UNIVERSITY OF VAASA
SCHOOL OF ACCOUNTING AND FINANCE

Joonas Jauhiainen

INVESTMENTS TO R&D AND AFTERMARKET PERFORMANCE OF INITIAL PUBLIC OFFERINGS

Evidence from Denmark, Finland and Sweden

Master's Thesis in
Finance
Master's Degree Programme in Finance

VAASA 2019

TABLE OF CONTENTS

page

LIST OF FIGURES AND TABLES **page**

UNIVERSITY OF VAASA
School of Accounting and Finance
Author: Joonas Jauhiainen
Topic of the Thesis: Investments to R&D and Aftermarket Performance of Initial Public Offerings: Evidence from Denmark, Finland and Sweden
Supervisor: Vanja Piljak
Degree: Master of Science in Economics and Business Administration
Master's Program: Finance
Year of Entering the University: 2013
Year of completing the Thesis: 2019 **Pages:** 82

ABSTRACT

Denmark, Finland and Sweden are research and development intensive nations. Investments in R&D have been recognized to affect positively in the cross-section of stock returns and IPOs are documented to be significantly underpriced and to realize poor market-adjusted returns in long-run. This thesis investigates whether research and development expenditure, measured as spending towards R&D scaled with revenue, can be used as a forward-looking measure in the aftermarket performance of Nordic initial public offerings with a sample of 136 IPOs from 2005 to 2015.

The aftermarket performance of IPOs in the Nordic markets is examined in event-time utilizing wealth relatives and in calendar-time setting employing time-series factor regressions of monthly excess returns for portfolios of IPO companies and various risk factors. In event-time, the performance is measured for the initial returns, 1, 3, 6, 12 and 36 months and in calendar-time for 6 and 36-month periods.

The results show that the sample IPOs are considerably underpriced and the R&D unintensive firms experience significantly higher average abnormal initial returns compared to the R&D intensive ones. Adding controversy to previous literature and initial assumptions, all IPOs outperform benchmarks in long-run event-time analysis and R&D intensive firms prove to perform worse than the R&D unintensive companies in nearly all of the measured time periods. Risk-adjusted returns further indicate that the issuers are exposed to size risk and the R&D unintensive firms' superior long-run performance is attributable by exposure to investment risk factor. IPO literature suggests that the performance measurement is prone to time periods, which most likely also explains the loftier returns of IPO firms over the benchmark indices in the sample. Moreover, some studies argue that R&D investments cause more volatility than investments to physical assets, which could be seen as the poor performance of R&D intensive firms due to negative skew in the payoffs from R&D investments compared to investments in tangible assets.

KEYWORDS: IPOs, R&D, short-run performance, long-run performance

1. INTRODUCTION

A remarkable milestone in a company's lifecycle often culminates into an initial public offering (IPO), which sets a business as a subject of public trading on a supervised and acknowledged market place. After transforming from a closely held business into a publicly traded enterprise, company and its aftermarket performance develop into a subject of curiosity for a larger group of people compared to time before as a private firm. The sharp increase in interest towards newly listed equities is largely explained by the desire of individual investors and financial institutions to generate returns in capital markets by either buying new issues for long-term holding or to realize quick gains via participating in equity offerings only to exploit the short-term market inefficiencies, often present with IPOs.

Motives for companies pursuing initial public offerings, in addition to purely raising capital, pinnacle to numerous reasons ranging from creating liquidity for the shares, forming employee retention and rewarding systems to increasing awareness of the company in its operating environment. However, the aforementioned reasons cannot be assumed to exhaustively dictate companies' desire to go public - although all of them frequently referred to in the listing prospectuses as the background and motive behind the decision to go public. Ritter and Welch (2002) blame data drought among private companies to empirically prove the previously mentioned reasons for going public, excluding the obvious capital collection and further improving equity component in firms' capital structure. Instead, Ritter and Welch (2002) suggest market timing and companies' stage in their life cycle being the most prominent factors to determine whether or not to assume public status. The market timing as a motive can also be seen from the distribution of IPOs in the Nordics from 2003 to 2015 in figure 1 as clustering of equity issues during "hot" market conditions and times with lesser amounts of listing activity due to less attractive state to issue equity.

IPOs have been a prosperous topic for research ever since anomalies shadowing the event were found and replicated globally. Still decades after the anomalies were discovered, the field remains important as investors exploit price patterns found in initial public offerings to generate abnormal returns and companies time their equity issuances to suit favorable market conditions to issue shares cheaply. Therefore, initial public offerings have been in the keen interest of market participants for a long time and the yearly volume of IPOs continues to live in close connection with prevailing economic conditions.

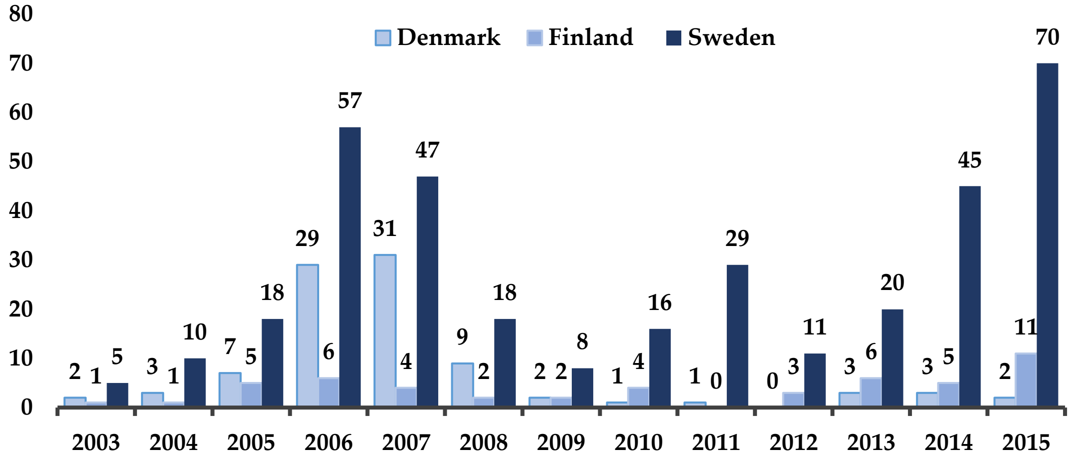

Figure 1. Distribution of IPOs in the sample countries from 2003 to 2015 (Pörssisäätiö 2018).

The literature on IPOs includes publications from varying points of view and different measures have been used in quest to unravel the puzzle of underpricing and poor long-term performance, often associated with initial public offerings. Using a novel point of view in the context of Nordic IPOs, this paper aims to examine whether research and development expenditure of a company prior to an exchange debut correlates with post-IPO performance in the Nasdaq Nordic stock exchanges covering IPOs over an 11 year time period from 2005 to 2015. The relationship between the R&D expenditure and IPO performance has not yet been studied in the Nordic context and therefore this paper provides new contribution to the well-documented literature on initial public offerings.

The post-IPO performance falls into two categories – short and long term performance. The long-run performance in its simplicity is determined by a company's ability to maximize shareholder wealth, ultimately dictated by the market and its view on the fair price of a business in aftermarket. The share price adjusts accordingly and either appreciates, depreciates or remains stagnant after an exchange inauguration. The performance is measurable by either tracking the raw returns for the selected long-run period or using a suitable benchmark to test the existence of abnormal returns of a given stock. Using benchmarks is common practice in the IPO research as the newly public firms do not realize negative returns intrinsically, but may lose to their respective benchmarks in long-run, thus underperforming the general market (Ritter and Welch 2002: 1797).

The long-run performance of newly listed companies is a well-documented field and the results promote underperformance for long periods when compared to benchmark indices or a set of comparable companies. Ritter (1991) attests significant long-run underperformance for IPO companies 36 months after assuming public status when compared to comparable corporations matched by similar size and industry. Loughran and Ritter (1995) show analogous underperformance that persists 60 months after claiming public status in comparison to matched non-issuing firms. In general, the long-run returns including holding periods from 12 months up to 60 months are deemed to provide inferior returns compared to market returns or comparable companies in several studies but are also found to be sensitive to methodologies and the time periods employed in the papers (see e.g. Levis 1993; Keloharju 1993; Rajan & Servaes 1997; Brav, Geczy & Gompers 2000).

In addition to the poor long-run performance of IPOs, the efficient market hypothesis defying short-run performance of initial public offerings also receives wide attention. In one of the groundbreaking papers on IPO performance studies, Ibbotson (1975) popularizes the puzzle of significant underpricing among newly listed equities. The field has since provoked a wide range of further studies (see e.g. Ritter 1991; Loughran, Ritter & Rydkvist 1994; Loughran & Ritter 1995; Loughran & Ritter 2002; Hahl, Äijö & Vähämaa 2014) striving to make sense of the "underpricing puzzle" that seems to prevail among IPOs globally even decades after the initial discovery.

The short-term performance of IPOs is measured by inspecting the difference in the issuing price of a company and the closing price on its first day of trading. Often times, the closing price has been substantially higher than the offer price, causing the issuing company to lose money and investors receiving a quick gain. The anomaly is also known as *underpricing* and suggests that initial public offerings are not either efficiently priced by issuers or investors act irrationally at times of equity issues. The efficient market hypothesis confronting glitch is exhaustively captured by Loughran et al. (1994) paper covering 25 countries, in which all witness significantly underpriced initial public offerings. Underpricing in its essence is important for longer-term returns as well especially at times of heavy underpricing, which may lead to eventual mean reversion in stock prices (Levis 1993). Underpricing benefits investors who realize free lunches on the expense of issuing companies and baffle academics as IPO companies leave "money on the table" and do not realize their full potential to raise capital via a costly and time-consuming initial public offering (Loughran & Ritter 2002).

Lastly, IPOs are a cyclical phenomenon that correlates positively with the general economic atmosphere. During fiscal booms, investors might perceive their option of investing in new entrants of the market place overly optimistically, which companies placing their stock as a subject of public trading exploit and seek for an IPO during economic expansions with generally high prices commanded from equities. The reversal occurs at times of market turmoil, where investors observe the stock market as an unattractive domain to allocate their wealth and companies tend to postpone their IPO plans due to unfavorable market conditions. As a result, there appear times of a large number of companies setting their shares for public trade and periods with only a few or no entrants as the figure already 1 demonstrates for a short period of 13 years in the relatively small Nordic market. The phenomenon is closely interwoven with aftermarket performance of initial public offerings and the underpricing is in amplified position during IPO peaks due to increased asymmetric information problem as witnessed with the technology sector in the turn of the millennium (Ibbotson & Jaffe 1975; Ritter 1991; Yung, Çolak & Wang 2008).

1.1. Purpose of the thesis and motivation

The Nordic countries are research and development intensive nations that invest heavily into R&D when scaled with GDP or per capita figures. Investments towards innovations and increasing efficiency are driven by public entities and private corporations in these countries, which results in the lively overall research and development activity. Figure 2 depicts this subject matter in the context of OECD and EU28 countries' R&D intensity on a yearly basis from 2003 to 2016. Denmark, Finland and Sweden are somewhat homogenous in terms of R&D intensity and have been on a systematically higher level on R&D expenditures scaled with GDP than other developed countries on average. The small size of the Nordics, peripheral location and fairly scarce natural resources have been key agitators in the high allocation of resources towards R&D in order to give birth to innovations that drive the economies of these countries and make them competitive in a global sphere.

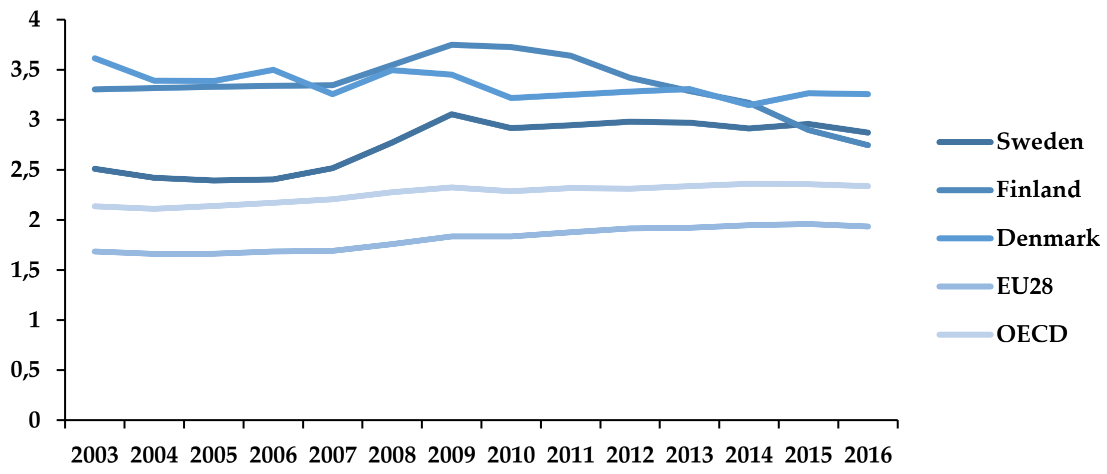

Figure 2. R&D expenditure as a percentage of GDP (OECD 2019).

Creating new technologies that generate new products or wholly new industries often pinnacle from rigorous investments towards research and development, which ultimately enrich the innovative entities due to capitalized innovations and increased outputs. Hsu (2009) argues in his paper that technological innovations increase stock returns and the associated premiums. Moreover, the author documents that R&D and patent shocks have significant and positive predictive abilities over the S&P 500 index returns and premiums. On an international level, the author also finds that patent and R&D shocks affect positively to returns and premiums commanded in stock indices of several big countries as well. Lin (2012) demonstrates with a dynamic equilibrium model that technological progress is driven endogenously by R&D investments and raise the expected marginal benefit of physical capital, whilst lowering marginal costs of physical investments. Due to otherwise decreasing marginal returns on physical investments, the model built in the paper depicts why R&D investment intensive companies earn higher average stock returns than physical investment intensive firms do.

The aim of this thesis is to investigate whether the research and development expenditures of Nordic companies prior to their exchange debut affects either initial underpricing, short or long-term performances. Moreover, it is examined whether grouping IPOs in two sets based on their research and development expenses can be used as an ex-ante measurement in the future performance of new listings to Nordic stock exchanges.

The commonly acknowledged main target of a business in its existence culminates in maximizing shareholder wealth via recurring dividends and share appreciation by engaging with profitable ventures that create value for investors via positive net present value for the series of projects a company decides to take upon. R&D activities are drivers of innovations that ultimately fuel companies' success in long-run and prosper societies beyond what maximizing labor and other factors of production could yield together. Therefore, companies invariably seek for a better future status by investing in research to discover new products and seek to develop processes to produce them, increasing productivity and profitability with the innovations.

1.2. Hypotheses

Even though some previous main studies find IPOs' underperformance sensitive to methodologies and sampling of the data due to periods of irrational investor behavior, on aggregate, the literature has recognized underperformance among new issues in long-run. Similarly, underpricing seems to be a global phenomenon that prevails among newly listed companies. Both of the anomalies captured with significant evidence from Finland by Keloharju (1993) and Hahl et al. (2014), underpricing in 25 countries including Nordics by Ritter et al. (1994) and both investment periods' performance more broadly in the Nordics by Westerholm (2006).

