

Figure 5.3 reveals only positive results. However, it is worth noticing that the performance is sensitive to the choice of benchmark. While using OSEBX and OSESX indicates the relative performance, it is unclear what establishes a proper benchmark. When analyzing longer time horizons, sensitivity towards the benchmark is common, as Dimsen and Marsh (1986) document.

5.3 Time-Series and Cross-Sectional Patterns for IPO Aftermarket Performance

This section shows several time-series and cross-sectional patterns to investigate potential determinants of the six-month IPO performance.

5.3.1 Performance Categorized by Initial Returns and Issue Size

Table 5.1 presents the distribution of six-month holding period returns, both excluding and including initial returns, of all 357 IPOs. The returns are shown as raw returns and adjusted for the OSEBX. All return distributions have a negative median. The raw returns distribution including initial returns is more positively skewed and has a mean of 14.42%, compared to the raw return distribution excluding initial returns with a mean of 4.89% return.

The highest six-month total return, including initial returns, of 767.96% belongs to Aker Carbon Capture, an August 2020 IPO at NOK 1.7 per share on Euronext Growth, with initial returns of 197.06%. We see several IPOs with high returns, even when adjusted for the benchmark, in 2020.

Table 5.2 categorizes the IPOs by their gross proceeds. This allows for further investigation of the generality of public offerings' performance. Ritter (1991) finds that there is a tendency for the firms with the lowest gross proceeds to have the highest average adjusted initial return (hereafter "adjusted initial returns") and the worst three-year aftermarket performance, excluding initial returns. Our findings suggest a tendency for small offerings to perform the best over six months when investing from the first closing price. We deem

Table 5.1: Six-Month Raw and OSEBX-Adjusted Holding Period Returns for 357 Initial Public Offerings in 1997-2021

This table provides an overview of raw returns and OSEBX-adjusted returns for 357 initial public offerings between 1997-2021. The six-month holding period returns are calculated as $\left[\prod_{t=1}^{127}(1+r_{idt})-1\right]\times 100\%$. r_{idt} is the daily return on stock i, retrieved from the OBI database. If an IPO is delisted before six months have passed, the total return period for the share is truncated accordingly and the total return is computed until the delisting date. Returns are adjusted for dividends. Benchmark returns are matched to the individual IPO's holding period, equal to 127 trading days if there is no delisting. OSEBX-adjusted IPO returns are calculated as $ar_{it} = r_{it} - r_{mt}$.

	Excluding inital returns		Including inital returns	
	Six-month holding period return		Six-month holding period return	
Rank	Raw (%)	OSEBX-adjusted (%)	Raw (%)	OSEBX-adjusted (%)
1 (lowest)	-81.30	-83.79	-82.56	-82.05
19	-51.15	-56.83	-51.21	-52.12
37	-43.22	-42.79	-40.00	-41.24
55	-35.14	-36.98	-30.70	-34.44
73	-27.38	-31.47	-25.00	-28.43
90 (25th percentile)	-23.46	-27.60	-20.97	-24.10
108	-19.12	-24.93	-15.33	-20.29
126	-14.00	-21.43	-10.36	-16.62
144	-10.00	-17.49	-6.26	-13.47
162	-7.27	-13.8	-3.13	-10.02
179 (median)	-3.70	-11.07	-0.04	-7.62
197	-0.88	-8.04	3.28	-4.67
215	4.00	-4.16	7.41	0.06
233	8.38	0.78	12.50	5.21
251	12.04	3.36	17.50	11.16
268 (75th percentile)	15.57	8.84	26.67	15.89
286	23.11	16.21	35.71	27.28
304	38.60	27.19	55.00	37.68
322	57.63	45.29	80.00	62.68
340	102.19	79.85	131.00	122.86
357 (highest)	367.46	347.05	767.06	749.01
Mean	4.89	-2.48	14.42	7.05

this a result of the shorter time frame and that fads and overoptimism in periods last longer than six months.

The two lowest gross proceeds intervals are the two only to outperform the OSEBX over the period (wealth relatives above one), excluding the initial return. Including the initial returns, four of the five intervals of gross proceeds have wealth relatives above one.

Table 5.2: Mean Performance for 357 Initial Public Offerings in 1997-2021 Sorted by Gross Proceeds

Table 5.2 shows the average returns and wealth relatives sorted by gross proceeds. The gross proceeds represent the capital raised, measured in 2021 purchasing power using the Norwegian GDP deflator. Average adjusted initial returns are calculated as $r_{IPO} - r_{OSEBX}$ for the initial return period (IPO price to the first closing price). The six-month holding period return is calculated both excluding and including the initial return. For IPOs delisted before six months of trading days have passed, the OSEBX return is matched to the same interval. Returns are adjusted for dividends. The wealth relative measures the performance of IPOs by the ratio of one plus the six-month average holding period return divided by one plus the average matching six-month OSEBX return. Note that the wealth relatives are not calculated in percent. Hence, for the firms with the lowest gross proceeds, the wealth relative is 1.0477/1.0455 = 1.002.

		Excluding initial returns			Including initial returns		
		Average 6-month holding period return			Average 6-month holding period return		
Gross proceeds, NOK	Average adjusted initial return (%)	IPOs (%)	OSEBX (%)	Wealth relative	IPOs (%)	Wealth relative	Sample size
900 000 - 89 999 999	8.27	4.77	4.55	1.002	13.49	1.086	72
90 000 000 - 199 999 999	8.91	11.39	9.34	1.019	18.79	1.086	68
200 000 000 - 399 999 999	5.78	-1.00	6.86	0.926	3.40	0.968	68
400 000 000 - 899 999 999	9.47	7.01	8.48	0.986	22.85	1.132	79
900 000 000 - 32 980 101 290	9.73	2.03	7.60	0.948	12.33	1.044	70
All (mean)	8.53	4.89	7.37	0.97	14.42	1.06	357
All (median)	1.78	-3.70	10.07	0.89	-0.04	0.93	357

Consistent with our previous results, those able to invest at the IPO price achieve the highest capital gains. Further, the table displays a median initial return of 1.78% and an average of 8.53%, where 133 of the 357 offers have negative adjusted initial returns.

From Table 5.3, the offers are sorted by their initial return, indicating whether IPOs are subject to an overreaction. Dark and Carter (1993) find that with an 18-month perspective, firms with higher initial returns have lower abnormal returns than those with lower initial returns. They explain this as being due to valuation errors. Ritter (1991) finds the same tendency for IPOs when holding them for three years and deems this as mildly consistent with the overreaction hypothesis. De Bondt and Thaler (1987)

find a negative correlation between initial abnormal returns and abnormal aftermarket performance for holdings periods of one year or more for low-capitalization stocks. The same pattern was found by Santos (2017) on a five-year basis. This is also consistent with the view of firms choosing to go public in times when the market is overoptimistic and achieves a favorable valuation, as described by Brau and Fawcett (2006).

However, our results illustrate that there are few clear trends between the initial return and the aftermarket performance measured from the closing price of the first day for a six-month holding period. Only the middle quintile outperforms the market. When measuring from the offering price, we observe that the top four out of five quintiles outperform the market, which may indicate that the overoptimism is still present for the six-month holding period. The size of the gross proceeds seems to play a minor role when focusing on the overoptimism in the market. From Table 5.3, it is unclear whether the performance is due to the market being overoptimistic or if there are fundamentals that lead to wealth relatives above one, measured from the offering price.

Table 5.3: Six-Month Performance Sorted by Initial Return Quintiles, with Results Distinguished Between Small and Large Offerings, for 357 IPOs in 1997-2021

The gross proceeds are measured in NOK of 2021 purchasing power. The median gross proceeds of NOK 305.07 million distinguish between small and large offerings for the 357 IPOs. Wealth relatives measure the performance of IPOs by the ratio of one plus the six-month average holding period return divided by one plus the average matching six-month OSEBX return. Note that the wealth relatives are not calculated in percent.

	All offers					Segmented by gross proceeds					
						Proceeds < NOK 305.036 million			Proceeds > NOK 305.036 million		
OSEBX adjusted initial return quintile (%)	IPO average 6-month total return excluding initial return (%)	IPO average 6-month total return including initial return (%)	OSEBX average 6-month total return (%)	Wealth relative excluding initial return	Wealth relative including initial return	Wealth relative excluding initial return	Wealth relative including initial return	Sample size	Wealth relative excluding initial return	Wealth relative including initial return	Sample size
15.65 < IR < 230.08	6.24	52.40	12.29	0.946	1.357	0.923	1.256	36	0.964	1.404	40
4.92 < IR < 15.65	3.55	12.84	4.77	0.988	1.077	1.085	1.190	38	0.882	0.953	34
-0.02 < IR < 4.92	9.93	11.62	7.52	1.022	1.038	0.981	0.999	35	1.064	1.078	35
-4.12 < IR < -0.02	2.19	5.00	4.27	0.980	1.007	1.011	0.996	35	0.950	1.018	36
-34.4 < IR < -4.12	2.69	-9.09	8.03	0.951	0.841	0.957	0.823	36	0.945	0.858	37

5.3.2 Performance Categorized by Firm Market Value

Table 5.4: IPO Performance Categorized by Firm Market Value

This table display average returns and wealth relatives sorted by firm market values. Market values are adjusted to 2021 purchasing power using GDP deflator values. Average adjusted initial returns are calculated as $r_{IPO} - r_{OSEBX}$ for the initial return period (IPO price to the first closing price). The six-month average holding period return is calculated both excluding and including the initial return. OSEBX returns are matched corresponding to the firms in each market value percentile. The wealth relatives measure the performance of IPOs by the ratio of one plus the six-month average holding period return divided by one plus the average matching six-month OSEBX return. Note that the wealth relatives are not calculated in percent.

			Excluding initial returns			Including initial returns	
			Average six-month holding period return			Average six-month holding period return	
Percentile	Avg. market value, NOK millions	Average adjusted initial return (%)	IPOs (%)	OSEBX (%)	Wealth relative	IPOs (%)	Wealth relative
0 - 24.99	371.26	6.13	4.04	5.81	0.983	11.37	1.053
25 - 49.99	998.16	7.34	1.73	6.52	0.955	7.33	1.008
50 - 74.99	2 209.70	9.36	6.64	8.13	0.986	17.31	1.085
75 - 100	16 363.41	11.02	7.12	8.94	0.983	21.60	1.116

Table 5.4 depicts firms with higher market values outperforming firms with lower market values. Firms in the top percentile have on average 1.80x higher initial returns than firms in the lowest percentile. In terms of holding period returns, both excluding and including initial returns, firms in the top percentile have on average 1.76x and 1.90x higher raw returns, respectively. These findings support the work of Ritter (1991), Loughran and Ritter (1995), Goergen et al. (2007), and Gregory et al. (2010), suggesting that small firms underperform large firms in the aftermarket. Also, Gao et al. (2013) suggest that small firm IPOs are less profitable than large firm IPOs, which fits well with our findings.

All IPO market value percentiles underperform OSEBX when initial returns are excluded from the holding period, showing that retail investors are better off investing in the market index. However, the six-month holding period returns are considerably higher when investors can buy at the IPO offering price and all percentiles outperform OSEBX. This indicates that cornerstone investors can utilize active trading strategies that generate higher returns than the market. When separating IPOs in different market value percentiles, the

six-month holding period returns with initial returns excluded support the null hypothesis that IPOs underperform the market. The alternative hypothesis is justified when including initial returns.

5.3.3 Performance Categorized by Sector

Tables 5.5 and 5.6 show the segmentation of firms on a sector level according to the S&P Global Industry Classification Standard (GICS). All 357 firms are assigned to one of the 11 GICS sectors.[9] Table 5.5 demonstrates that the number of firms going public from 1997 to 2021 is not evenly distributed across sectors. The energy, industrials, and information technology sectors have many offerings, accounting for 55% of total offerings. On the other hand, communication services, utilities, and real estate are sectors with few offerings. Historically, the Norwegian economy has been heavily dependent on the oil and gas industry, making it natural that many companies are within the energy sector. In total, 28% of IPOs on OSE and 37% of IPOs on Euronext Expand are characterized as firms operating in the energy sector. Moreover, the consumer staples sector is overweighted seafood companies, which is typical for the Norwegian market. Norway is a prominent exporter of salmon and IPOs within the salmon farming industry are therefore common. For Euronext Growth, industrials and information technology firms comprise 41% of total offerings.

Table 5.5 also reports each sector's mean and median firm market value, age, and gross proceeds. Market values and gross proceeds are expressed in terms of real values reflecting the purchasing power in 2021. There are noticeable differences in terms of age and gross proceeds between sectors.[10] The median age for all firms is seven years when going public. The energy sector has a particularly low median age of just four years and raises median gross proceeds of 429.24 million. This indicates that the energy sector historically has been able to raise new capital as young companies. 42% of all firms in the energy sector

[9]The sector identifiers are retrieved from the OSE listing changes dataset. Where there are undefined sector identifiers, we assign GICS codes according to Refinitiv Eikon. See the complete GICS overview here: https://www.spglobal.com/marketintelligence/en/documents/112727-gics-mapbook_2018_v3_letter_digitalspreads.pdf

[10]We observe that sectors with few offerings are exposed to outliers influencing the values. For instance, mean gross proceeds for the communications services sector (with 10 offerings) are higher than for the industrials sector (with 61 offerings). One of the reasons why this sector has large gross proceeds is because Telenor raised NOK 32.98 billion (expressed in terms of 2021 purchasing power) in gross proceeds in 2000.

went public between 2005-2007. This was a period categorized by increased offshore investments and an oil price that more than doubled from 2003 to 2007 (SSB, 2008), which partially explains the high number of offerings of young companies in the energy sector. On the other side, the financial sector has a high median age of 16 years. Several of the IPOs in the financial sector involve old savings banks going public, which naturally makes the median firm age higher.

Table 5.6 reports the IPO performance measures by sector and gives an overview of sector performance from 1997 to 2021. We compute wealth relatives using OSEBX returns as a benchmark to determine whether sectors outperform the market. There are large differences in terms of sector performance. The materials sector has the highest adjusted initial returns, but industrials have better aftermarket performance. Some of the high returns for this sector may be explained by a relatively large number of IPOs conducted in 2020 being characterized as industrials, and the second half of 2020 and most of 2021 were great years for IPO aftermarket performance. Health care stands out as a particularly poor-performing sector with negative holding period returns. This supports the findings in Table 5.4, documenting that small firms underperform large firms. Nevertheless, other fundamental sector-specific factors, which we do not cover in this thesis, will most likely influence returns, making it challenging to draw absolute conclusions.

While close to every sector has a positive initial return, only four sectors outperform the market over six months when initial returns are excluded (equal to 36% of total sectors). Six sectors outperform the market when adding the initial returns (equal to 55% of total sectors). The sector underperformance relative to OSEBX may simply reflect the general six-month IPO underperformance that appears to be a tendency for aftermarket performance excluding initial returns. If so, sectors may not be a determinant of performance. This would support the findings of Arcuri et al. (2018), who analyze 437 IPOs from 1997 to 2011 in Germany, France, and Italy, concluding that industries do not determine initial underpricing or long-run performance. However, Akhigbe et al. (2006) argue that favorable industry forecasts increase firms' willingness to go public and that industry effects are more prominent in small firm IPOs. Table 5.6 shows some dependency between adjusted initial returns for each sector and aftermarket performance in six months.

Table 5.5: Mean and Median Market Value, Age, and Gross Proceeds of 357 Initial Public Offerings Sorted by Sectors

Table 5.5 present sectors, GICS codes, number of offerings, market values, age of issuing firms and gross proceeds for all IPOs. Market values are computed as the closing price on the first public trading day multiplied by shares outstanding, including new shares from the offering. Sector definitions are based on the first two digits of the SP Global Industry Classification Standard (GICS). Age is calculated as the difference between the year of going public and the year of founding. In the case of a spinoff, the founding year is set to be the year of the spinoff. Gross proceeds from overallotment options, if exercised, are included. Using GDP deflator values, firm market values and proceeds are adjusted to 2021 purchasing power.