What ultimately drives the underpricing and poor performance still remains as a mystery, although size and book-to-market ratio have explanatory power over initial underpricing and following performance of IPO companies (see e.g. Ritter 1991; Brav et al. 2000; Gompers et al. 2003; Hahl et al. 2014). More recently, R&D activity has been documented to affect positively in stock returns (see e.g. Hsu 2009; Lin 2012). The hypotheses of this study are based on the research and development investments of companies prior to their exchange inauguration and subsequent performance in the following manner starting with the null hypothesis:

H0: Investments to R&D have no effect on IPO performance

Assuming that the null hypothesis is proven wrong, two alternative hypotheses are formulated following the results of previous literature. Firms with allocation of funds to research and development activities are assumed to be future winners via new innovations and also victors in the early aftermarket due to investors' expectations on these companies with plausibly high and grand future growth. Therefore, the first alternative hypothesis goes as follows:

H1: R&D intensive IPOs beat unintensive IPOs and benchmarks in short-run

Putting effort and allocating resources in research and development are expected to bear fruit in long-run when new innovations are given birth to as the result of R&D activity. These new innovations are capitalized via new products or services that generate cash inflows and in successful cases increase the market capitalization of a company many times over. Deliberate investments in R&D activities produce these innovations on a regular basis and previous literature (see e.g. Eberhart, Maxwell & Siddique 2004; Guo, Lev & Shi 2006; Songur and Heavilin 2017) suggest a positive relationship between investments to R&D, increases in investments to R&D and stock market returns. Thus, the second alternative hypothesis is formulated in the following manner:

H2: R&D intensive IPOs beat unintensive IPOs and benchmarks in long-run

1.3. Structure of the thesis

This thesis is structured in the following way from this point onwards. The first part discusses previous literature on IPOs and R&D investments relation to stock market performance more broadly. The third part introduces the Nordic equity markets briefly and the concept of market efficiency that is threatened by the anomalies shadowing IPOs. The chapter is followed by some theoretical foundations behind IPOs as a process and few of the often employed valuation metrics used to arrive with a fair price for an equity issue are introduced.

The part following the features of the Nordic markets and initial public offerings presents the methodologies and dataset collected to empirically test the formulated hypotheses. After introducing and reviewing the data, the research methodologies used to test the sample are discussed. The methodology follows seminal research on IPO performance studies and more recent factor models are also employed due to the previous literature's skepticism towards IPO performance and sensitivity towards methodologies employed.

The final part of the paper focuses on presenting the results and their implications in practice. Results section discusses the obtained empirical outcomes and ends this thesis.

2. LITERATURE REVIEW

In this chapter, the earlier literature on initial public offerings and their performance are introduced. The literature on the topic is vast and publications from various markets globally have been made beginning from the seminal short term findings by Ibbotson (1975) and long-term underperformance popularized in the literature by Ritter (1991). In addition to general IPO performance studies, papers regarding research and development in the context of stock market performance are discussed to scope the motivation of this paper in examining the relationship of R&D expensing to post-issue performance of IPOs.

2.1. Short-run performance of initial public offerings

In the groundbreaking work by Ibbotson (1975), IPOs produced average abnormal returns of 11.4 percent when measured as gains from offer price to closing price after one month of trading with a sample of U.S. issues occurred from 1965 to 1969. As a plausible explanation of the phenomenon, the author reasoned that issuing companies underprice their issues deliberately in order to avoid poor immediate aftermarket performance for their issues and possible lawsuits. Continuing with the Ibbotson (1975) results, Ibbotson and Jaffe (1975) observed more pronounced underpricing with a larger sample and document an average underpricing of 16.8 percent. Moreover, the authors argue that IPO markets are cyclical, moving between hot and cold conditions, and claim that underpricing is more severe during hot market conditions.

Similar underpricing figures are attained by Ritter (1984). His sample includes IPOs from 1960 to 1982 and documents an initial abnormal return of 16.3 percent during "cold issue " market but significantly higher average initial return of 48.4 percent for a 15 month "hot market" period from 1980 to 1981. The sample was later augmented by Ibbotson, Sindelar and Ritter (1988) paper, which investigates IPOs occurred between 1960 and 1987, documenting an average underpricing of 16.4 percent. Both of the previous papers have examined the "hot issue" markets and found further evidence for the Ibbotson and Jaffe (1975) hypothesis of a positive relationship between having hot markets and more adverse underpricing.

Well-motivated by the previous seemingly enduring results, Loughran et al. (1994) inspect the underpricing phenomenon across 25 countries and exhaustively produce evidence in favor of underpricing of IPOs. In all of the sample countries, including both developed and developing nations, the new issues were underpriced in short-run. Timing motives for companies to issue equity is also documented and those firms issuing equity during peak market valuations realize the worst long-run returns for investors betting on them.

In Finland, the underpricing was first inspected by Keloharju (1993), who discovers average initial excess returns of 8.7 percent for new issues in the Finnish equity market. The sample period under investigation from 1984 to 1991 includes high variation in the initial excess returns ranging from years with closer to 20 percent average first-day gains to years with negative average excess returns on the first day of trading.

Westerholm (2006) documents IPO performance patterns across the Nordics with a sample of 254 new equity issues from 1991 to 2002. The sample countries witness a combined average initial return of 17.11 percent but a median return of only 5.22 percent due to the inclusion of the technology boom ingested high initial returns and the consequent high variation in the sample. Denmark witnesses the lowest average underpricing of only 8.5 percent, whilst in Finland and Sweden the corresponding figures are 21.89 percent and 15.88 percent, respectively. Westerholm (2006) argues that high industry clustering results in higher initial returns, contributing to the "hot market" assumption and IPO markets' tendency to rotate between hot and cold conditions.

Purnanandam and Swaminathan (2004) record in their paper that the median IPO is overvalued at the offer price with about 50 percent in comparison to industry peers. Another main finding of their paper dictates that the most overvalued IPOs tend to realize higher first day returns than companies with less underpriced issues and they have lower profitability, higher accruals and greater growth projections granted by analysts, which suggests that IPO performance is prone to investors' biased visions of the future success.

Hahl et al. (2014) inspect the aftermarket performance of Finnish IPOs from 1994 to 2006 and find significant underpricing with mean first-day gains of 15.6 percent and median first day returns of 4.1 percent. Moreover, the authors divide their sample in growth and value IPOs by their initial market-to-book ratios at the offer price and document slightly higher underpricing for growth stocks than value stock IPOs. Similarly to Westerholm (2006), Hahl et al. (2014) sample period includes the technology boom and the resulting abundant years in IPOs, which shows as large difference in mean and median values of the underpricing and the initial returns' effect on the subsequent longer-term periods.

2.1. Long-run performance of initial public offerings

The long-run performance is a vital branch in IPO literature offering several points of view explaining the commonly known anomaly as well as varying results. The performance in long-run is measured by comparing the IPO shares' price development to benchmark indices or to a set of comparable companies over a period of time that may or may not exclude the effect of initial underpricing by assuming the measuring period to start from a point where the short-term effects are not present.

Despite the early literature on the anomaly reaching well before the nineties (see e.g. Ibbotson 1975), an examination by Ritter (1991) is often referred to as the seminal work on describing the underperformance of initial public offerings in long-run. The paper examines the long-term performance of IPOs with a sample of 1526 U.S. equity issues over a ten year time period extending from 1975 to 1984. According to Ritter (1991), in the course of 36 months following the issuing day, the companies issuing new shares generate cumulative returns that underperform significantly the control sample of matching firms during the same period. The underperformance is most adversely pronounced among small companies and firms issuing in congested years, which the paper refrains to explain exhaustively due to short sampling period that could rule out interpretations, but deductions on negative relationship between market timing and company size to underperformance are implied. However, Ritter (1991) indicates suspicion towards the resilience of the underperformance past the 36 month period by referring to Ibbotson's (1975) results on a 48 month period proposing disappearance of the post-issue underperformance in a longer performance examination period.

Brav et al. (2000) proceed the study with American IPOs on the course of 18 years from 1975 to 1992. The sample is partly the same to that of Ritter (1991) and includes 4622 initial public offerings, which are further sorted by book-to-market ratios and size measured with total market capitalization. Quintile sets are created amounting to 25 different portfolios, which collectively include all IPO stocks in the NYSE, Amex and NASDAQ during the sample period. The authors find that IPO returns are similar to non-issuing companies' matched by the book-to-market ratio and firm size. Moreover, the authors note that over 77 percent of the IPOs are classified into the lowest book-to-market quintile and over 50 percent of the observations fall into the smallest quintile in terms of size. Therefore, the underperformance in the sample is attributed to small growth stocks similar to Ritter (1991) pondering on small growth companies fairing the worst in the long term, whilst being the most underpriced.

Rajan and Servaes (1997) inspect the relationship between IPO stocks covered by analysts and the long-run performance of those with a sample of 2725 U.S. initial public offerings from 1975 to 1987. They document a positive relationship between analyst coverage and initial underpricing, suggesting that underperformance is attributable to analysts' over-optimism towards newly public companies and their growth prospects. Moreover, stocks with high growth projections forecasted by analysts underperformed the three benchmarks used significantly, whilst stocks with the lowest growth assigned by analysts overperformed the respective benchmarks. On aggregate, however, after the 48 month period following the IPOs, the issuing companies returned a raw return of 23.8 percent but significantly underperformed the three benchmarks by -17.1, -40.6 and -47.1 percent, respectively.

Loughran and Ritter (1995) assume a long time period in measuring the long-run performance of newly issued equities by examining 4753 initial public offerings on the course of 21 years from 1970 to 1990. They exploit a 48 month period in measuring the long-run performance and find evidence that investors received an average annual return of 5 percent from IPOs, whilst investing to non-issuing companies with similar size for the same period returned a 12 percent average annual return. The authors' give a possible explanation relying on behavioristic disciplines suggesting that investors justify high valuations of companies with high growth prior to an equity issuance, which ultimately leads to mean reversion when growth prospects are not met in reality.

In quest of seeking robustness for the previous results on long-run underperformance of IPOs, Ritter and Welch (2002) collect a massive sample of 6249 initial public offerings occurred between 1980 and 2001. They document mixed results suggesting that IPO returns are sensitive to a number of attributes. The methodologies used (e.g. calendar-time vs. event-time returns) and how the sampling period for longer time periods that include times of market turmoil or irrational exuberance (i.e. technology bubble for instance) are included in the period. Also, similar to Ritter (1991) and Brav et al. (2000), the poor long-run performance is driven in their sample by penny stocks that yield high returns on their first day but lead to a poor subsequent long-run performance.

Gompers and Lerner (2003) further test the robustness of initial public offerings' long-run performance literature by executing a large out-of-sample study covering 3661 American IPOs from 1935 to 1972. The sample period takes place before the founding of the NASDAQ and provides evidence for the underperformance phenomenon before the returns of IPOs were not systematically analyzed. The results show underperformance 60 months after the IPOs if event-time buy-and-hold abnormal returns are used, although statistically insignificant. The underperformance disappears when cumulative abnormal returns are used. In addition, similarly to Brav et al. (2000), a calendar-time analysis displays that IPOs return as much as the market in terms of returns over the same sampling period, contradicting the previous results and bringing up the importance of using various methodologies in IPO studies.

Previously discussed studies have exclusively focused on American exchanges and reported long-run underperformance of IPO firms, although to some extent sensitive to time periods and methodologies. Levis (1993) conducts a study covering 712 initial public offerings in the London Stock Exchange from 1980 to 1988 and discovers poor performance for new equities over a 36 month period after an issue. The underperformance varies between 8.3 and 23 percent, depending on the benchmark used. Controversially to previous assumptions (see e.g. Ritter 1991; Ibbotson 1975), Levis (1993) suggests that the underperformance in the long-run would exceed beyond the 36 month period employed.

The U.K. initial public offerings' performance is revisited by Espenlaub, Greogry and Tonks (2000), who seek to further examine the robustness of previous results obtained by Levis (1993) with a new sample of 588 IPOs by non-financial companies. The authors find evidence for the methodologies concern in IPO literature as the underperformance over 60 months after an issue depends significantly on the methodologies and benchmarks used. Event-time methods provide negative abnormal performance 36 months after an issue regardless of the benchmark, whilst after 60 months abnormal returns are less negative and the negative sign even becomes dependent on the benchmark applied. Calendar-time regressions on underperformance further suggest that IPOs perform at par with the market similar to findings by Brav et al. (2000) and Gompers and Lerner (2003).

The robustness of underperformance literature conducted in larger financial markets is examined by further investigations on smaller ones. Keloharju (1993) studies the phenomenon in the Helsinki Stock Exchange and collects results indicating significant underpricing by 8.7 percent and substantial negative underperformance of -21 percent for IPO companies compared to the stock exchange's value-weighted index in long-run. Westerholm (2006) further extends the long-run performance to cover the Nordic IPO markets over a period from 1991 to 2002. His sample of 254 new equity listings on the main official exchanges in Denmark, Finland, Norway and Sweden provide mixed results. Initial public offerings in Norway and Denmark outperform the market index significantly, whilst IPOs in Finland and Sweden underperform their respective market indices over long-run in event-time analysis.

The relationship between having venture capital backing prior to issuing equity and long-run performance is studied by Brav and Gompers (1997) with issues from 1972 to 1992. The authors find that venture-backed IPOs beat non-backed initial public offerings with equally weighted returns, whilst value weighting diminishes differences in performance to insignificant terms and reduces the underperformance of IPOs with no venture-backing. However, using the Fama-French three-factor model shows no significant underperformance for venture-backed companies, whereas the smallest non-backed issuing companies do underperform. The authors also document that the underperformance is not unique for the IPOs per se as non-issuing companies of similar size and book-to-market ratios also underperform during the same sample period.

2.2. Hypotheses for IPO performance

Although there is no fundamental theory explaining the underpricing and underperformance of IPOs exhaustively, previous literature has come up with various ideas seeking to explain both phenomena. Underpricing is often emphasized by information asymmetries and poor long-run performance with the size of the issuers, methodological issues and time periods as well as with behavioral schools of thought. Several informational and behavioral points of view have been developed to explain the phenomenon and the most prominent ones are discussed further in this subchapter.

The role of investment banks' importance in underpricing of new issues is examined by Beatty and Ritter (1986). The authors test two propositions, expecting a monotonic relationship between investors' ex-ante uncertainty and underpricing as well as assuming that investment banks have an incentive to create a desirable underpricing for an issue. If an IPO is underpriced to the extreme, issuing company is not satisfied, deteriorating investment bank's reputation among plausible future issuers. Also, investors lose interest in IPOs of an investment bank that systematically provides low levels of underpricing, leading investment banks to a price optimization puzzle for new issues.

Rock (1986) suggests a "winner's curse" model in which some investors hold superior information from issues at hand and know when to bet on a certain new issuer and withdraw from the market when low-quality IPOs are being offered. The well-informed investors overcrowd less-informed counterparties at times of good issues, when offer price is lower than the observable fair value, and leave the expensive and less-desirable IPOs at hands of the less-informed investors. The company offering the shares must take this into account in the pricing and deliberately discount the issue to let the uninformed investors claim their part of the issues as well.