			Market value, NOK millions		Age of issuing firm		Gross proceeds, NOK millions	
Sector	GICS sector code	Number of offerings	Mean	Median	Mean	Median	Mean	Median
Energy	10	79	7 979.49	1 933.50	10.00	4	1 347.56	429.24
Materials	15	21	4 066.30	2 211.96	27.95	6	905.37	320.00
Industrials	20	61	2 264.95	1 318.14	17.72	9	565.75	319.68
Consumer Discretionary	25	16	4 531.68	2 921.30	24.69	16	1 009.31	504.44
Consumer Staples	30	37	2 662.44	1 836.57	10.51	8	439.50	273.94
Health care	35	28	1 700.16	841.09	11.36	8	350.31	166.00
Financials	40	31	4 662.57	903.50	61.03	16	1 244.50	234.50
Information Technology	45	58	5 189.15	950.71	12.28	10	403.16	195.60
Communication Services	50	10	24 076.87	4 683.37	26.20	10	4 639.03	541.33
Utilities	55	10	3 260.45	743.22	5.70	5	536.02	499.09
Real Estate	60	6	1 285.02	2 361.86	6.00	4.5	464.21	453.36
All firms	-	357	5 017.50	1 432.00	18.26	7	892.71	305.04

Table 5.6: Average Performance Categorized by Sector

This table shows the average sector performance across all sample years. Sectors are based on the first two digits of the Global Industry Classification Standard. OSEBX returns are matched corresponding to the firms in each sector. Average adjusted initial returns are calculated as $r_{IPO} - r_{OSEBX}$ for the initial return period (IPO price to the first closing price). The wealth relatives measure the performance of IPOs by the ratio of one plus the six-month average holding period return divided by one plus the average matching six-month OSEBX return. Note that the wealth relatives are not calculated in percent.

		Excluding initial returns			Including initial returns	
		Average six-month holding period return			Average six-month holding period return	
Sector	Average adjusted initial return (%)	IPOs (%)	OSEBX (%)	Wealth relative	IPOs (%)	Wealth relative
Energy	4.76	3.18	3.13	1.000	9.43	1.061
Materials	19.59	12.45	9.13	1.030	33.16	1.220
Industrials	12.35	15.30	7.40	1.074	34.96	1.257
Consumer Discretionary	3.81	11.65	8.06	1.033	16.45	1.078
Consumer Staples	8.09	3.58	8.17	0.958	9.99	1.017
Health care	3.95	-7.50	6.77	0.866	-2.48	0.913
Financials	6.07	0.78	7.98	0.933	6.01	0.982
Information Technology	10.26	4.43	9.70	0.952	12.25	1.023
Communication Services	7.36	-5.70	11.66	0.845	0.44	0.900
Utilities	15.53	-3.94	14.58	0.838	10.23	0.962
Real Estate	-0.01	0.91	7.79	0.936	1.37	0.940

Consequently, we suggest that initial returns for the sectors somewhat affect IPO aftermarket returns in six months, which we interpret as periods of overoptimism in specific sectors. For instance, IPOs in 2020 and 2021 on Euronext Growth were mainly in the materials, industrials, consumer staples, and information technology sectors. It is worth noticing that all sectors perform better when including initial returns in the holding period return calculations. In other words, regardless of industry, investors have higher returns when buying at the IPO offering price than buying at the first-day closing price.

5.3.4 Performance Categorized by Issuance Year

Table 5.7 arranges firms by their issuing year. The results from Table 5.7 show that the performance of IPOs when including the initial return generally outperforms the return when the initial returns are excluded, as the wealth relative is higher in 20 of the 25 sample years. The wealth relative is above one for seven and ten of the sample years for excluding and including initial returns, respectively. This outcome is consistent with Ritter's (1991) conclusions on the three-year long-run performance and points towards an underperformance of IPOs at a six-month timeline as well. The average initial return is 8.53%, compatible with most literature regarding the phenomenon of initial returns of IPOs (Ljungqvist, 2007; Ritter and Welch, 2002). There is a positive correlation between the volume and the six-month performance, enforced when the initial return is included. Ritter finds that the three-year performance is negatively related to the IPO volume. Hence, our findings contradict this result over a six-month term.

Table 5.7 presents findings indicating that firms take advantage of windows of opportunities in hot markets where investors are willing to pay high multiples, consistent with literature (Günther et al., 2006; Ibbotson et al., 1975). Only 28% of the sample years outperform the OSEBX, measured from the first closing price. We find a positive relationship between the number of offerings and the initial return and also between the number of offerings and the six-month performance. The correlation between the number of issues and the initial return is well documented (see for example Lowry and Schwert (2002)), while the positive relation between the six-month aftermarket performance and the IPO volume is rare in studies considering longer time frames. Hence, the duration of overoptimism seems to be longer than six months for some periods. We lean towards the conclusion of fads and overoptimism explaining the aftermarket performance, consistent with Pagano et al. (1998) results for the Italian market. Pagano finds that firms take advantage of overvaluations in their sector, following periods of high investments and not merely bad luck.

IPO performance appears to have some cyclicality related to major macroeconomic events. OSEBX outperformed the six-month IPO returns following the dot-com bubble for five subsequent years. The same pattern is observed with the financial crisis, with the years from 2010 to 2016 having wealth relatives below one when excluding the initial return. This

Table 5.7: Performance Sorted by Issuing Year for Initial Public Offerings in 1997-2021

The table presents GDP deflator values, average gross proceeds, number of issues, average adjusted initial return, average six-month holding period returns (excluding and including initial returns) and wealth relatives for all IPOs sorted by issuing year. The product of the Norwegian GDP deflator and the nominal average gross proceeds gives the average real gross proceeds, measured in 2021 purchasing power. Gross proceeds, both nominal and real, are expressed in NOK millions. Average adjusted initial returns are calculated as $r_{IPO} - r_{OSEBX}$ for the initial return period (IPO price to the first closing price). The wealth relatives measure the performance of IPOs by the ratio of one plus the six-month average holding period return divided by one plus the average matching six-month OSEBX return. Note that the wealth relatives are not calculated in percent.

		Average gross proceeds, NOK millions				Excluding initial returns			Including initial returns	
						Average 6-months holding period return			Average 6-months holding period return	
Year	GDP deflator	Nominal	Real	Number of issues	Average adjusted initial return (%)	IPOs (%)	OSEBX (%)	Wealth relative	IPOs (%)	Wealth relative
1997	2.67	327.24	873.72	12	16.78	-2.36	12.00	0.87	14.89	1.03
1998	2.67	161.67	431.67	10	9.84	-33.06	-19.32	0.83	-29.64	0.87
1999	2.41	181.49	437.39	3	-11.39	73.19	18.63	1.46	39.83	1.18
2000	2.11	2 452.62	5 175.03	8	2.43	-31.49	5.65	0.65	-30.45	0.66
2001	2.24	2 365.98	5 299.79	6	10.29	-37.93	-14.83	0.73	-32.04	0.80
2002	2.19	177.14	387.94	2	-2.32	-50.38	-21.61	0.63	-52.83	0.60
2003	2.12	62.66	132.83	2	-1.54	-25.18	21.13	0.62	-29.47	0.58
2004	1.95	575.62	1 122.47	4	10.29	0.92	15.21	0.88	12.76	0.98
2005	1.79	320.48	573.66	32	6.50	43.85	21.91	1.18	52.84	1.25
2006	1.72	249.64	429.37	18	4.27	26.28	12.91	1.12	31.04	1.16
2007	1.60	300.70	481.12	34	2.73	-4.91	-2.19	0.97	-1.82	1.00
2008	1.52	47.38	72.02	11	-1.80	-40.47	-35.60	0.92	-40.56	0.92
2009	1.57	391.68	614.93	2	-3.83	25.25	13.75	1.10	20.75	1.06
2010	1.46	1 419.20	2 072.04	16	1.66	3.03	11.97	0.92	5.53	0.94
2011	1.38	942.70	1 300.92	9	8.10	-20.22	-11.74	0.90	-13.61	0.98
2012	1.36	739.24	1 005.37	3	2.83	-2.56	11.87	0.87	-1.01	0.88
2013	1.31	536.56	702.89	12	15.84	3.54	11.83	0.93	25.96	1.13
2014	1.34	477.81	640.26	15	-2.49	-6.01	2.73	0.91	-7.01	0.91
2015	1.39	904.45	1 257.19	7	3.84	-12.96	-5.50	0.92	-10.36	0.95
2016	1.35	315.49	425.92	6	5.90	27.80	7.47	1.19	38.04	1.28
2017	1.30	694.66	903.06	16	1.98	0.77	9.12	0.92	2.28	0.94
2018	1.22	915.26	1 116.62	11	8.78	5.57	3.25	1.02	16.22	1.13
2019	1.25	798.13	997.66	11	-0.03	-8.31	-1.72	0.93	-7.92	0.94
2020	1.28	507.12	649.11	49	20.09	38.34	21.50	1.14	68.58	1.39
2021	1	558.76	558.76	58	14.80	-9.50	10.11	0.82	1.72	0.92
All	-	592.63	892.71	14.28	8.53	4.89	7.37	0.97	14.42	1.06

is consistent with Loughran and Ritter (2004) findings of fluctuations in underpricing and aftermarket performance over time. They find that younger firms went public before the

dot-com bubble, while older firms went public post-bubble. As an alternative explanation, Santos (2017) finds that firms without positive net present value projects delay their IPO until market conditions improve. Based on these findings, the IPO performance could be reasoned as a compensation for the increased risk of the firms going public.

5.3.5 Performance Categorized by Age

Table 5.8: Performance Sorted by Age for Initial Public Offerings in 1997-2021

The table includes all 357 initial public offerings from 1997 to 2021 categorized by age. Age is calculated as the difference between the year of going public and the year of founding. Average adjusted initial returns are calculated as $r_{IPO} - r_{OSEBX}$ for the initial return period (IPO price to the first closing price). The six-month holding period return is calculated both excluding and including the initial return. OSEBX returns are matched corresponding to the firms in each age interval. The wealth relatives measure the performance of IPOs by the ratio of one plus the six-month average holding period return divided by one plus the average matching six-month OSEBX return. Note that the wealth relatives are not calculated in percent.

			Excluding initial returns			Including initial returns	
			Average six-month holding period return			Average six-month holding period return	
Age (years)	Sample size	Average adjusted initial return (%)	IPOs (%)	OSEBX (%)	Wealth relative	IPOs (%)	Wealth relative
0-1	64	9.01	10.87	5.06	1.055	28.53	1.223
2-4	64	9.85	0.61	7.41	0.937	8.64	1.011
5-9	73	10.35	10.37	8.50	1.017	18.59	1.093
10-19	83	8.89	-1.26	9.84	0.899	8.48	0.988
20-up	73	4.43	4.90	5.43	0.995	9.71	1.041

Table 5.8 shows the IPO performance categorized by firms' age when going public. According to Table 5.8, newly established firms tend to have higher holding period returns than older firms and outperform the market. Firms in the age group 0-1 have the best benchmark-adjusted holding period returns, as can be seen by having the highest wealth relatives. This contradicts the findings of Ritter (1991) on the long-run underperformance. Ritter documents that the youngest firms have the lowest aftermarket performance three years later, with a wealth relative of only 0.623 (compared to matching firms). Our findings suggest that the youngest firms outperform the benchmark in six months. It

seems to be a tendency for firms aged nine and older to have lower underpricing. This may be a manifestation of investors requiring higher returns for risky assets and that age is a proxy for risk. Ritter (1991) and Muscarella and Vetsuypens (1989) document a similar negative correlation between age and initial returns.

Adding the age perspective to findings in Table 5.5 and Table 5.6 gives a deeper understanding of sources of IPO performance. We find that the most established firms raise on average more capital when going public and have higher average market capitalizations. More surprisingly, the least established firms raise on average more capital than firms with up to 19 years of experience and have market values equal to companies with up to 10 years of experience. It seems like investors have high confidence in the least established firms and are particularly optimistic about firm valuations when going public.[11] We interpret the high performance of firms aged 0-1 years as investor overoptimism, consistent with Teoh et al. (1998). They argue that, for new firms with limited historical information available, investors are at risk of being overly optimistic at the time of IPO due to positive accruals in earnings management.

5.3.6 Correlation and Regression Results

Table 5.9 provides the Pearson's correlation coefficients for firm characteristics and external factors. Looking at firm performance characteristics, there is a correlation of 0.34 and 0.42 between the OSEBX return and the six-month return, including and excluding the initial return. There is a natural correlation between the adjusted initial return and the six-month return from the IPO price. However, when excluding the initial return, the correlation is 0.04.

Focusing on the external factors, there is a negative relation between the nominal deposit rate and the six-month return of IPOs. Hence, a higher deposit rate leads to a lower six-month return of IPOs ceteris paribus. As expected, the number of issues and the nominal deposit rate negatively relate. When the nominal deposit rates increase, the market is less willing to invest in equities. This macro phenomenon helps explain the theory of firms exploiting windows of opportunity when deposit rates are low. The negative

[11] As described in section 4, spinoffs' founding date is set to be the spinoff date. This is slightly misleading in this context because the new firm will most likely have resources and knowledge to utilize from the parent company's experience, thus reducing operational risk.

Table 5.9: Pearson's Correlation Matrix for Firm Characteristics and External Factors

This table reports the Pearson's correlations for regression and causality analysis variables. Variables included are (1) six-month return from the offering price, (2) six-month return from the first closing price, (3) matched six-month OSEBX performance, (4) IPO volume, (5) the age of the issuing firm, (6) the average nominal deposit rate, (7) firm market value, and (8) gross proceeds.

	Six month return including initial return	Six month return excluding initial return	OSEBX matched six month return	Adjusted initial return	IPO volume	Age	Nominal deposit rate	Market value	Gross proceeds
Six month return including initial return	1.00								
Six month return excluding initial return	0.80	1.00							
OSEBX matched six month return	0.34	0.42	1.00						
Adjusted initial return	0.40	0.04	0.07	1.00					
IPO volume	0.17	0.13	0.36	0.17	1.00				
Age	-0.08	-0.04	0.00	-0.05	-0.03	1.00			
Nominal deposit rate	-0.24	-0.23	-0.53	-0.13	-0.59	-0.10	1.00		
Market value	-0.03	-0.03	-0.05	-0.01	-0.03	0.15	0.08	1.00	
Gross proceeds	-0.03	-0.01	-0.01	-0.03	-0.08	0.20	0.05	0.71	1.00

correlation between interest rates and IPO volume is consistent with a strand of literature regarding the relationship between interest rates and the effect on the stock market (see among others Elyasiani and Mansur (1998), Brewer III et al. (2007), and Ioannidis and Kontonikas (2008)).

We document cross-sectional patterns in previous results and find that these correlate with each other. The number of issues, the aftermarket performance, and the deposit rate in the current year are effects proven not to be independent of each other. Table 5.10 shows the results of a multiple regression where the six-month raw holding period return is the dependent variable. The independent variables are the OSEBX-adjusted initial return, the natural logarithm of one plus the age, the corresponding six-month return of OSEBX, the volume divided by a hundred in the issuing year, the deposit rate, and

Table 5.10: Results from the Ordinary Least Square Regression using Six-Month Holding Period Return as the Dependent Variable for 357 IPOs in 1997-2021

$Return_i = b_0 + b_1 IR_i + b_2 Log(1+age_i) + b_3 Market_i + b_4 Vol_i + b_5 Depositrate_i + b_6 2020_i + b_7 2021_i$. $Return_i$ is the six-month raw holding period return from the first day of trading until 127 trading days later or its delisting date. IR_i is the market-adjusted initial return measured from the offering price to the first closing price. $Log(1 + age_i)$ is calculated by taking the natural logarithm of one plus the number of years between the founding and the firm going public. Firms founded before 1938 are assumed to be founded in 1938. $Market_i$ is the OSEBX return over the same interval as the dependent variable. Vol_i is the corresponding number of issues in the respective year of the dependent variable going public divided by 100. *Deposit Rate*$_i$ is the yearly average Norwegian deposit rate corresponding to the firms' listing year. The dummy variables *2020*$_i$ and *2021*$_i$ represent the years of 2020 and 2021, taking on the value 1 in the case of a firm going public in one of those years and 0 otherwise. P-values are stated below the coefficients.