Seeking to explain reasons for short-term underpricing and subsequent long-term underperformance from a behavioral point of view, Miller (1977) proclaims *the divergence of opinions hypothesis.* According to the theory, investor sentiment is divided between over-optimism and pessimism on the verge of initial public offerings and early aftermarket. The number of investors with positive outlook overrun their downbeat peers due to short selling constraints that exist in the early aftermarket, thus solely creating the demand towards the asset and pricing it, consequently driving its price beyond the intrinsic value. Eventually, prices decline after investors' opinions harmonize and over-optimism diminishes with new information flowing to the market. Therefore, the underpricing becomes the product of short-term optimistic valuation, which in turn contributes to poor long-run performance.

Purnanandam and Swaminathan (2004) provide evidence for the theory of diverging investors' opinions in their study claiming that investors with an overly positive outlook on an IPO company overrun investors with more modest expectations, contributing to high early aftermarket prices and poor subsequent performance. Investors do not act rationally, which makes the underpricing possible, assuming that the offerings are efficiently priced following company fundamentals. The Miller (1977) paper is the base for behavioral theories explaining the performance of IPOs in short and long-run, therefore also acts as a source of inspiration for the *Impresario hypothesis* coined later.

The impresario hypothesis by Shiller (1990) states that IPOs fall as victims to fads, where short-term share appreciation may be a product of excessive demand created by underwriters' intentional undervaluation, which ensues to investors' collective interest towards a "hot" issue. The fake news creates interest towards the share and generates high short-term aftermarket returns, which will affect the long-term returns as optimism-laden share prices tend to convert towards intrinsic values in long-run, contributing to the underperformance. Ritter (1991) provides evidence for the hypothesis and stresses how young companies with high market-to-book ratios (i.e. young growth companies) at times are targets of mania among investors due to surreal growth prospects, which ultimately might lead to poor long-run performance for these kind of companies especially – adversely witnessed during and after the burst of the dot-com bubble at the turn of the millennium. Similar low book-to-market and small size effect driving poor long-run performance are documented in the literature (see e.g. Brav et al. 2000; Gompers et al. 2003; Hahl et al. 2014) as discussed previously.

In a third explanation seeking to demystify the underperformance relying on behavioristic disciplines, Ritter (1991) introduces the *windows of opportunity hypothesis* in which companies exploit favorable market conditions to issue new equity during times of low book-to-market and earnings-per-share ratios. The encouraging conditions culminate to the market being in a "hot" state, where valuations are high and investors share bullish views on new entrants, creating the "windows of opportunity" for issuers. The hypothesis is closely linked with the fads hypothesis by Shiller (1990) as the over-optimism among investors culminate into the opportunities, which in turn contribute to underperformance due to prices' tendency for mean reversion after periods of irrational investor behavior.

Loughran and Ritter (1995) later provide evidence for the hypothesis stating that companies gone public in high volume periods underperform in long-run, further reinforcing the concept that poor long-run underperformance is related to and perhaps compiled from initial underpricing. Schultz (2003) contributes by stating that when interpreting ex-post, during times of high IPO activity with higher prices commanded in the market, companies with poor quality in terms of profits and unreliable future prospects tend to exploit. The optimism among new investors ultimately leads to poor long-term performance due to mean reversion after high initial aftermarket prices. Opposing evidence against the windows of opportunity hypothesis unsurprisingly is found from Japan by Kang, Kim and Stulz (1999), who discover no evidence supporting the theory as issuers with high market-to-book ratios witness no poorer subsequent long-run performance than their peers with lower figures.

2.3. R&D and stock returns

Chan, Lakoshnik and Sougiannis (2001) investigate the relationship of investments towards research and development and stock market pricing over a sample period from 1975 to 1995. The authors find companies investing in R&D faring no better than firms with no investments towards research and development with very similar 19.65 and 19.50 percent annual returns for both groups. Subsequently, the authors argue that markets incorporate all the benefits of R&D expenditure and the R&D intensive companies do not, therefore, witness abnormal returns, although their returns are observed to be more volatile. Despite overruling the over performance of R&D expensing portfolio in their sample, the authors document a positive relationship between research and development intensity and positive abnormal returns.

Using a longer sample period than Chan et al. (2001), Eberhart et al. (2004) examine the relationship between unexpected investments to research and development and subsequent stock performance in the US with a sample from 1951 to 2001. They document consistent evidence for positive abnormal returns for five years following sudden increases to R&D. More importantly, the authors' findings suggest that the benefiting nature of investments towards R&D is not immediately or fully absorbed by the market and therefore are mispriced.

Motivated by previous studies, Chambers, Jennings and Thompson (2002) examine the earlier documented positive relationship between R&D investments and cross-section of stock returns and challenge the prevailing explanation of mispricing of R&D intensive firms' abnormal returns. The authors investigate 89 419 firm-year observations from 1979 to 1998 and argue that conventional methods for controlling risk do not capture the riskiness of R&D intensive companies correctly, which causes the measured excess returns to be positively biased. Positive abnormal returns persist up to ten years in event-time analysis, whereas calendar-time setting produces lots of variation, supporting their claim that the riskiness of R&D intensive companies drives the positive abnormal performance.

Kothari, Laguerre and Leone (2002) observe in their study how investments towards research and development cause more variability in future earnings when compared with investments to tangible assets. The result suggests that the payoff from investing to R&D activities does not necessarily always realize as future success. Also, there is high variation in the level of realized returns, which contributes to Chambers et al. (2002) argument on R&D intensive stocks having higher risk levels driving the abnormal returns.

In the first attempt seeking to demystify IPO performance with R&D, Guo et al. (2006) inspect the effect of R&D on initial underpricing and long-term performance of IPOs in the U.S. over a sample period from 1980 to 1995. The authors find significant evidence for R&D activity and short-term underpricing and long-run performance. Guo et al. (2006) find that research and development activities are positively related to both initial underpricing and long-term performance of new equity issues. They argue that in the modern world, companies are in a continuous need to engage with growth-inducing activities and R&D is a path for future growth valued by investors.

Ehie and Olibe (2010) investigate investment allocation to research and development and stock market value of companies over an 18 year period by dividing their sample between service and manufacturing industries. The sample period also includes the 9/11 attacks in order to examine whether a major market turmoil and black swan type of events could affect the robustness of previous results. The authors find out that investments towards R&D affect positively in the market value of the sample companies in accordance with the previous literature, despite having a major negatively affecting period in their sample. Interestingly, in their subsample period prior the 9/11 attacks, the R&D investments in manufacturing sector contributed more positively than in the service sector, whilst the opposite holds true for the period after the 9/11 attacks.

Contributing to Chambers et al. (2002) initial assumptions on R&D intense companies' riskiness, Li (2011) investigates financial constraints, R&D and stock returns. The author argues that investments to intangible assets, such as R&D, are more inflexible than investments to capital goods, which adds financial constraints to R&D intensive firms. R&D intense companies' risk increases alongside with the level of financial constraints and finically constrained firms' risk increases alongside R&D intensity, showing a relationship between being financially constrained and having uncertain future payoffs for R&D intense firms. Overall the results suggest that R&D intense companies' returns are driven by the increased risk due to financial constraints.

Songur and Heavilin (2017) examine stock returns and abnormal changes in R&D expenditures over a period from 1975 to 2015 and find a positive relationship between increases towards research and development and subsequent stock market performance. The phenomenon is in pronounced position for smaller companies that have been past winners. The companies with positive changes in R&D expenditure beat the market benchmarks and firms with negative changes in research and development expenditure with abnormal returns ranging from 3.2 to 11.5 percent. The results are robust and not driven by size, technological endowments nor asset growth effect. Also, the authors argue that due to the less ambiguous nature of R&D investments, stock prices do not fully reflect information signaled by the R&D increases similar to Eberhart et al. (2004).

3. MARKET EFFICIENCY AND THE NORDIC EQUITY MARKETS

Initial public offerings are events that allow the capital allocation to happen in a somewhat efficient way by connecting the resource-laden investors with companies looking to raise additional funds. In spite of IPOs role as a forum for capital distribution, previously seen short and long-term anomalies coincide with initial public offerings, which deteriorate market efficiency in the presence of price inefficiencies that should not appear in fully efficient capital markets. However, Lowry and Schwert (2004) note that even though IPOs suffer from market inefficiencies related to pricing as underwriters might not include all available information to the initial pricing band, the economic impact remains small. Contradicting to Lowry and Schwert (2004) findings on IPOs being fairly efficient events, Purnanandam and Swaminathan (2004) note that the most overvalued IPOs gain the most during the first day of trading, whereas in efficient markets the most undervalued issues should gain the most as the markets would determine the price according to the underlying fundamentals, not by fads and investor herding per se that drive the price in reality often times.

3.1. Efficient markets

Capital markets exist for the purpose of sourcing wealth from entities with excess funds to those in need of capital beyond their own reach. In an efficient market, capital flows with ease and prices incorporate fully all available information i.e. there are no opportunities for investors to use specific set of skills to realize positive abnormal returns by exploiting market inefficiencies and price patterns. Assuming efficient markets acts as a cornerstone for modern financial theory and virtually every asset pricing model holds an assumption of efficient markets in order for them to provide reliable results.

The debate of having efficient markets or not has been an essential part in finance literature for decades with proponents in favor and opponents suggesting more behavioristic explanations. Despite the roots of market efficiency theories most likely reaching centuries back, groundwork on the topic by Bachelier (1900) discusses the modern features of market efficiency. Bachelier (1900) studies the capital market price movements and discovers that prices reflect both past and present information in addition to future expectations discounted to the present moment. More importantly, Bachelier (1900) reasons mathematically that the expected value of price development of stocks is zero and the process is random, suggesting that the probability for a price to go either up or down in consecutive trading days is comparable to a coin toss. The findings later developed into the random walk hypothesis that attests stocks' prices moving up or down in an arbitrary manner. Moreover, according to the random walk theory, it is not possible to forecast future prices infinitely as price movement is a series of mutually independent occurrences i.e. similar to tossing a coin.

The seminal work of Bachelier (1900) remained in the dark for decades before the modern time efficient market acolytes took over the rostrum with further implications to factors describing market efficiency. Moreover, Fama (1970) coins the efficient market hypothesis (EMH) in which market efficiency is divided into three forms. In the *weak-form efficiency*, prices reflect fully all the information garnered in the past prices. Therefore, future stock prices cannot be forecasted by using past pricing data and technical analysis is not applicable for making abnormal profits on a regular basis. *Semi-strong efficiency* attests that prices fully reflect all available information and adjusts to new market news instantly and accordingly. Anomalies may occur, but they are quickly swept away by well-informed investors. In the greatest form of market efficiency, the *strong-form efficiency*, markets fully reflect all public information and insider information held by small groups of company insiders. According to the strongest form of market efficiency, investors should not be able to generate positive abnormal returns, regardless of the amount of research conducted or additional information obtained. Therefore, beating the market does not rely on deliberate actions or a specific set of skills, but merely on pure luck or assuming more risk by investing in riskier assets. Exploiting insider information also has its hindrances as there are national financial supervisors for the reason that insiders would not abuse their position in companies at the expense of less informed market participants.

It can be reasonably argued that markets are not efficient in the strongest form at all times as there exists a great number of investment professionals and private entities seeking to exploit own expertise and superb information in order to beat the market by abusing anomalies and observable patterns in asset prices. Free lunches in forms of numerous documented anomalies exist in the markets and they prevail even decades after their initial documentation, but arbitrage opportunities are quickly swept away, suggesting that markets operate efficiently but hold inefficiencies regarding asset prices.

3.2. Nordic equity markets

The Nordics have fairly new but developed markets for issuing and trading equities and consists of five countries in total: Denmark, Finland, Iceland, Norway and Sweden. However, in this study the focus is appointed to IPOs in Denmark, Finland and Sweden as their stock exchanges are under the NASDAQ group, whereas the Norwegian Oslo Børsen is not and the NASDAQ Iceland is very small and consists largely of financial firms.

The included stock exchanges have developed rapidly over the past few decades alongside with the economies of the respective countries. The stock exchanges have developed during the past three decades from relatively small domains into more actively followed forums of trading and fund collection. Small stock exchanges, such as the Nordic ones, are thought to operate more inefficiently than their major peers due to information asymmetries, less developed investment analysis because of fewer analysts covering the markets and less restrictive trading rules (Kallunki, Martikainen, Martikainen & Yli-Olli 1997: 475). The small exchanges also suffer from the thinness of liquidity, which might repel large institutional players as they are not able to buy and sell large blocks of shares without constraints, although IPOs offer to do so as cornerstone investors. The Nordic countries are among the most stable nations in the world in terms of having unwavering and predictable political and institutional environments, which are important factors to ponder when conducting global asset allocations and therefore these markets are followed globally due to asset diversification benefits.

The recession in the early 1990s took its toll in the Nordic economies, but the countries and their stock markets rose from the adverse shock eventually in congestion with the rapid growth of the economies of these countries. In addition to the sheer economic expansion, deregulation of capital markets and technological advances in electric trading took place gradually during the 1990s, contributing to the rise in stock market capitalizations (Vaihekoski 1997: 533).

The Finnish and Swedish equity markets witnessed irrational exuberance alongside with the rest of the developed world in the turn of the millennium. In 1999 stock market capitalizations peaked as the result of rapid growth a few years preceding. In hindsight, the rapid share appreciation and public's great interest towards new technology stocks was given the name "dot-com bubble", which eventually burst and the stock market capitalizations melted in both countries. The less volatile Danish stock exchange was not nearly as adversely hit by the event due to the smaller amount of new technology stocks that were more abundant in the Finnish and Swedish stock exchanges during that time. Since the technology boom and the subsequent crash, the Danish market has caught up with its neighbors. Another hit was taken during the global financial crisis in years 2007 to 2008 as each market place lost over 50 percent of their market capitalizations in a single year as the result of asset bubble bursting and reduced global output. Overall, the Nordic equity markets have evolved from a small and isolated market place at the beginning of nineties into a more integrated part of the global economy and the market capitalizations have grown consequently. The development of the equity markets in terms of market capitalization in billions of Euros over the most recent three decades is illustrated in Figure 3.