Panel A: Parameter Estimates

	Intercept	IR	Log(1+age)	Market	Vol	Deposit rate	2020	2021	$R^2_{adjusted}$
β	0.0005	0.0136	-0.0128	1.0227	0.5923	-4.0783	-0.0747	-0.5005	0.208
p-values	0.9962	0.8730	0.5370	0.0000	0.0414	0.0906	0.5263	0.0004	

Panel B: Variables statistics

Variable	Median	Average	Standard Deviation	Pearson Mode Skewness
Return	-0.037	0.049	0.505	0.510
IR	0.018	0.085	0.287	0.706
Log(1+age)	2.079	2.118	1.173	0.098
Market	0.101	0.074	0.158	-0.514
Vol	0.180	0.282	0.190	1.611
Deposit rate	0.014	0.019	0.014	1.029
2020	0.139	0.383	0.770	0.954
2021	-0.123	-0.095	0.356	0.233

dummy variables for 2020 and 2021.[12]

Previous findings show that using data for 25 years makes it challenging to find clear trends without deviations. Table 5.10 gives the significance of each coefficient and is mostly consistent with the conclusion from earlier tables. The significant variables are: *market* (at all conventional statistical significance levels), *volume* (at a five percent significance level), the *deposit rate* (at ten percent significance level), and the *2021* dummy (at all

[12]2020 and 2021 dummy variables are included to disentangle the effect of two extraordinary and record-breaking years for the Norwegian stock market. 91.8% and 91.4% of the total volume of listings these years was on Euronext Growth. Accounting for the significant number of issues and given the macro influence of the pandemic, dummy variables are included to boost the adjusted R-squared. Other regressions tested numerous variables to improve the adjusted determination coefficient without effect. The natural logarithm of real gross proceeds, the ratio of gross proceeds divided by market cap, the VIX index, and a dummy variable for Euronext Growth were some of the insignificant variables, hence not included in Table 5.10.

conventional levels). However, the variables *age*, *initial return*, and the *2020* dummy are statistically insignificant. We observe that all statistically significant variables are also economically significant. For example, an increase in the deposit rate of one percent would lead to -4.08% lower holding period return ceteris paribus, which supports the results of Papadamou et al. (2017) and Bredin et al. (2009) who document the negative relation between stock returns and interest rates. The volume coefficient indicates that the difference between a high-volume year as 2021 (with 58 offerings) and a low volume year as 2002 (with 2 offerings) gives a difference of 33.2% in the six-month holding period return ceteris paribus. As opposed to Ritter's findings, higher volume leads to higher returns, which could be reasoned with the shorter time frame. Our market beta is slightly above one, in line with the findings of Clarkson and Thompson (1990).

6 Conclusion

This thesis examines the six-month performance of 357 Norwegian initial public offerings between 1997 and 2021. Consistent with academic literature for several other countries (Loughran et al., 2022), we conclude that short-run IPO underpricing is evident in the Norwegian stock market between 1997 and 2021, with an average initial return of 8.53%. We document that the aftermarket underperformance is not only a long-run phenomenon but also occurs in the shorter time frame of six months. According to our research question, we do not reject the null hypothesis, and conclude that Norwegian IPOs underperform the market in a six-month period. A strategy investing in all 357 IPOs and holding for six months underperform the benchmark indices OSEBX and OSESX when measured from both the offering price and the first closing price. Hence, neither retail nor cornerstone investors are able to generate excess returns by utilizing such an IPO investment strategy.

However, there are significant variations in the underperformance. We argue that cornerstone investors who are able to invest from IPO offering prices can outperform the market in some instances. Consistent with Brau and Fawcett (2006) and Günther and Rummer (2006), our results indicate that firms take advantage of windows of opportunity and utilize the investor sentiment in hot markets. Similarly, cornerstone investors can achieve returns above the market if they successfully exploit these fads to benefit from both high initial IPO returns and aftermarket performance. Returns are sensitive to the choice of holding period, and our results indicate that a theoretical holding period of one day yields the highest returns.

On the other side, retail investors are on average better off investing in market indices because buying IPOs at the first trading day closing price and holding for six months does not outperform the market, even when timing the market.[13] Our findings indicate that IPOs with the lowest aftermarket performance over a six-month holding period, excluding initial returns, have one or more of the following characteristics: (1) going public in low-volume periods, (2) having low market capitalization, and (3) raising high gross proceeds. Further, we argue that the underperformance is not merely due to bad luck, but

[13]By timing the market, we mean that investors are able to predict economic downturns. To test this theory, we vary the starting point of the investment strategy, for instance, starting to buy IPOs after the dot-com bubble or after the financial crisis. We show that portfolios investing from 2003 to 2021 and 2010 to 2021 still underperform the market when buying at the first day closing price.

the tendency for firms to go public in times of fads and overoptimism. The conclusions in this thesis differ from existing literature (Ritter, 1991) in the sense that firms going public in high-volume periods outperform firms going public in low-volume periods in the aftermarket. We consider these differences to be a result of the shorter time frame and point to the explanation of overoptimistic market sentiment lasting longer than six months in specific periods. Thus, there is a positive relation between six-month returns and IPO volume. We believe our findings have implications for investors, firms, and academics by providing explanations that supplement the existing literature on long-run underperformance.

Finally, this thesis provides some evidence that the Norwegian IPO market is cyclical. Transition periods from high to low interest rates tend to be followed by periods of IPOs overperforming over a six-month period, and we argue that the decision to go public is influenced by external economic factors. We find a statistically significant relationship between the interest rate and IPO performance, suggesting that higher interest rates result in lower IPO returns. Still, we cannot with certainty disregard other explanations. Hence, the thesis does not find sufficient evidence that investors can predict IPO performance.

6.1 Limitations

It should be noted that alternative interpretations cannot be ruled out. Results are sensitive to the methods used, both in terms of sample selection criteria and the measurements, and the time frame chosen. We emphasize that data providers may have inconsistent data. Evaluating IPO performance to sets of matching firms would enhance the analyses, but the difficulties in finding comparable companies for old, delisted companies explain why we do not construct such benchmarks. We acknowledge that our findings on the optimal holding period are from a theoretical perspective, thus not feasible in practice due to regulations. However, they provide an understanding of how the holding period affects returns.

We cannot with certainty reject the possibility that firms perform better or worse merely because of fundamental reasons. A potential concern with our analysis is that wealth relatives and cumulative benchmark-adjusted returns fail to accurately control for risk. Hence, there could be firm-specific differences in risk between offerings in high-underpricing

periods and low-underpricing periods. Santos (2017) finds no evidence that IPOs in high-underpricing periods are less risky than in periods of low underpricing. Additionally, using gross proceeds to explain aftermarket performance does not show clear patterns, because it is challenging to know the motivation behind large stock issues. Large gross proceeds could be a sign of firms successfully timing windows of opportunity or simply because bigger firms raise more equity.

6.2 Further Research

We encourage more research on active trading strategies exploiting short holding periods. Several aspects not included in this thesis could further explain the six-month underpricing. We find that higher six-month returns characterize periods of high IPO volume, but whether this is due to fads or fundamentals is difficult to assess from our data. Hence, analyzing the fundamentals could solve this issue. Santos (2017) finds that companies going public in high volume periods are characterized by low net present value projects. Assessing the fundamentals could reveal if there are differences in risk that leads to a higher initial return in high volume periods.