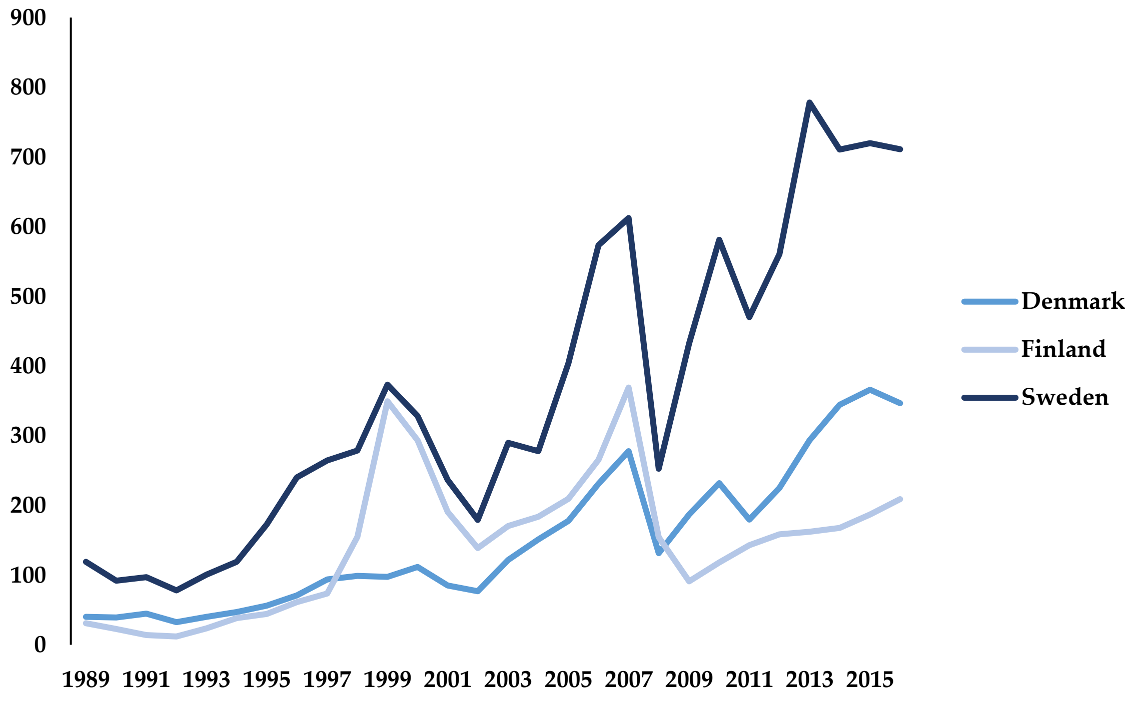

Figure 3. Stock market capitalizations in billions of Euros from 1989 to 2016 (Datastream 2018).

4. FEATURES OF IPOS AND THE PROCESS

In order to get a better grip on why companies decide to pursue a public status via initial public offerings, it is important to discuss further features of the issuance processes, requirements and also the stages that companies need to engage with to see an IPO ensue from an intention to a successful execution. The following chapter discusses the aforementioned topics and presents some common valuation metrics used to determine the issue price that investors are interested in when seeing new companies seeking for a market admission.

4.1. Why do companies take part in IPOs?

Apart from raising capital, what really drives companies to pursue an IPO depends naturally on a variety of things. Regardless of firm-specific reasons behind the intentions to chase an IPO, each company is expected to fulfill certain requirements and go through a regulated process before seeing its equity traded in a public market place. The process is time-consuming and costly to say at least and therefore screens out the smallest firms due to resource constraints. Smaller companies also have a difficult time in raising the interest of investors, who might not have ever heard of some small company thriving for an IPO. Selling a part of a company via an IPO also takes away ownership and voting rights from the initial owners even if they decide to remain as major shareholders after the issuance, which might adversely steer the interest of especially family-owned businesses to go public. In the light of the prior aspects, it can be reasoned that there appear hindrances in the process that limit the interest of companies and most often the firms going public have surpassed a certain stage in their life cycle.

Literature studying the incentives behind IPOs is scarce due to the overall lack of data among private firms to provide generalizing results for motivation to go public. A seminal theory by Zingales (1995) suggests that companies seek exchange listing to make M&A activity easier by having a publicly traded share for future acquisitions and added visibility via the public status. Pagano, Panetta and Zingales (1998) revisit the question by inspecting a large set of private companies in Italy that could have gone public based on their accounting data if compared to similar public companies and their figures. The authors' capture similar market timing motive as Ritter (1991) and Loughran and Ritter (1995), suggesting that market conditions with high valuations (high M/B ratios) motivate firms for two main reasons: Companies are attracted to the thought of issuing equity during peak valuation in order to sell shares at low cost and the high market valuation also signals good growth prospects in a given industry, which motivates companies to engage in the public equity market of a such prosperous domain. Pagano et al. (1998) further state that companies do not seek the equity financing to pursue future investments per se, they rather use the proceeds to lower leverage after a period of investments and allow owners to liquidate their positions during the process. In the sample, the issuance process is observed to follow aggressive growth and the consequential increase in leverage that can be eased with the proceeds from selling equity via an IPO.

Inspired by Pagano et al. (1998) paper, Kim and Weisbach (2005) collect a massive cross-sectional sample of 16 958 IPOs with which they unsurprisingly reason that capital collection is an important intention for an initial public offering. In their sample, 79 percent of all funds raised come through the sale of primary shares, which is correlated with companies' plea for capital, whilst selling secondary shares does not signal the demand for incremental funds and suggests greater motivation towards market timing. Ritter and Welch (2002) also comment that favorable market condition is the most important factor in determining companies' willingness to seek for an IPO, in the expectation that companies are past a certain stage in their spans of life.

The motivation for IPOs is further explored by Kim and Weisbach (2008) who estimate the actual uses of proceeds from initial public offerings and find out that equity offers are commenced to raise capital for future investments. More specifically, funds are explicitly collected for R&D activities and evidence of market timing is also found from the sample as high market-to-book firms tend to keep a substantial amount of the offer proceeds as cash, whereas low market-to-book companies put the proceeds to work in terms of investments.

Brau and Fawcett (2006) take a different point of view in the companies' willingness to apply for public trading by surveying 336 CFOs in the United States for their companies' primary motivation for an IPO. The authors find that creating publicly traded shares for future acquisitions is the most important factor with market timing, whereas lowering cost of capital does not play a significant role in their consideration nor do they seek to repay debt with IPO proceeds as documented by Pagano et al. (1998). In comparison to American CFOs' motives for an IPO, Bancel and Mittoo (2009) document the most important incentives for European CFOs being in increasing awareness of the company and raising funds for future investments. Even though the motives vary significantly across countries, companies and legal systems in Europe, Bancel and Mittoo (2009) find a significant difference between European and American CFOs' motives. European chief financial officers consider external monitoring by financial authorities and analysts as a major benefit, whilst their US colleagues experience increased external monitoring as a major cost induced with the IPO.

4.2. IPO process

When the decision to assume public status is made, the first step in the route from private to public is to look for *underwriters* that will take the procedure from start to finish. Depending on the size of the issue and risk allocation, the chosen underwriter may act alone or can form a syndicate of underwriters that work together. Often times, the underwriters chosen, have an important role throughout the process as they give initial financial advice and most importantly are involved in the issuance procedure as enablers via buying the shares of an issuing company and reselling them in the aftermarket. (Brealey, Myers & Allen 2014: 377).

The previously described method to arrange an IPO is known as *firm commitment*, where underwriters buy shares to be sold from the issuing company to sell them forward to the public via the IPO. The underwriters bear the risk of the process by acquiring shares from an issuing company and need to be confident with selling the acquired shares to the public in order to exit from their position and not be left with shares of a company with poor demand. With the added risk, however, the procedure profits the underwriters the more shares they can sell to the public from the spread between acquiring and selling the shares. In more risky IPOs with uncertain demand, underwriters may engage with the *best efforts* method, where they seek to sell as much of the issue as they can without being responsible for selling the issue in full. In best efforts method, risks are more limited but as a tradeoff, the profits are fixed. As a third method *all-or-none* deal may be used, which gives an issuer a right to cancel the issuance process if the offered shares are not bought in full by the public, leaving underwriters with no compensation and the issuing firm without the proceeds pursued with the IPO nor public status. (Brealey et al. 2014: 379; Ellis, Michaely & O'Hara 2000: 1042).

The IPO process in full involves lots of stakeholders in addition to the issuing company and the underwriter or syndicate formed. External services including the underwriter are bought from financial, legal and auditing companies to perform due diligence analysis to prove the soundness of the firm and to make sure that markets are informed of the company and its intentions. Table 1 describes the process in Finland according to the Pörssisäätiö (2016) with a timeline from start to finish and can be generalized to concern the Nordic stock exchanges under the NASDAQ group as Westerholm (2006) comments how the institutional aspects of Denmark, Finland and Sweden are quite harmonic. Generally, the procedure from an initial intention of going public to an IPO varies depending on the preparedness of a given company but a time frame can be generalized to be 6 to 12 months, although can be followed through much faster.

Table 1. IPO process (Pörssisäätiö 2016).

Preliminary work **T- (6 to 12 months)**	- Going through goals and needs (gains via an IPO) - Choosing the underwriter and external advisors (financial, legal etc.) - Making deals with the counterparties regarding the process - Surveying readiness for an IPO (size, profitability, investors' interest) - Creating equity story and preliminary pricing - Converting to applicable accounting standards if needed
Preparing the IPO **T - (3 to 6 months)**	- IPO plan, schedule and fulfilling requirements - Meetings with Financial Supervisory Authority (FSA) and the Exchange - Due diligence process starts - Pricing continues - Drafting prospectus - Planning the issuance and its marketing - Preparing for increasing disclosure requirements
Detailing and decision **to issue equity** **T - (1 to 3 months)**	- Finishing prospectus - Presentation to Exchanges listing committee - Drafting terms and conditions for the IPO - Getting prospectus accepted by the FSA - Premarketing phase
IPO and applying as **a subject of trading** **T - (0 to 4 months)**	- Application to IPO committee and press release - Disclosure obligation begins - Prospectus becomes public - Releasing terms and conditions of the IPO - Marketing the IPO to investors - Board's final call on the IPO - Exchange release on the new public company
T	**TRADING BEGINS**

The listing requirements and disclosure rules are harmonized between the Nasdaq Nordic Main Exchanges and there are only minor differences between Danish, Finnish and Swedish First North market places due to national legislation (Nasdaq 2019). Companies seeking to list their equity in either of the marketplaces need to disclose all information that may have an effect on their valuation in a manner that reaches all market participants simultaneously. Table 2 below depicts the key requirements to be listed in one of the Nordic Main markets or First North according to Nasdaq (2019):

Table 2. Listing requirements for Main and First North markets (Nasdaq 2019).

Key requirements for a listing on Nordic Main Markets
- At least three years of financial and operating history
- Proof of working capital to last at least for 12 months following an IPO
- Corporate governance criteria regarding board composition, financial controls and disclosure liability
- At least 25 % of the shares must be owned by the general public prior to an IPO
- Market value of at least 1 million euros
- Listing prospectus

Key requirements for a listing on First North
- Company must be incorporated according to the laws of its establishment
- At least 10 % of the shares must be owned by general public on a continuous basis
- Minimum offer price of 50 Euro cents
- Firm must publish a company description or prospectus in some cases
- Company must have a contract with a Certified Advisor at all times
- Company must be able to disclose information to market at a timely and reliable manner
- Company must follow accounting standards with applicable laws
- Proof of earnings capacity or sufficient working capital to last 12 months following an IPO

The two market places differ slightly with the requirements faced for an IPO. Main market companies need to be more established with proof of operating and financial history, whereas First North companies do not possess this requirement. All though, First North companies do have a requirement to show earnings potential or proof of working capital sufficiency similarly to Main Market companies. Public float is also a bit different as First North companies are required to have only 10 % of all shares outstanding to be held by the general public, whereas Main Market companies need to have at least 25 % of shares in public holding before commencing an IPO. All though not visible from the table 2, First North Premier companies have stricter requirements that are almost fully harmonized with the Main Market requirements.

4.3. IPO valuation

Valuing the company is an integral part of the IPO process and is run throughout the procedure multiple times due to possible new information alongside the process that could affect an initial valuation made in the get-go. In the literature review previously, initial public offerings suffer from underpricing (see e.g. Ibbotson 1975; Loughran et al. 1994) that culminates in abnormal first-day gains. In order to decrease large abnormal first-day gains and companies not "leaving money on the table" for investors to feast on, valuation of IPOs should be done by practicing extreme care, employing multiple methods.

Underwriters are responsible for the valuation process and they should operate with multiple valuation methods to arrive at a reasonable share price range for an IPO. Regardless of the rigorous use of the various valuation metrics, Roosenboom (2012) documents underwriter biased discounting in the fair value of the preliminary offer, which is further reasoned to accelerate underpricing. The author also documents that the underwriters most often perform discounted cash flow analysis, conduct a dividend discount model and use valuation multiples to perform a sanity check in the process of determining a fair value for an issue. Valuation multiples are important to benchmark the price of a company going public with the rest of the industry, and also often given high emphasis during hot market conditions as discussed previously.

4.3.1. Discounted cash flow method

In the model, estimated future free cash flows of a company are discounted in the present moment and summed, consequently forming the company value. The model is quite the lifesaver in cases, where dividends are not commonly paid and the dividend discount model would either be virtually impossible to conduct or deliver imprecise results at best. The DCF model is also considered as a safe choice because it is not bothered by dividend payment policy nor financial statement arrangements such as deferrals. The model is only reliant on cash flows in and out of the company during a financial period. (Bodie, Kane & Marcus 2014: 617; Kallunki & Niemelä 2012: 224-225.)

In order to perform the discounted cash flow valuation, one needs to determine the free cash flows first. The free cash flow can be determined either for the whole company (FCFF) or for equity (FCFE) (Bodie et al. 2014: 617). When calculating FCFF, capital expenditures and change in net working capital (ΔNWC) are deducted and depreciation added to earnings before interest and taxes ($EBIT$) adjusted with the after-tax term $(1 - t_c)$. The formula according to Bodie et al. (2014: 618) is demonstrated below:

(1) $$FCFF = EBIT(1 - t_c) + Depreciation - Capital\ expenditures\ - \Delta NWC$$

When calculating the free cash flow for equity (FCFE), after-tax adjusted interest expenses are subtracted from the FCFF and change in net debt is added. The formula for FCFE according to Bodie et al. (2014: 618) is described below:

(2) $$FCFE = FCFF - Interest\ expense\ x\ (1 - t_c) + Change\ in\ net\ debt$$

The formulas above are just one way to calculate FCFF and FCFE. The importance in the DCF calculation lies behind the discount rate that should not be mismatched with the type of cash flow. When using FCFF, the discount rate is obtained by using WACC. Reciprocally when free cash flow for equity is being discounted, the evaluator should use the cost of equity as the discount factor, which can be obtained for example with the CAPM or multifactor models. Using an accurate discount rate is essential, since it has a big impact on the valuation outcome, meaning that using a distorted discount factor results in corrupt valuation quickly. (Kallunki & Niemelä 2012: 225; Koller, Goehardt & Wessels 2015: 42-43).

It goes without saying that the free cash flow model faces challenges. Estimating future cash flows is difficult and gets remarkably problematic after the first few years of the forecast even when there is a good amount of data to track. In theory, companies are founded to be eternal, thus leading to an infinite amount of cash flows to be discounted in the present moment when performing a DCF valuation. Calculating infinite cash flows is not reasonable, which is why analysts usually take an arbitrary point of view in the length of the forecast, ranging from a few to ten years (Brealey et al. 2014: 94).

In furtherance of getting cash flows beyond the forecast period, one needs to determine the *terminal value* of cash flows at the last discount period, which considers the problem that the going concern mentality induces (Koller et al. 2015: 145). Terminal value of cash flows is used because of increasing uncertainty in future cash flows and for practical matters for not having to estimate these uncertain cash flows reaching infinity. Choosing a suitable growth rate for terminal year cash flow is difficult and should not be chosen to be greater than the average growth rate of economy on infinite periods, because this results in value that would surpass the combination of all companies in the world over time, which simply is not realistic (Palepu et al. 2016: 363). Determining future growth rate precisely is a difficult task and plays a big part in the terminal value, which adds uncertainty into the calculation (Bodie et al. 2014: 621).

Finance textbooks say that terminal value for free cash flow can be calculated in different ways either by the usage of different multiples (e.g. earnings or EBIT) or by employing the terminal cash flow, perpetuity growth and discount factor (Bodie et al. 2014: 618; Brealey et al. 2014: 94-95; Palepu et al 2015: 366-367). Recently mentioned textbooks suggest the use of steady growth discounted cash flow formula as the most common one in use. In the model, the terminal year free cash flow ($FCFn$) is divided with the subtraction of discount factor and assumed long-term growth rate. The calculus for terminal value is demonstrated below:

(3) $$TV = \frac{FCF_n}{(discount\ factor - long\ term\ growth\ rate)^t}$$

The formula for determining company value using free cash flows including the terminal value goes in the following way: Estimated free cash flows (FCF) of each year and the terminal value (TV) at time t are divided by the yearly discount factors $(1 + WACC)^t$ and added together forming the present value of the company (P_0).

(4) $$P_0 = \frac{FCF_1}{1+WACC} + \frac{FCF_2}{(1+WACC)^2} + \frac{FCF_3}{(1+WACC)^3} + \ldots + \frac{FCF_t}{(1+WACC)^t} + \frac{TV}{(1+WACC)^t}$$

Intuitive from the formula number 4, having a higher cost of capital results in bigger denominators in the equation, which will lead to lower net present value of the company. Therefore, considering even slightest changes in the valuation inputs have a remarkable effect on the output and multiple different scenarios should be made with different figures.

4.3.2. Dividend discount model

Another often employed valuation method based on the future payoffs generated by the company is the dividend discount model (DDM). The model uses future dividends as a proxy in determining the intrinsic value of a company. According to the model, the present value of a firm is the summation of its future dividends for shareholders. On occasions with no dividends in the near future e.g. with growth companies that invest aggressively, the method is difficult to apply, though fundamentally correct in valuing equity. (Brealey et al 2014: 84).

When there is sufficient dividend history recorded, the method is relatively nonchalant to apply even though future dividends must be forecasted. When there are no recorded dividends, the model faces immense problems and forecasting will be based on subjective assumptions. The model calculates estimated future dividends (D) from year one onwards and discounts them to the present moment by using the cost of equity $(r_e + 1)^t$ as the yearly discount factor (Brealey et al. 2014: 81-82). The model is mathematically illustrated in the following form:

(5) $$P_0 = \frac{D_1}{(1+r_e)} + \frac{D_2}{(1+r_e)^2} + \frac{D_3}{(1+r_e)^3} + \ldots + \frac{D_t}{(1+r_e)^t}$$

Similarly to the free cash flow calculation, the present value of the company is dependent on the assumptions made in both denominators and nominators. Moreover, the cost of equity and future dividends dictate the present value of the company in the dividend discount model. The more expensive equity capital becomes over time or a lesser amount of dividends it is expected to distribute to shareholders, the less the company is worth today.

Since forecasting dividends indefinitely is a tedious task and produces high chances of error, a more pragmatic point of view has been developed. Gordon's growth formula disregards the calculation of yearly dividends to the unforeseeable future and rather assumes a steady growth rate for the next year dividend to take into account the future dividends. (Brealey et al. 2014: 84) The model's algebraic illustration is the following:

(6) $$P_0 = \frac{D_1}{r_e - g}$$

Intuitive from the formula above, the stock price is dependent on three factors: forecasted next year dividend (D_1), cost of equity (r_e) and growth rate of the future dividends (g). The stock price is positively correlated with higher next year dividend and growth rate of the future dividends, whilst negatively related with the cost of equity. The formula faces some limitations as the growth rate of dividends cannot be assumed to surpass the cost of equity, which would yield negative stock value. Similarly, the growth rate of future dividends cannot be extremely close to the cost of equity due to the infinitely high stock prices when denominator approaches zero (Brealey et al. 2014: 84).

4.3.3. Market approach to valuation

Companies looking to execute an IPO might be young firms with no reliable track record, which are generally difficult to value with either cash flow or dividend discount methods that depend on a firm's ability to generate cash flows to a company and its owners. Therefore, using accounting data to form multiples is a standard practice in valuing such companies (Ritter & Kim 1999: 409). In addition, investors value companies basing on existing companies' values and are suspicious of companies whose value deviates from the average of a specific industry's multiple under investigation.

When companies are appraised from the perspective of the market, a comparable group of companies and their respective multiples formed from accounting information are exploited to form a fair value of the business under evaluation. This can be done by examining similar public companies and their multiples, recent public market transactions or by inspecting private business transactions attainable from databases. In order to get a hold of the value, one needs to employ valuation multiples as a proxy to reflect the value of a comparable company. In theory, utilizing the market approach should provide the same value as the previously seen DCF and DDM methods due to the same fundamentals ultimately driving the value in each approach. Evidently, forming a fair value via market approach stresses the fact that comparable companies are valued correctly based on their intrinsic value and are not priced by irrational investor sentiment. (Bernström 2014: 5-6.)

Often used multiples employ company's market price (P) or enterprise value (EV) divided with various accounting metrics to arrive with a price that the company should be traded in the markets. As a sign of versatility, Bernström (2014: 43) notes how multiples can be generated for industry-specific reasons, employing variables that are characteristic or important in describing the value created in a certain industry.

4.3.4. Price multiples

The price multiples compare the market value of equity to various parameters such as earnings and sales. The price-earnings multiple enjoys fame granted by investors. It is coined nearly a hundred years ago and is still in common use and a relevant metric. What the P/E-ratio defines, is the amount of time it would take for the company to pay back the market value of equity with its earnings. The ratio is calculated by dividing the market value of equity capital with the net income, or the market value per share divided with earnings per share. (Kallunki & Niemelä 2012: 189-195.) The formula is demonstrated below:

(7) $$P/E - ratio = \frac{market\ value\ of\ equity}{net\ income} = \frac{market\ value\ per\ share}{earnings\ per\ share}$$

The P/E-ratio can be trailing or forward-looking, meaning that it can be derived by trailing historical P/E-ratios or forecasting the future earnings and their growth (Palepu et al. 2015: 313). Regardless of which way of approaching is used, the data reliability arises in a key position (Bernström 2014: 50). Kim and Ritter (1999) make a finding in their study on IPO valuation that suggests forward-looking P/E-ratio much more accurate than the historical values trailing one even though it requires forecasting of volatile future earnings. On the other hand, history does not necessarily act as good guarantee on future success than what more dynamic forward-looking measures do.

All though the P/E-ratio definitely is widely recognized and well kept, it is not a ubiquitous method that applies in every situation. In cases of negative earnings the ratio gets a negative value, and when earnings are zero or close to zero, the ratio is uninterpretable (Kallunki & Niemelä 2012: 198). In most cases, IPO companies do have revenues and earnings as they are required to show at least earnings potential and sufficiency of working capital as seen in the requirements to be admitted in a Nordic exchange previously in this chapter.

4.3.5. Enterprise value multiples

Valuation by enterprise value multiples is done by dividing the market value of invested capital (EV) by various metrics available from income and cash flow statements. In practice, these metrics are e.g. EBITDA, sales and FCF (Bernström 2014: 40). The enterprise value based models are better than P/E-ratio because they take company debt level into account. Operating income and profits are also easier to interpret and tax level differences do not affect operating income and profits as they do in net income (Kallunki & Niemelä (2012: 204).

After hearing such benefits, one could wonder why enterprise value based methods are not as popular as price based P/E-ratio among practitioners doing valuation. Once again, this can be reasoned by the easy calculation of P/E-ratio and vast availability of information to do a "quick and dirty" valuation of a company with a simple P/E-ratio.

5. DATA AND METHODOLOGY

The following chapter discusses the data collected and the methodologies used to empirically test the developed hypotheses based on previous literature. The chapter is divided as follows: The dataset is introduced first and analyzed for descriptive purposes. Then the methodology is presented and fitted in the context of empirically testing the data concerning listed equity issues in the Nordic markets.

5.1. Data

The data gathered for this study come from a variety of sources. Information regarding the characteristics of the issue such as the number of shares, gross proceeds collected, offer price, sales and R&D expenditure are primarily gathered from listing prospectuses of the issues occurred in the Nordic countries from 2005 to 2015. The prospectuses' information is further cross-checked by using news articles of the issuing company to see if there have been updates to the characteristics of the IPO after the prospectus has been released.

The year 2005 was chosen as the starting point as initial public offerings started to occur more often after the turn of the millennium technology bubble and its aftermath and the year 2015 as the ending point to have 36 months of share price data to determine the long-term performance. Moreover, the prospectuses of companies gone public from 2005 onwards from Finnish issues, 2006 onwards from Swedish issues and from 2007 onwards from Danish issues are freely available from each country's financial supervisory authority's online archive. Prospectuses from Swedish and Danish issues not included in the financial supervisor's web archives are collected by manual web searches.

A range of exclusions have been made to arrive at the final sample of IPOs. First, stocks that have gone public in an alternative Nordic market place (e.g. Aktietorget and Bequoted in Sweden) are excluded from the sample and so are stocks that have switched lists from an alternative market place to main exchanges or First North market place. Secondly, banks and financial firms are not included in the sample as they have largely different debt and equity ratios to non-financial firms. Thirdly, companies that have a primary listing elsewhere, are dual listed or if the home country of an issuer is not a Nordic nation are excluded. Fourthly, companies with no revenues the year prior to an exchange debut are omitted from the sample. Lastly, companies that have listed via a reverse acquisition, spinoff or a carve-out are excluded from the sample to include only the listings of companies with no previous trading history in order for the sample to represent "true" IPOs. Norwegian IPOs are excluded as the Oslo exchange does not belong to the NASDAQ Group, which governs the Danish, Finnish, Icelandic and Swedish First North and Main markets. Icelandic IPOs are also excluded from the sample due to the markets' outlier nature, very small size and high amount of financial firms listing to the market place. These exclusions provide a sample of 136 IPOs in the three Nordic countries for the 11 year time period from 2005 to 2015.

The sample includes IPOs of companies that have delisted after their initial public offering either due to an acquisition or financial distress. In event-time setting, the last observable time period for these companies are utilized and in calendar-time setting the returns of last month of public trading are taken into consideration. Therefore, survivorship bias is not present in the sample as all IPOs included in the sample are also imported to the analyses, regardless of the length of their history as a publicly traded enterprise.

Stock price data for the issuing companies' are collected from Datastream as well as from the NASDAQ OMX Nordic website. As a benchmark for the IPO returns in event-time analysis each country's capped price indices are used to adjust raw returns with market returns and the MSCI Nordic price index is used as the benchmark in the calendar-time analysis due to portfolios including IPOs from each of the three countries. The price indices ignore dividends and they are not taken into account on firm-specific level either in this study. Stock splits, however, are taken into account with the adjusted prices. As the risk-free rate in calendar-time regressions the 1-month Euribor rate is used.

Accounting data, if not retrieved from individual prospectus, are derived from Datastream and Orbis. Moreover, the sales and R&D expenditure prior to exchange admission are mainly checked from the company publications in order to avoid noise in the data that that is in pronounced position especially for the smallest firms that are also scarcely available from Datastream and Orbis.

According to Pörssisäätiö (2018), during the sample period there occurred a total of 479 IPOs in Danish, Finnish and Swedish markets including alternative market places in Sweden and switches between exchange lists that are in a pronounced role in the Swedish initial public offerings scene. Conferring to Nasdaq (2019), through the life of Swedish First North market place, on average five companies yearly have switched from First North to Main Market. Also, a majority of the companies IPOing in Sweden during the sample period have been already publicly traded companies in either of the smaller alternative market places or First North switching between lists. Some of the list switchers have issued new equity in the process, whilst others have merely been content with switching to a more widely known market place in order to gain awareness of the company and its business. Regardless of the motives for an exchange switch, these list switching companies are excluded from the sample altogether.

The offer price, if not fixed, is calculated as a weighted average from the price and shares allotted to institutional investors, individual investors and in some cases to personnel. Often times the weighted offer price is very close to the institutional investors and individual investors received price as they are allotted the most shares in an offering and the often substantially discounted personnel subscription prices pay therefore only a minor effect with small economic significance. The final offer price is also checked from press releases close to the issue date to see if the offer price has changed due to altered demand towards a company's equity and in order be sure of the figures affecting underpricing.

5.1.1. Descriptive statistics

After considering all the necessary exclusions needed to make the sample as clean as possible from noise caused by list-switching companies and other "impure" IPOs, the final sample consists of 136 new equity issues occurred in the Danish, Finnish and Swedish markets during the 11 year time period from 2005 to 2015. The number of IPOs in the sample is left-skewed as there occurred quite substantially more initial public offerings in the last two observation years, whereas the first years were more moderate and the heart of financial crisis took its toll in listing activity in the midpoint of the sample. Sweden is the biggest issuing nation with most activity in its market places as seen in figure 1 previously. The country has more alternative market places than Denmark and Finland, which partially explains it, but also the sample including only First

North and Main market listings dwarfs the same figures of Denmark and Finland. Table 3 further shows the listing activity over the sample period in the three countries.

Table 3. Distribution of IPOs included in the sample.

Year	Denmark	Finland	Sweden	Total
2005	1	2	5	8
2006	5	2	5	12
2007	4	2	6	12
2008	2	0	2	4
2009	1	0	0	1
2010	3	0	6	9
2011	0	0	6	6
2012	0	1	2	3
2013	1	2	4	7
2014	2	5	23	30
2015	1	9	34	44
Total	**20**	**23**	**93**	**136**

The descriptive statistics of the sample are displayed in table 4. The mean IPO in the sample was underpriced by 6.85 percent for the period, including outliers, which is lower than the average underpricing of 17.11 percent that Westerholm (2006) finds in his Nordic sample or the 15.62 percent average initial abnormal return of Hahl et al. (2014) sample of Finnish IPOs. The median underpricing of 4.87 percent in the sample is expectedly lower than average due to the positive skew of underpricing. Westerholm documents a median value of 5.22 percent, which is far lower than the average underpricing in his sample. The result signifies a more adverse positive skew in his sample of Nordic IPO underpricing attributable to the sample period with high degree of underpricing among IPOs.

The average sales prior to an IPO in the sample is about 384 Meur and average market capitalization at the offer price is about 330 Meur. Mean expenses towards research and development in the sample is 2.4 Meur and scaled to sales the mean expenses, or mean R&D intensity, is about 35 percent. Mean gross proceeds for the issues are almost 114 Meur. Median values are expectedly lower due to the inclusion of First North IPOs that are smaller on aggregate.

Table 4. Descriptive statistics.