Additionally, an interesting angle would be to look closer into the differences between the three Norwegian exchanges or analyze Euronext Growth in isolation. Companies listed on Euronext Growth mainly use private placements, accounting for 91.58% of the listings in 2020 and 2021. These firms have an extraordinary short-term return, and it is interesting to see how they perform in the long run with data for more than six months and whether the IPO performance trend will continue. Lastly, separating between private placements and public offerings available to all retail investors could reveal different patterns than what we find and will enhance the knowledge about investing in IPOs.

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Appendices

A1 Granger Causality Test Between Six-Month IPO Performance and OSEBX

To further establish the causality of the six-month performance of IPOs and the OSEBX we perform a Granger causality test. We perform two F-tests to test whether the earlier performance of IPOs effects the OSEBX and vice versa. We use the regression:

$$IPO = \alpha + \beta IPO_{t-1} + \beta OSEBX_{t-1} + \beta IPO_{t-2} + \beta OSEBX_{t-2}$$

For the F-test:

$$H_0 : \beta OSEBX_{t-1} = 0 \text{ and } \beta OSEBX_{t-2} = 0$$

against

$$H_A : \beta OSEBX_{t-1} \neq 0 \text{ and } \beta OSEBX_{t-2} \neq 0$$

We get a p-value of 0.0000, hence reject the null hypothesis on all conventional significance level. Then we run the opposite regression:

$$OSEBX = \alpha + \beta IPO_{t-1} + \beta OSEBX_{t-1} + \beta IPO_{t-2} + \beta OSEBX_{t-2}$$

For the F-test:

$$H_0 : \beta IPO_{t-1} = 0 \text{ and } \beta IPO_{t-2} = 0$$

against

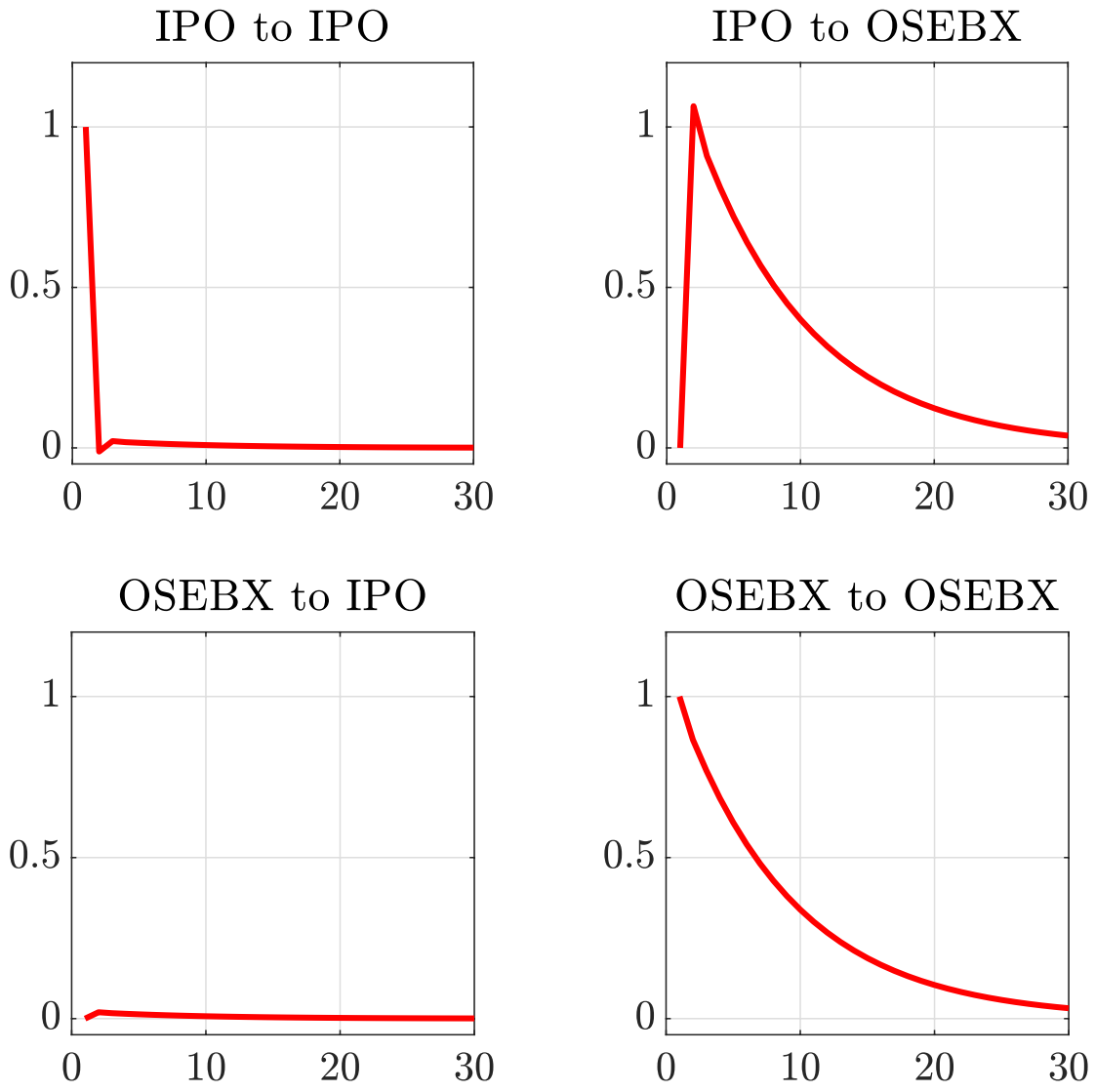
$$H_0 : \beta IPO_{t-1} \neq 0 \text{ and } \beta IPO_{t-2} \neq 0$$

We get a p-value of 0.4049, hence the past performance of OSEBX influences the performance of IPOs, but not vice versa.

A2 Impulse Response Function IPOs and OSEBX

Figure A2.1: Impulse Response Functions over a Thirty-Day Period

(1) Six-month IPO return response to six-month IPO return (2) Six-month IPO return response to OSEBX (3) OSEBX response to six-month IPO return (4) OSEBX response to OSEBX.