Panel A						
Offer Characteristics	**Mean**	**Median**	**Min.**	**Max**	**Std.**	**N**
Underpricing	6.85 %	4.87 %	-33.33 %	163.47 %	22.42 %	136
Offer price EUR	6.57	5.29	0.52	58.32	6.65	136
Proceeds MEUR	113.91	37.91	1.02	1335.78	199.63	136

Panel B						
Firm Characteristics	**Mean**	**Median**	**Min.**	**Max**	**Std.**	**N**
Age	25	15	0	155	29	136
Market Cap. MEUR	329.56	86.72	4.23	3980.19	657.08	136
Sales MEUR	383.59	33.56	0.01	10511.00	1327.25	136
R&D MEUR	2.40	0.00	0.00	57.27	6.64	136
R&D to Sales	35.05 %	0.00 %	0.00 %	2000.00 %	184.50 %	136

5.1.1. Constructing portfolios

In this paper, the key distinction in dividing the sample IPOs in two groups is made by observing the research and development expenses of a company year prior to its exchange admission. A portfolio holding all companies is built for each analysis period and method, but also two additional portfolios are built similarly to Chan et al. (2001) depending on the question whether a firm had research and development expenses in the year prior to its exchange debut. Firms with R&D expenditure prior to an exchange admission are assigned to "R&D intensive" portfolio and firms with no expenditures to "R&D unintensive" portfolio. The portfolio holding all IPOs consists of 136 companies assuming a public status in either one of the sample countries, R&D intensive portfolio holds 55 of those companies and the R&D unintensive portfolio 81 of the IPO companies.

In order to synchronize differences in trading days between calendar months in the event-time analysis, an average number of trading days for each holding period are used. The one month event-time period includes 22, three month period 66, six month period 132, twelve month period 252 and thirty six month period 756 consecutive trading days. In the calendar-time analysis, the problem is tackled by including an IPO in a portfolio the month following its exchange debut and held there for either 6 or 36 months until dropping them from the portfolio, if not delisted before.

5.2. Methodology

The aftermarket performance of issuing companies is examined from two points of view using event-time and calendar-time approaches in measuring short and long-term performances of the issuing companies. The short-term performance is studied by examining 1, 3 and 6 month periods' returns in addition to the first-day stock return following an exchange debut. The long-term returns are calculated by imitating similar periods as previous literature (see e.g. Ritter 1991; Keloharju 1993; Hahl et al. 2014; Amor and Kooli 2017) on using 12 and 36 month periods after the issue. If a firm is delisted before reaching its 36 months anniversary, the last quotation is implemented and company is omitted from subsequent periods reaching the three-year mark in a stock exchange. The sample includes 2 companies that do not last a full year in their respective market places and 6 companies that are delisted before 36 months of trading. Survivorship bias is omitted with these results in mind.

5.2.1. Event-time returns

First measuring the initial underpricing, event-time abnormal returns (AR) are calculated, which take into account the initial return of an issuing company adjusted to benchmark returns on the given issue day. The benchmark-adjusted initial abnormal returns for each issue at event-time t are calculated as:

$$ar_{it} = r_{it} - r_{bt} \qquad (8)$$

In the formula above, ar_{it} is the initial abnormal return for company i at time t. r_{it} is the return for company i at time t and r_{bt} is the return of the benchmark index at time t. The previous formula further elaborates to calculating the average abnormal returns in the following manner by taking an equally-weighted average of the benchmark adjusted returns of the sample IPOs:

$$AR_t = \frac{1}{n} \sum_{i=1}^{n} ar_{it} \qquad (9)$$

The above formula sums up the abnormal returns of each issue and the result is the average abnormal return for a given portfolio. AR_t in the model depicts the average abnormal return at time t, n is the number of IPOs and ar_{it} denotes the abnormal return for a company i at time t. Each IPO's abnormal returns are calculated by benchmarking the company's stock market debut day return with its stock exchange's capped price index return on the same day. Capped indices are used due to the inclusion of the First North listings and their aggregately smaller size compared to main listed companies. Using value weighted indices would therefore skew the benchmark returns to match those of the largest companies, especially harmful in the Finnish exchange where a big portion of the total market capitalization is firmly dictated by a few large corporations.

Having calculated the average abnormal returns for the whole sample of IPOs, R&D intensive IPOs and R&D unintensive IPOs, the average values of each group are tested to see whether they differ significantly from zero i.e. if the groupings witness statistically significant underpricing. Calculating t-values to determine whether the abnormal returns significantly differ from zero is done in the following way by using the Student's t-test:

(10) $$t = \frac{AR-0}{s/\sqrt{n}}$$

In the formula above, t denotes the test statistic for the Student's t-test, AR is the average abnormal return, s denotes standard error and n signifies the number of companies for this instance. In addition to testing the means of each IPO group, the medians are tested with the Wilcoxon signed-rank test to examine whether the median values differ significantly from zero as well. Following methods by Hahl et al. (2014), a comparison between the two IPO groups' initial abnormal return means is done with an independent two-sample t-test of unequal sample sizes and variances (Welch's t-test) to test the equality of means:

(11) $$t = \frac{AR_{int.R\&D} - AR_{un.R\&D}}{\sqrt{\left(\frac{S^2{}_{int.R\&D}}{n_{int.R\&D}} + \frac{S^2{}_{un.R\&D}}{n_{un.R\&D}}\right)}},$$

where $AR_{int.R\&D}$ is the average abnormal returns of R&D intensive IPOs, whilst $AR_{un.R\&D}$ is the average abnormal return of the R&D unintensive firms. S^2 denotes variance and n is the number of initial public offerings in this instance. Similarly, the difference in medians is tested using the nonparametric Wilcoxon Ranked-sum test to examine whether the R&D intensive and R&D unintensive groups' median initial abnormal returns differ significantly from each other.

In addition to the initial first day returns, 1, 3 and 6-month returns depicting short-term performance are also examined in this paper with the long-run performance for 12 and 36-month periods. Following methodology by Ritter (1991), Keloharju (1993) and Hahl et al. (2014) wealth relatives are used to measure benchmark-adjusted returns for the previously mentioned periods of short and long-term returns. Wealth relatives are implemented due to their nonchalant nature what comes to interpretation, and as Keloharju (1993: 258) notes, the included holding period return, required to calculate wealth relatives, does not require similar monthly rebalancing what CAR methods would do. If an attained wealth relative is above 1, a particular IPO has outperformed the benchmark and in a similar manner, an IPO underperforms with wealth relatives that are below the value of 1. Before calculating wealth relatives for each examination period, the holding period returns for each IPO for every examination period should be calculated first. Wealth relatives are examined on two different occasions by including the initial returns and by making an exclusion with the initial first-day gains of an offering. The holding period return for stock i at time t is calculated in the following manner in equation 12:

$$HPR_{it} = \frac{P_t - P_0}{P_0}, \tag{12}$$

where P_t denotes the closing price of a stock in a certain measurement period and P_0 is either the offer price or the closing price on the first day of trading. With the holding period returns calculated for each company at times t, the wealth relatives can be calculated for each of the short and long-term periods to see if there occurs abnormal returns in either direction in the following manner in equation 13:

$$WR_{it} = \frac{(1 + HPR_{it})}{(1 + r_{bt})} \tag{13}$$

In the formula above, WR_{it} denotes the wealth relative of stock i at time t. HPR_{it} depicts the holding period return of a stock i at time t, and r_{bt} is the benchmark return at time t. Similarly to average abnormal returns previously, the equally-weighted average of wealth relatives are calculated for all IPOs and the two sub groups in the following manner for each examination period as in equation 14 on the next page:

(14) $$WR_t = \frac{1}{n}\sum_{i=1}^{n} wr_{it}$$

WR_t denotes the average wealth relative for period t, n is the number of IPOs in this instance and wr_{it} is an individual stock's i wealth relative at time t. Similarly to testing initial abnormal returns, the mean wealth relatives are studied with the Student's t-test to examine whether they differ significantly from the value of 1.00, which signifies faring at par with the market. The median WRs significance is examined with the Wilcoxon Signed-rank test in a similar manner to measuring the median abnormal returns' significance.

(15) $$t = \frac{WR-1}{s/\sqrt{n}}$$

In the equation 15, *WR* denotes the equally-weighted average wealth relative, s denotes standard deviation and n is the number of IPOs in this instance. Similarly in tests with average abnormal returns, the mean wealth relatives of the two subgroups are tested following Hahl et al. (2014) with the independent two-sample t-test for unequal sample sizes and variances in the following manner:

(16) $$t = \frac{WR_{int.R\&D} - WR_{un.R\&D}}{\sqrt{\left(\frac{S^2{}_{int.R\&D}}{n_{int.R\&D}} + \frac{S^2{}_{un.R\&D}}{n_{un.R\&D}}\right)}},$$

where $WR_{int.R\&D}$ is the average wealth relative of the R&D intensive portfolio for the examination period under inspection, $S^2{}_{int.R\&D}$ is the variance of the R&D intensive portfolio and $n_{int.R\&D}$ is the number of IPOs in the R&D intensive portfolio, the same logic with the notations apply with the R&D unintensive portfolio as well in the formula. Lastly, the Wilcoxon Ranked-sum test is employed to examine whether the R&D intensive and R&D unintensive groups' median WRs differ significantly from each other.

5.2.2. Calendar-time returns

Following previous literature (e.g. Brav et al. 2000; Hahl et al. 2014 and Amore et al. 2017) risk-adjusted returns are also implemented to test the return characteristics of IPOs in the sample. The event-time returns completely discard the riskiness of an individual company and assumes that each IPO shares the same risk features. Therefore, the event-time analysis is accompanied by the calendar-time analysis utilizing factor models. Previous studies also note that IPO performance measurement is affected by the choice of methodologies and Fama and French (1993) three-factor model has exerted insignificant results for abnormal returns and evidence of no abnormal performance compared to event-time methods. In this paper, the abnormal IPO returns are regressed with multiple risk factors starting with the single factor Capital Asset Pricing Model.

(17) $$R_{pt} - R_{ft} = \alpha_p + \beta_1(R_{mt} - R_{ft}) + \varepsilon_t$$

Where $R_{pt} - R_{ft}$ depicts portfolio's monthly excess return over the prevailing risk free rate for a given period, α_p depicts the abnormal returns for a portfolio, β_1 is portfolio's sensitivity to market returns, $(R_{mt} - R_{ft})$ is the market risk premium and ε_t is the error term of the regression. The single factor model above seeks to explain stock returns by only using excess market returns, which has turned out to be an incomplete measure and further studies have proven other factors to explain stock returns. Fama and French (1993) come up with two additional risk factors that explain the cross-section of stock returns and introduce the three factor model that builds on the single factor model above:

(18) $$R_{pt} - R_{ft} = \alpha_p + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3\text{HML} + \varepsilon_t$$

The additional factor SMB depicts the return of small stocks minus the return of big stocks and HML describes the return of value stocks minus the return of growth stocks, proxied with the book-to-market ratio. Fama and French (1993) combined the already documented outperformance of small stocks over large ones and value stocks over growth stocks in long-run, which formulated in their analysis in the above risk factors to describe cross-sectional stock returns.

The three-factor model is further augmented by Carhart (1997) into a four-factor model that includes the momentum factor, which depicts the return difference of past winners and past losers. The author noticed on his examination of mutual fund managers that their performance was not attributable to superior stock picking skills per se, but was explainable with common factors that the asset pricing models did not take into account at the time.

(19) $$R_{pt} - R_{ft} = \alpha_p + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML + \beta_4 WML + \varepsilon_t$$

In the above Carhart (1997) model, the additional WML factor explains the stock returns better than the three-factor model of Fama and French (1993) as investor sentiment often affects the stock returns and stocks may engage in momentum generating positive alphas. The factor models were most recently updated by Fama and French (2015) five-factor and Fama and French (2018) six-factor models. The five-factor model incorporates two additional factors in the three-factor model and six-factor model adds the Carhart (1997) momentum factor in the five-factor model. The Fama and French five-factor model (2015) is demonstrated in equation 20:

(20) $$R_{pt} - R_{ft} = \alpha_p + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML + \beta_4 RMW + \beta_5 CMA + \varepsilon_t$$

The additional factors RMW and CMA are known as the profitability factor and investment factor, which add explanatory power to the previous three-factor model. RMW is the return of robust operating profitability companies minus the return of weak operating profitability companies, suggesting that profitability explains stock returns as first introduced by Novy-Marx (2013). The CMA factor measures the return difference of aggressively investing companies from conservative investors as a proxy for investment and average returns, an anomaly documented by Aharoni, Grundy and Zheng (2013).

The six factor model by Fama and French (2018) includes the previous five factors and adds the Carhart (1997) momentum factor in the model. The six-factor model goes in the following way:

(21) $$R_{pt} - R_{ft} = \alpha_p + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML + \beta_4 RMW + \beta_5 CMA + \beta_6 WML + \varepsilon_t$$

All of the factor loadings used in this paper are on European level and downloaded from the Kenneth French data library, except for the excess market return. As the market portfolio in this study, the monthly returns of the MSCI Nordic Countries Index are used due to the index' better representativeness of the Nordic stock universe and its low about 10 % weight on Norwegian stocks and capped weights of companies, which gives smaller emphasis to the large-cap stocks in the country indices. The loadings are used on a monthly level and portfolios holding all IPOs, R&D intensive IPOs and R&D unintensive IPOs are constructed separately for 6 and 36-month periods. A company is included in a portfolio the month following its exchange debut and dropped 6 or 36 months after the portfolio inclusion. Equally weighted returns are calculated for each portfolio for each calendar month and excess returns are calculated by adjusting the monthly portfolio returns with the prevailing risk-free rate. The six-month portfolios suffer from thinness from time to time and few observation months have to be excluded from the calendar-time regressions due to no observations during those months. The 36-month portfolios are exempt from this problem because of the more abundant nature of IPOs in portfolios given by the longer holding period.

5.3. Limitations of the study

This study faces certain limitations. The final sample size will not be as big as have been in previous literature that focuses on the biggest equity markets in the world. Even when the Nasdaq Nordic markets are combined, the sample remains relatively small due to the range of exclusions made to preserve a pure sample of IPOs. Therefore, the results may not be fully compatible with the previous studies and certain patterns might get a pronounced position in the smaller market setting. If economic significance is found, statistical significance is more demanding to obtain and the results need to be interpreted with objectivity.

The returns for each stock at given periods are obtained by observing the split-adjusted price history, which discards return properties accompanied by firms paying out dividends, although controlled by using price indices as benchmarks. This may have an effect for the long-run results of companies with generous dividend policies, although IPO markets are usually more plentiful with younger companies with no intentions to pay out dividends and the exclusion of dividends should not as a result pay a significant role in this thesis.

6. RESULTS

The results of the IPO aftermarket performance analyses are presented in this chapter. The methodologies and data presented in previous parts are put to practice with the data fitted to the presented models. The short-term performances are first examined in event-time on the first trading day and for 1, 3 and 6 month periods and then in a calendar-time setting using a 6-month rolling portfolio to assess the difference in risk profiles of the portfolios that event-time analysis discards. The long-term performance is further assessed for 12 and 36 month periods in event-time and for a 36-month rolling period in calendar-time.

6.1. Abnormal initial returns

Table 5 below depicts results for the initial returns adjusted for market returns for both IPO groups, their difference and for the whole sample as well. Mean and median abnormal initial returns are presented in this analysis and the significance of the means are tested with the Student's and Welch's t-tests, whereas the significance of medians are tested with the nonparametric Wilcoxon Signed-rank and Wilcoxon rank sum tests. The t-statistics (z-statistics) signifying statistical significance are presented below the mean (median) values and their level of significance adjusted for the degrees of freedom are denoted with asterisks, where * denotes significance at the 10 % level, ** denotes significance at the 5 % level and *** denotes significance at the 1 % level.

Table 5. Abnormal initial returns.

	All IPOs	**R&D intensive**	**R&D unintensive**	**R&D int. – R&D unint.**
Mean	7.32 %	3.62 %	9.83 %	-6.22 %
t-stat	3.73 ***	1.92 *	3.29 ***	-1.76 *
Median	5.17 %	3.22 %	5.87 %	-2.65 %
z-stat	4.18 ***	4.52 ***	6.41 ***	-0.89
Max.	163.09 %	39.06 %	163.09 %	
Min.	-34.35 %	-34.35 %	-32.64 %	
St.dev.	0.23	0.14	0.27	
N	136	55	81	

All new equity issues on average produced abnormal returns of 7.32 percent (5.15 percent with outliers removed), which is in accordance with previous literature on IPOs being significantly underpriced and producing positive abnormal returns on their first trading day globally and in the sample countries (see e.g. Ibbotson 1975; Ritter 1991; Keloharju 1993; Westerholm 2006; Hahl et al. 2014). The median values are expectedly lower than the averages due to the few extreme positive observations in the sample, such as the maximum initial abnormal return of 163.09 percent. Also, the mean and median values are closer to each other as opposed to previous studies in the Finnish and Nordic markets due to the exclusion of the technology bubble and high levels of underpricing back then.

An interesting notion is the considerably lower underpricing of R&D intensive companies compared to the R&D unintensive firms. The average abnormal initial returns for R&D intensive firms is only 3.62 percent, whereas R&D unintensive companies, on average, have initial abnormal returns of 9.83 percent. The mean difference of the underpricing between the two groups is also statistically significant. Referring to Li (2011), R&D intense companies should be more financially constrained and are more risky than firms with no R&D investments, and in the case of inclusion of smaller First North companies in the sample, the financial constraints are largest for the small R&D intensive companies. The results of initial abnormal returns are against the first hypothesis, which assumes that R&D intensive companies are more underpriced due to their high growth expectations granted by investors. The adverse relationship between investments towards R&D and underpricing could be the result of information asymmetry and investors being less convinced by investments to research and development in the R&D intense Nordic nations as opposed to the previous results by Guo et al. (2006) with U.S. data.

6.2. Short-run performance

Results of the short term performance for the sample IPOs measured by 1, 3 and 6 month periods in event-time and for 6 month period in the calendar-time setting are presented here. The event-time approach includes using both initial returns adjusted wealth relatives and wealth relatives excluding the first day returns. Panels “a” in event-time wealth relative tables exclude the initial returns and panels "b" include the initial returns. Calendar-time analysis omits the first trading day returns as companies are included in the rolling calendar-time portfolios the month following their exchange debut.

Statistical significance of the regression factors are measured with the Student's t-test for which the t-statistics are marked in parenthesis under the factor loadings and their statistical significance are further implied with asterisks, where * denotes significance at the 10 % level, ** denotes significance at the 5 % level and *** denotes significance at the 1 % level. The event-time mean and median significance are measured in a similar manner to the initial abnormal returns with the t-test and z-test and their significance are marked with the previously described asterisks as well. Table 6 shows the results for 1 month wealth relatives.

Table 6. 1 month wealth relatives.

	All IPOs	**R&D intensive**	**R&D unintensive**	**R&D int. – R&D unint.**
***Panel a:* 1 month WRs excluding initial return**				
Mean	0.99	0.97	1.00	-0.04
t-stat	-0.61	-2.04 **	0.18	-1.22
Median	0.97	0.97	0.97	0.0053
z-stat	-2.92 ***	-2.32 **	-1.96 *	-0.14
Max.	2.54	1.30	2.54	
Min.	0.64	0.67	0.64	
St.dev.	0.20	0.12	0.24	
N	136	55	81	
***Panel b:* 1 month WRs including initial return**				
Mean	1.04	1.00	1.07	-0.07
t-stat	1.77 *	0.01	2.04 **	-1.58
Median	1.00	1.00	1.00	-0.01
z-stat	0.91	0.00	1.28	-0.86
Max.	2.54	1.80	2.54	
Min.	0.53	0.57	0.53	
St.dev.	0.28	0.21	0.32	
N	136	55	81	

A noteworthy finding table 6 is the IPO companies' marginally poor and highly significant performance if the initial returns are not taken into consideration. R&D intensive firms' subsequently poorer performance compared to unintensive firms continues when mean WRs are examined, but both groups and the whole sample have significant and equally poor median WRs if initial returns are excluded. When initial returns are included in the analysis, the R&D unintensive and whole sample of IPOs fare significantly better than their respective benchmark indices in terms of mean WRs, whilst the R&D intensive firms' returns are positive but insignificant from the market returns. Mean and median differences are not significant as the differences are only slight and therefore the two groups do not differ meaningfully in terms of mean and median WRs. The result of R&D unintensive IPOs receiving better WRs for the 1 month period seems self-explanatory as the R&D unintensive companies are significantly more underpriced and realize higher initial returns, which in turn has a positive influence in their early aftermarket performance as documented by Purnanandam et al. (2004).

Table 7. 3 month wealth relatives.

	All IPOs	**R&D intensive**	**R&D unintensive**	**R&D int- R&D unint.**
***Panel a:* 3 month WRs excluding initial return**				
Mean	0.99	0.96	1.02	-0.06
t-stat	-0.23	-1.45	0.56	-1.36
Median	0.98	0.97	0.98	-0.01
z-stat	-0.92	-1.01	-0.39	-0.42
Max.	2.07	1.33	2.07	
Min.	0.29	0.33	0.29	
St.dev.	0.26	0.20	0.29	
N	136	55	81	
***Panel b:* 3 month WRs including initial return**				
Mean	1.05	1.00	1.08	-0.09
t-stat	1.71 *	-0.12	2.21 **	-1.62
Median	1.03	1.01	1.05	-0.04
z-stat	1.33	0.26	1.72 *	-1.07
Max.	1.97	1.73	1.97	
Min.	0.23	0.29	0.23	
St.dev.	0.32	0.29	0.33	
N	136	55	81	

The phenomenon of R&D unintensive companies performing better than the R&D intensive firms acknowledged with the initial returns and 1 month WRs continues in the 3 month observation period as seen in table 7. Without the initial returns taken into account, the R&D intensive companies lose to the markets at a similar magnitude as in the 1 month WR examination and R&D unintense companies perform at slightly higher figures, although both insignificantly. When initial returns are taken into account in panel "b", the R&D unintensive companies significantly beat the market in mean and median terms, whereas the R&D intensive companies perform at par with the market with no significant difference. Similarly to 1 month performance in table 6, the portfolio holding all companies in table 7 performs at a similar level above market returns, suggesting the importance of initial returns in the short-term holding of IPO firms.

Hahl et al. (2014) find similar underperformance with the 1 month WRs excluding initial returns providing an insignificant mean value of 0.97 for all IPOs but statistically significant median values of 0.97 for value IPOs and portfolio holding all IPOs. As opposed to results in table 6 panel "b", Hahl et al. (2014) find greater outperformance for IPO companies when initial returns are included in the analysis, which can be reasoned with the sample period from 1994 to 2006 they used in their paper. The sample period includes the technology boom that arrogated very high initial returns for companies listed during that time, contributing to high 1 and 3 month WRs when initial returns are included. The mean differences in panels "a" and "b" are not significant, but witness similar pattern in both tables 6 and 7 with values bordering statistically significant standards, whereas medians are more indifferent from each other.

Table 8. 6 month wealth relatives.

	All IPOs	**R&D intensive**	**R&D unintensive**	**R&D int. – R&D unint.**
***Panel a:* 6 month WRs excluding initial return**				
Mean	1.02	0.97	1.06	-0.09
t-stat	0.64	-0.69	1.16	-1.32
Median	0.98	0.92	1.00	-0.08
z-stat	-0.37	-1.10	0.41	-1.18
Max.	3.03	1.94	3.03	
Min.	0.14	0.33	0.14	
St.dev.	0.39	0.31	0.43	
N	136	55	81	

Panel b: **6 month WRs including initial return**				
Mean	1.08	1.02	1.12	-0.11
t-stat	2.04 **	0.32	2.29 **	-1.37
Median	1.04	1.02	1.05	-0.03
z-stat	1.36	-0.06	1.76 *	-1.13
Max.	3.40	2.68	3.40	
Min.	0.11	0.30	0.11	
St.dev.	0.46	0.41	0.49	
N	136	55	81	

Yet again in table 8 analysis of the 6 month WRs, the previously documented short-run pattern seems to be present in the sample as IPOs fare significantly better after including the initial returns in calculating the WRs. R&D intensive companies underperform the market in a similar mean figure as in the previous time periods but the median value suggests more adverse performance for R&D intensive companies than in the shorter horizons, although both of the values are statistically insignificant. Median WR in the panel "a" for all IPOs is also below 1.00 and suggests deteriorating performance for the IPO companies 6 months after being publicly traded.

WRs including the initial returns, on the other hand, propose that all IPOs once again perform better than the market for the given time period and the economic significance is also higher than was in the shorter time periods, suggesting that investing to IPOs for 6 months provides superior returns to markets for short-run in event-time analysis. Furthermore, screening companies with no R&D expenses would be a superior bet in determining the short-term performance of IPOs in Nordics with the highest mean and median WRs for the time period with statistical significance.

Hahl et al. (2014) find similar pattern in short-run, where the IPOs return poorly during the 1 month of trading if bought at the first day closing price but gradually move away from the slump. Also, the IPOs provide economically and statistically significantly better returns than the market if the stocks are bought at the initial public offering. The importance of buying the issuing stock at the offer is in pronounced position in the Hahl et al. (2014) analysis due to high initial returns, which most likely is one of the root causes behind the high WRs in their sample for the observed periods compared to the ones obtained in this study.

Table 9. Calendar-time regressions of rolling 6 month portfolio holding all IPOs.

6 MONTH PORTFOLIO	**CAPM**	**2-factor**	**3-factor**	**4-factor**	**5-factor**	**6-factor**
All IPOs						
α	-0.007	-0.007	-0.005	-0.011	-0.008	-0.012
	(-1.059)	(-1.052)	(-0.778)	(-1.435)	(-1.024)	(-1.512)
Rm – Rf	0.496 ***	0.493 ***	0.419 ***	0.426 ***	0.350 **	0.328 **
	(3.868)	(3.830)	(3.148)	(3.224)	(2.199)	(2.067)
SMB		0.155	0.201	0.183	0.186	0.090
		(0.446)	(0.582)	(0.521)	(0.502)	(0.241)
HML			0.630 *	0.870 **	1.290 **	1.499 ***
			(1.907)	(2.380)	(2.449)	(2.772)
WML				0.404		0.782
				(1.530)		(1.060)
RMW					0.971	-0.723
					(1.328)	(-1.123)
CMA					-0.527	0.417
					(-0.829)	(1.539)
Adj. R^2	0.107	0.100	0.121	0.132	0.127	0.137
F-stat	14.961 ***	7.528 ***	6.346 ***	5.431 ***	4.403 ***	4.109 ***

The calendar-time regressions for the short-run show quite similar results to event-time analysis. In table 9, the results for a portfolio holding all IPOs for six months are presented. Initial inspection brings interesting observation implying that the portfolio holding all companies has a beta of 0.496 in the one factor CAPM regression, which seems very low, considering that the market has a beta of exactly 1. The companies are, in the short run, very defensive and seem not to move in tight accordance with the market. The HML factor describes that the portfolio holding all IPOs for a rolling 6 month period has value exposure and the returns are driven by value IPOs with high book-to-market ratios.

Each of the regression alphas are negative, proposing that the IPOs perform worse than markets, albeit the coefficients are statistically insignificant. The regressions show similar results as the previous event-time inspection, where the 6 month WRs excluding initial returns have mean and median values of 1.02 and 0.98, although both statistically insignificant. The six-factor model has the lowest negative and closest to being significant alpha, which suggests that the factor models do not capture the cross-sectional stock returns of the IPO companies, but adding more factors to the model increases the explanatory power describing all IPOs returns, although the adjusted R^2s remain low for each regression.

Table 10. Calendar-time regressions of rolling 6 month portfolio holding R&D intensive IPOs.

6 MONTH PORTFOLIO	CAPM	2-factor	3-factor	4-factor	5-factor	6-factor
R&D Intensive IPOs						
α	-0.011	-0.011	-0.009	-0.019 **	-0.014	-0.022 **
	(-1.301)	(-1.393)	(-1.126)	(-2.128)	(-1.470)	(-2.274)
Rm – Rf	0.797 ***	0.817 ***	0.721 ***	0.584 ***	0.677 ***	0.506 **
	(4.322)	(4.442)	(3.772)	(2.979)	(3.358)	(2.419)
SMB		0.660	0.637	0.507	0.654	0.423
		(1.446)	(1.408)	(1.112)	(1.401)	(0.910)
HML			0.748 *	1.218 **	1.422 **	1.864 ***
			1.657	(2.490)	(2.073)	(2.687)
WML				0.907 **		0.942 **
				(2.341)		(2.394)
RMW					0.993	0.716
					(1.049)	(0.770)
CMA					-0.767	-1.080
					(-0.871)	(-1.244)
Adj. R^2	0.156	0.165	0.180	0.220	0.183	0.224
F-stat	18.684 ***	10.496 ***	8.042 ***	7.791 ***	5.320 ***	5.619 ***

In table 10, the results are similar to the event-time analysis. All of the regression alphas are negative and also significant at conventional levels in the 4 and 6-factor models, suggesting that R&D intensive IPOs lose to the MSCI Nordic benchmark index in the 6 month period after exchange inauguration. Interestingly, the R&D intensive portfolio's returns are value stock-driven, similar to the portfolio holding all IPOs, but with slightly greater magnitude. The returns of 6 month portfolio holding R&D intensive companies are also explained with momentum factor that shows a positive and significant effect in 4 and 6-factor models similar to Hahl et al. (2014) short-run regressions. Deviating from previous literature (see e.g. Purnanandam & Swamintaham 2004; Hahl et al. 2014) the sample IPOs returns are not driven by the small size effect as the SMB loadings are insignificant in all of the regressions.

Table 11. Calendar-time regressions of rolling 6 month portfolio holding R&D unintensive IPOs.

6 MONTH PORTFOLIO	CAPM	2-factor	3-factor	4-factor	5-factor	6-factor
R&D Unintensive IPOs						
α	0.001	0.001	0.002	0.005	0.001	0.003
	(0.221)	(0.223)	(0.338)	(0.658)	(0.136)	(0.399)
Rm - Rf	0.417 ***	0.415 ***	0.381 ***	0.377 ***	0.308 **	0.317 **
	(3.580)	(3.543)	(3.106)	(3.071)	(2.080)	(2.132)
SMB		0.079	0.097	0.121	0.028	0.076
		(0.241)	(0.296)	(0.359)	(0.078)	(0.210)
HML			0.289	0.161	0.811 *	0.705
			(0.952)	(0.471)	(1.661)	(1.384)
WML				-0.191		-0.191
				(-0.777)		(-0.752)
RMW					0.686	0.769
					(1.003)	(1.108)
CMA					-0.557	-0.462
					(-0.955)	(-0.773)
Adj. R^2	0.103	0.095	0.094	0.090	0.095	0.0911
F-stat	12.814 ***	6.377 ***	4.550 ***	3.548 ***	3.166 ***	2.721 ***

The regressions results of the portfolio holding R&D unintensive IPOs in table 11 suggest that these companies fare no better or worse than the benchmark index for the six month period, which held also true in the event-time analysis for the same period excluding the initial return from the first day of trading. The factor models seem to be incapable of describing the return characteristics of the 6 month portfolio of R&D unintensive IPOs as the adjusted R^2s are very low and only the 5-factor model shows significance for factors other than the excess market return.