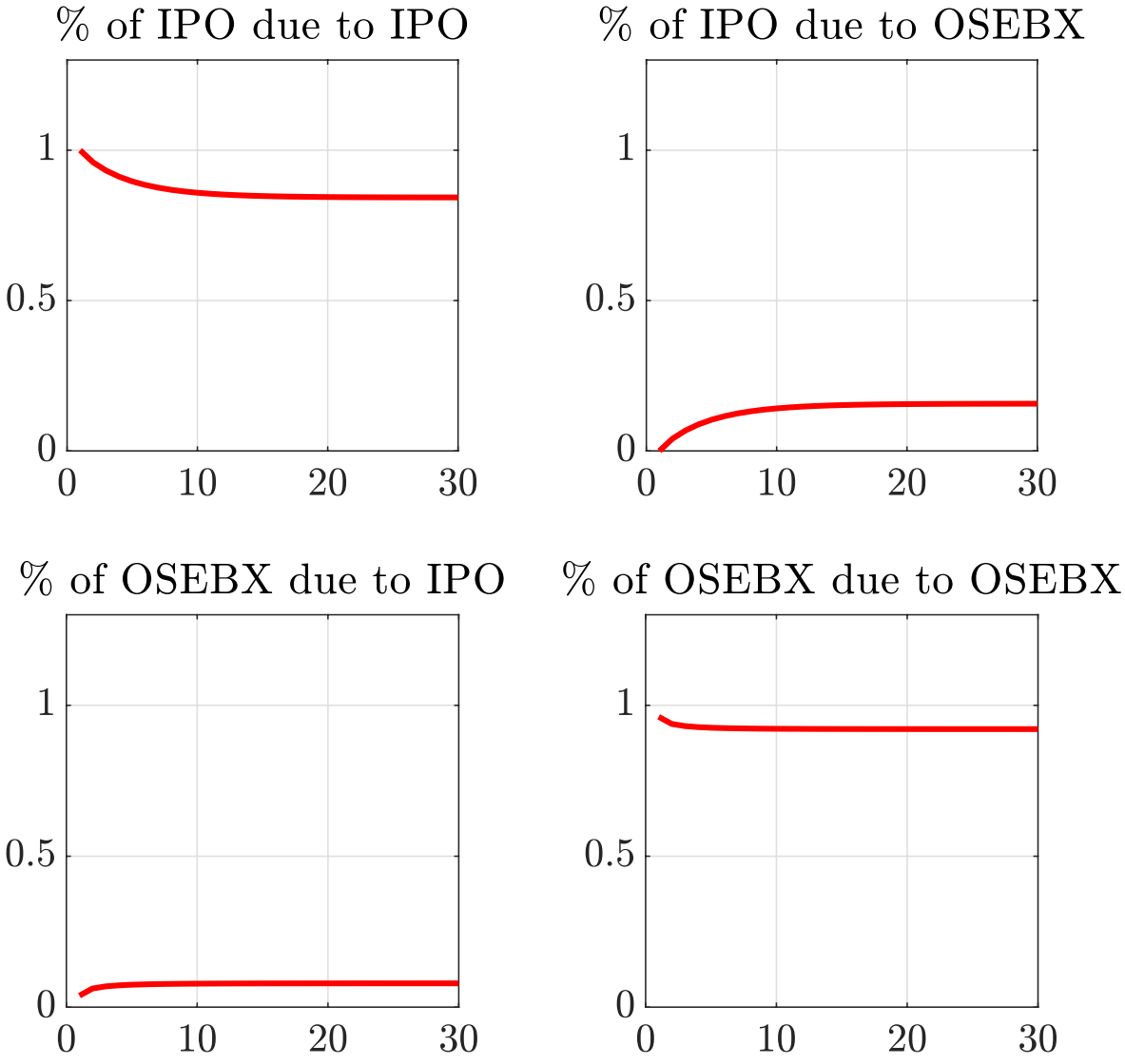


From Figure 4 we observe that a shock in the IPO performance has close to zero effect on OSEBX, while a shock in OSEBX has larger effect on the IPO performance than the shock itself.

A3 Variance Decomposition IPOs and OSEBX

Figure A3.1: Variance Decomposition over a Thirty-Day Period

(1) Six-month IPO return variance due to six-month IPO return (2) Six-month IPO return variance due to OSEBX (3) OSEBX variance due to six-month IPO return (4) OSEBX variance due to OSEBX.



From Figure 5 we observe that some of the variance in IPO six-month returns are due to OSEBX, approximately 10%. IPO variance explains approximately 6.6% of the variance in OSEBX.

A4 Granger Causality Test Between Six-Month IPO Performance and OSESX

To further establish the causality of the six-month performance of IPOs and the OSESX we perform a Granger causality test. We perform two F-tests to test whether the earlier performance of IPOs effects the OSESX and vice versa. We use the regression:

$$IPO = \alpha + \beta IPO_{t-1} + \beta OSESX_{t-1} + \beta IPO_{t-2} + \beta OSESX_{t-2}$$

For the F-test:

$$H_0 : \beta OSESX_{t-1} = 0 \text{ and } \beta OSESX_{t-2} = 0$$

against

$$H_A : \beta OSESX_{t-1} \neq 0 \text{ and } \beta OSESX_{t-2} \neq 0$$

We get a p-value of 0.0000, hence reject the null hypothesis on all conventional significance level. Then we run the opposite regression:

$$OSESX = \alpha + \beta IPO_{t-1} + \beta OSESX_{t-1} + \beta IPO_{t-2} + \beta OSESX_{t-2}$$

For the F-test:

$$H_0 : \beta IPO_{t-1} = 0 \text{ and } \beta IPO_{t-2} = 0$$

against

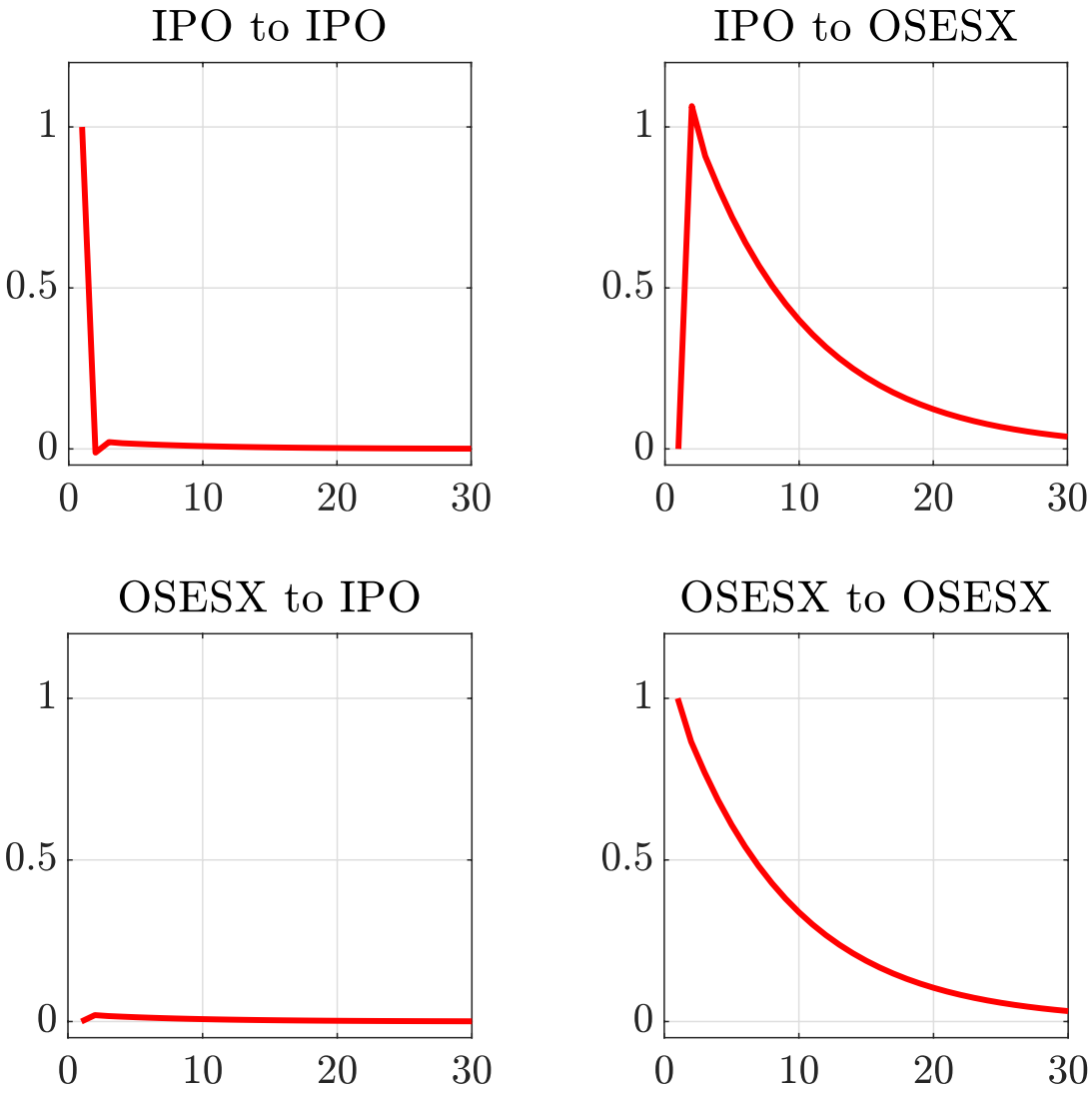
$$H_0 : \beta IPO_{t-1} \neq 0 \text{ and } \beta IPO_{t-2} \neq 0$$

We get a p-value of 0.1957, hence the past performance of OSESX influences the performance of IPOs, but not vice versa.

A5 Impulse Response Function IPOs and OSESX

Figure A5.1: Impulse Response Functions over a Thirty-Day Period

(1) Six-month IPO return response to six-month IPO return (2) Six-month IPO return response to OSESX (3) OSESX response to six-month IPO return (4) OSESX response to OSESX

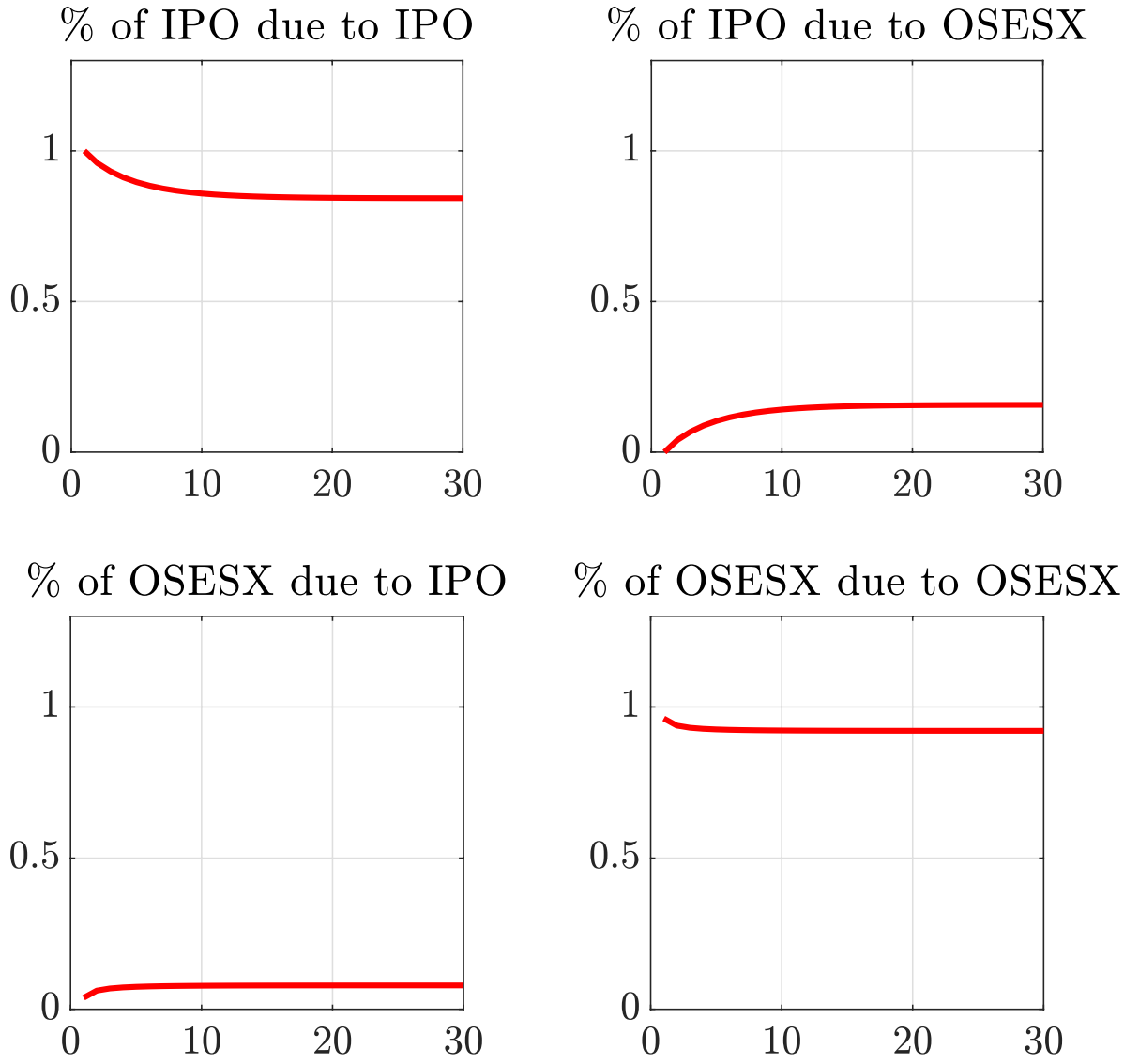


From Figure 6 we observe that a shock in the IPO performance has close to zero effect on OSESX, while a shock in OSESX has larger effect on the IPO performance than the shock itself.

A6 Variance Decomposition IPOs and OSESX

Figure A6.1: Variance Decomposition over a Thirty-Day Period

(1) Six-month IPO return variance due to six-month IPO return (2) Six-month IPO return variance due to OSESX (3) OSESX variance due to six-month IPO return (4) OSESX variance due to OSESX.



From Figure 7 we observe that some of the variance in IPO six-month returns are due to OSESX, approximately 15%. IPO variance explains approximately 7.7% of the OSESX variance.

A7 Regression using more variables

Table A7.1: Regression using more Variables

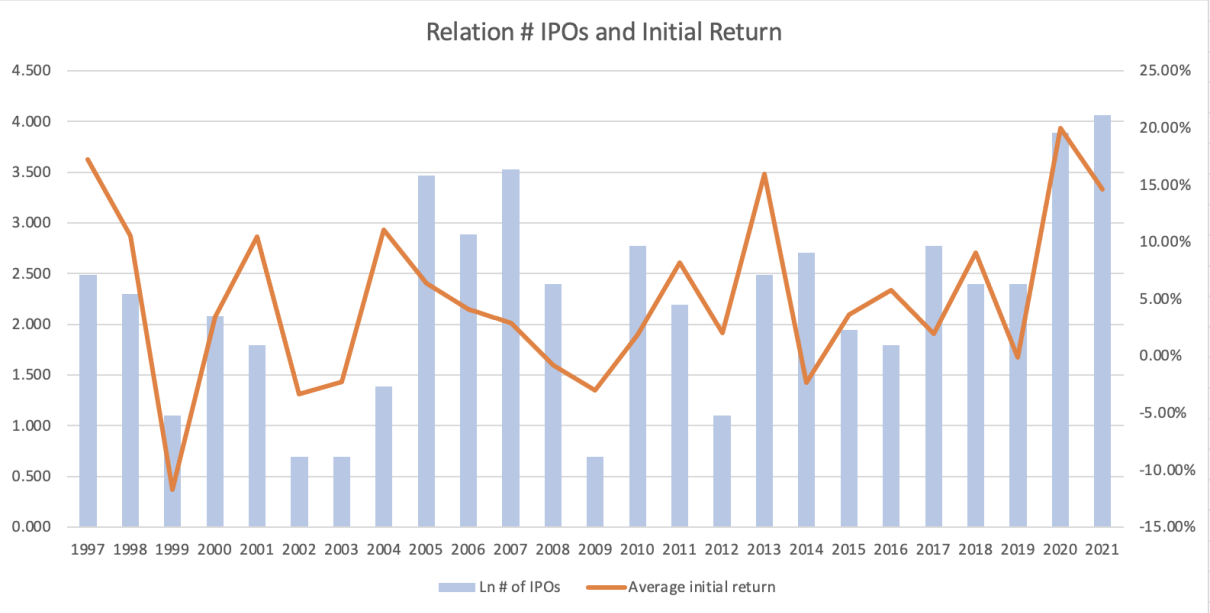
Panel C: Parameter estimates									
	Intercept	IR	Log(1+age)	Market	Vol	Deposit rate	VIX	Log(gross proceeds)	$R^2_{adjusted}$
Beta	0.473	0.015	-0.018	1.327	-0.166	-2.534	0.348	-0.024	0.166
p-values	0.154	0.867	0.390	0.000	0.348	0.318	0.446	0.142	

Panel D: Summary statistics of variables				
Variable	Median	Average	Standard Deviation	Pearson Mode Skewness
Return	-0.037	0.049	0.505	0.510
IR	0.018	0.085	0.287	0.706
Log(1+age)	2.079	2.118	1.173	0.098
Market	0.101	0.074	0.158	-0.514
Vol	0.180	0.282	0.190	1.611
Deposit rate	0.014	0.019	0.014	1.029
VIX	0.197	0.199	0.060	0.094
log(gross proceeds)	19.114	19.094	1.535	-0.039

As explained in footnote 12, R squared is lower.

A8 Relation between number of IPOs and Initial Return

Figure A8.1: Relation between 357 IPOs between 1997 and 2021 and Average Initial Return



The graph shows that the natural logarithm of the number of IPOs and average initial return to some extent are related, suggesting that the Norwegian IPO market is somewhat cyclical.