Comparing the factor loadings on SMB, although all of them insignificant, suggest that the R&D unintensive portfolio is affected by big companies' returns, whereas the R&D intensive portfolio is tilted towards small companies. Similarly, the return characteristics of the momentum factor is opposite in the R&D intensive portfolio, where past winners explain the portfolio returns and in the case of R&D unintensive portfolio is tilted towards past losers, although the result is not significant in the 4 and 6 factor models in table 11.

6.3. Long-run performance

The results of the performance analysis for the 12 and 36 month periods are shown in this chapter in event and calendar-time. The event-time returns are first introduced and then the calendar-time analyses are further discussed and compared.

Table 12. 12 month wealth relatives.

	All IPOs	**R&D intensive**	**R&D unintensive**	**R&D int. - R&D unint.**
***Panel a:* 12 month WRs excluding initial return**				
Mean	1.10	1.11	1.09	0.02
t-stat	1.89 *	1.21	1.48	0.17
Median	1.05	1.09	1.02	0.07
z-stat	1.08	0.96	0.57	0.43
Max.	5.14	5.14	3.72	
Min.	0.11	0.18	0.11	
St.dev.	0.62	0.70	0.56	
N	134	55	79	
***Panel b:* 12 month WRs including initial return**				
Mean	1.15	1.14	1.16	-0.02
t-stat	2.82 ***	1.68 *	2.29 **	-0.17
Median	1.09	1.17	1.07	0.10
z-stat	2.22 **	1.42	1.61	0.11
Max.	4.17	3.85	4.17	
Min.	0.10	0.22	0.10	
St.dev.	0.62	0.62	0.61	
N	134	55	79	

Reaching the one year anniversary in the wealth relatives brings interesting results. First of all, two R&D unintensive companies have been delisted before being publicly traded for a full year. In table 12, the average wealth relative for all IPOs excluding initial returns reaches statistical significance and a value of 1.10, signifying that IPO companies have outperformed the market for that period. Also, the tables have turned, and R&D intensive companies have a higher mean and median WRs in the panel "a" than the unintensive companies, albeit all of them are statistically insignificant.

When initial returns are included, the positive performance becomes even more pronounced in favor of the IPO firms. In table 12 panel "b", a highly significant mean WR of 1.15 is achieved for all IPOs in the 12 month period. The R&D intensive and unintensive firms fare almost equally well with significant mean WRs of 1.14 and 1.16, respectively. Median WR is also significant for all IPOs, whereas the subgroups have insignificant median WRs, although the R&D intensive group possesses the highest median value of all groups. The result and higher standard deviations of the WRs could signify that the investments in R&D are more volatile than capital investments, generally mispriced by investors and take a longer time to realize as positive stock market gains as hypothesized by Chan et al. (2001) and Kothari et al. (2002). The mean and median differences are not significant in either panels as the returns for both subgroups show similar characteristics for the examined time horizon.

Table 13. 36 month wealth relatives.

	All IPOs	**R&D intensive**	**R&D unintensive**	**R&D int. - R&D unint.**
***Panel a:* 36 month WRs excluding initial return**				
Mean	1.12	1.05	1.18	-0.13
t-stat	1.53	0.41	1.61	-0.83
Median	1.07	0.96	1.15	-0.19
z-stat	0.22	-0.51	0.98	-0.99
Max.	6.37	4.84	6.37	
Min.	0.00	0.00	0.05	
St.dev.	0.91	0.83	0.95	
N	130	54	76	
***Panel b:* 36 month WRs including initial return**				
Mean	1.16	1.05	1.24	-0.19
t-stat	1.96 *	0.48	2.03 **	-1.20
Median	1.12	0.88	1.17	-0.29
z-stat	0.93	-0.22	1.51	-1.11
Max.	7.15	3.63	7.15	
Min.	0.00	0.00	0.03	
St.dev.	0.92	0.76	0.99	
N	130	54	76	

In a 36 month period following the IPOs, the WRs receive more inconclusive values. All mean values suggest that IPOs outperform benchmarks, regardless of the categorization of companies or inclusion of initial returns, although significantly only in two occasions. R&D unintensive IPOs are found to outperform the market most prominently with statistical significance when initial returns are included. WRs of all IPOs also show significant evidence in favor of the IPO companies faring better than the benchmarks. Median values of the R&D intensive companies are below 1.00 in both panels, but the figures are not significant. The standard deviations are very high due to some observations nearing bankruptcy and others returning multiple times the market return in a three year period after an initial public offering.

Table 14. Calendar-time regressions of rolling 36 month portfolio holding all IPOs.

36 MONTH PORTFOLIO	**CAPM**	**2-factor**	**3-factor**	**4-factor**	**5-factor**	**6-factor**
ALL IPOs						
α	0.000	-0.001	-0.001	-0.001	-0.002	-0.002
	(-0.151)	(-0.471)	(-0.472)	(-0.418)	(-0.844)	(-0.818)
Rm – Rf	0.700 ***	0.690 ***	0.691 ***	0.689 ***	0.673 ***	0.673 ***
	(11.852)	(12.828)	(12.110)	(11.713)	(9.687)	(9.652)
SMB		0.865 ***	0.865 ***	0.864 ***	0.884 ***	0.884 ***
		(5.879)	(5.833)	(5.812)	(5.579)	(5.548)
HML			-0.010	-0.018	0.168	0.164
			(-0.076)	(-0.128)	(0.752)	(0.695)
WML				-0.012		-0.004
				(-0.137)		(-0.044)
RMW					0.302	0.303
					(0.982)	(0.979)
CMA					-0.158	-0.155
					(-0.594)	(-0.550)
Adj. R^2	0.462	0.554	0.551	0.548	0.550	0.547
F-stat	140.463 ***	102.059 ***	67.621 ***	50.410 ***	40.863 ***	33.838 ***

In table 14 above, the results of the factor regressions for the portfolio including all IPOs for a 36 month rolling period are shown. The beta coefficient for the portfolio is still rather low, suggesting that the sample IPOs are also defensive on the 36 month period as was the case with the 6 month portfolio. Each of the alphas are insignificant, proposing that the IPO companies do not outperform the market in the long-run as opposed to the event-time analysis that showed IPOs being a good investment for long-run if initial returns are considered with the 36 month holding period return. In the 36 month period, the previously documented size effect among IPOs (see e.g. Ritter 1991; Loughran & Ritter 1995; Brav et al. 2000; Hahl et al. 2014) is captured by the models. The SMB factor loadings are positive, tilted towards small stocks and highly significant, meaning that in a 36 month period, the returns are driven by the small size of the issuing firms.

Hahl et al. (2014) find quite similar results in their factor analysis of 36 month performance. The alphas of their regression models are negative, but marginally significant only in the 4-factor model, suggesting that their sample of IPO companies fare indifferently from the benchmark index, excluding the 4-factor model. Also, the SMB factor loadings are significant and positive, signifying that the returns of portfolio holding all IPOs for a 36 month rolling period are driven by small firms. The magnitude of SMB factor loadings in this study are unsurprisingly higher for all IPOs as opposed to Hahl et al. (2014) more middle ground results due to the inclusion of the First North marketplaces.

Table 15. Calendar-time regressions of rolling 36 month portfolio holding R&D intensive IPOs.

36 MONTH PORTFOLIO	**CAPM**	**2-factor**	**3-factor**	**4-factor**	**5-factor**	**6-factor**
R&D Intensive IPOs						
α	-0.002	-0.003	-0.003	-0.003	-0.006	-0.005
	(-0.661)	(-0.945)	(-0.961)	(-0.858)	(-1.479)	(-1.351)
Rm – Rf	0.810 ***	0.799 ***	0.812 ***	0.807 ***	0.850 ***	0.849 ***
	(10.681)	(11.197)	(10.720)	(10.341)	(9.230)	(9.193)
SMB		0.917 ***	0.908 ***	0.907 ***	1.003 ***	1.012 ***
		(4.690)	(4.620)	(4.601)	(4.780)	(4.797)
HML			-0.085	-0.105	0.059	0.005
			(-0.501)	(-0.558)	(0.200)	(0.014)
WML				-0.028		-0.065
				(-0.248)		(-0.538)
RMW					0.441	0.457
					(1.081)	(1.116)
CMA					0.222	0.283
					(0.628)	(0.761)
Adj. R^2	0.413	0.483	0.480	0.477	0.480	0.472
F-stat	114.074 ***	75.426 ***	50.134 ***	37.395 ***	30.494 ***	25.346 ***

In table 15, the factor regressions for R&D intensive IPOs show a similar pattern as the event-time analysis, which documents a mean WR of 1.05 and a median value of 0.96, although both of them statistically insignificant. The regression results propose that R&D intensive IPOs fare no better or worse than the market, although the 5 and 6 factor models show increasingly negative alphas, which could turn as significant negative abnormal returns with better fitting models.

Similarly to the portfolio holding all IPOs, the returns of R&D intense companies are driven by small stocks as the positive and significant factor loadings on SMB demonstrate. This is no surprise, as IPO stocks tend to be smaller in terms of size, when compared to seasoned stocks and R&D intensive companies incline to be smaller than companies intense towards capital investments. The HML loadings, although insignificant, propose that R&D intense companies have a growth tilt in the long-run period, which could explain the more negative alphas as Hahl et al. (2014) document that growth IPOs perform significantly worse in the long-run than value IPOs and portfolio holding all of their sample issues. Expectedly the R&D intense companies have low asset growth in comparison to the portfolio holding all companies seen as negative factor CMA loadings in table 14 and positive factor loadings in table 15.

Table 16. Calendar-time regressions of rolling 36 month portfolio holding R&D unintensive IPOs.

36 MONTH PORTFOLIO	**CAPM**	**2-factor**	**3-factor**	**4-factor**	**5-factor**	**6-factor**
R&D Unintensive IPOs						
α	0.001	0.000	0.000	0.001	0.002	0.002
	(0.331)	(0.137)	(0.135)	(0.269)	(0.417)	(0.400)
Rm – Rf	0.609 ***	0.598 ***	0.599 ***	0.587 ***	0.493 ***	0.493 ***
	(7.965)	(8.181)	(7.723)	(7.308)	(5.269)	(5.248)
SMB		0.787 ***	0.787 ***	0.784 ***	0.675 ***	0.674 ***
		(3.951)	(3.922)	(3.898)	(3.164)	(3.143)
HML			-0.004	-0.052	0.124	0.130
			(-0.026)	(-0.270)	(0.413)	(0.406)
WML				-0.066		0.007
				(-0.563)		(0.053)
RMW					-0.093	-0.094
					(-0.223)	(-0.225)
CMA					-0.750 **	-0.756 **
					(-2.103)	(-2.011)
Adj. R^2	0.282	0.343	0.339	0.336	0.347	0.346
F-stat	63.448 ***	42.501 ***	28.152 ***	21.099 ***	17.939 ***	14.852 ***

In table 16, the calendar-time analysis of portfolio holding each R&D unintensive IPO for a rolling 36 month period produces no significant results in favor of the IPOs outperforming the market, disrespecting the results obtained in the event-time analysis. Analysis with the event-time market adjustments produced results that promoted the superior nature of R&D unintensive IPOs as investments over the 36 month period, whereas the calendar-time risk-adjustments show positive but insignificant alphas for each of the 6 regressions.

Similarly to previous calendar-time portfolio regressions, the 36 month portfolio of R&D unintensive companies is affected by the small size of the issuers with positive and significant SMB factor loadings. As opposed to previously investigated portfolios, the investment factor loadings on 5 and 6-factor models have negative and significant values, implying that the 36 month rolling R&D unintensive portfolio is exposed to firms with aggressive asset growth. An interesting result that signifies that firms with no or low investments towards intangible capital operate in more capital intensive industries and therefore require capital expenditures, whereas the R&D intensive firms are less savvy towards growing assets base and have positive and insignificant CMA factor loadings in the 36 month period. Also, although not significant result, the R&D unintensive firms have weak operating profitability compared to R&D intensive firms as the negative RMW coefficient in table 16 implies.

The factor loadings' nature changes somewhat over the examined time periods. The SMB loadings tilt towards higher positive values for each group in the longer period and HML loadings lean towards lower values with growth tilt in the longer examination period for each group. Similarly, the RMW loadings show a trend as the figures decrease in the longer examination periods, suggesting weakening operating profitability for IPO companies, which could imply motives of market timing. According to Pagano et al. (1998), companies use IPO proceeds to lower leverage after times of heavy investments, which can be seen as the negative and high magnitude CMA loadings for R&D intensive companies in the 6 month period and positive figures for the 36 month period.

7. CONCLUSIONS

This thesis has examined the initial underpricing, short and long-run performances of Danish, Finnish and Swedish initial public offerings over an eleven year period from 2005 to 2015. Moreover, the IPOs included in the sample are divided in two portfolios by assigning companies with expenses towards research and development in one and firms with no R&D expenditures prior to an exchange introduction to a second portfolio. The study is motivated by previous documentation on research and development investments positive relationship with stock returns, short and long-run anomalies shadowing IPOs and the sample countries overall high ranks as one of the most R&D intense nations in the world.

The sample examined consists of 136 successful IPOs commenced during the examination period and covers only the purest initial public offerings in the Nordic Main and First North Markets with no previous trading history. Financial firms, list switching companies, OTC notes, reverse acquisitions, spinoffs and carve-outs are excluded from the initial sample of all occurred IPOs in the First North and Main Market exchanges of the sample countries. The performance is measured in event-time using market returns to benchmark each IPO return in every measuring period and risk-adjusted returns in calendar-time setting to take into consideration the varying risk levels of initial public offerings.

The analysis provides mixed results. All IPOs have significant initial abnormal returns of 7.32 percent when outliers are included. With the outliers removed, the initial abnormally returns of sample companies reduces to 5.15 percent and remains statistically significant. The R&D unintensive firms witness higher underpricing than the R&D intensive businesses with a marginally significant mean difference of 6.22 percentage points. The similar pattern continues between the R&D intensive and unintensive companies throughout the event-time analysis as the R&D intensive firms lose systematically to the unintensive businesses in almost every measuring period for both short and long-run. Including the initial returns also has a significant effect to the results and promotes the superior performance of the R&D unintensive companies over the benchmark indices and R&D intensive firms in each of the event-time measurement period.

Using median returns provides fairly different results. Each of the subgroups witness statistically significant underperformance for the 1 month measurement period, when examined with medians and the poor performance continues with the R&D intensive companies in most of the measurement periods, albeit with insignificant test values. The inclusion of initial returns to the median results has a similar effect as with the mean returns and the underperformance of each group becomes indifferent from the market, and in long-run even turns into superior performance for all IPOs and R&D unintensive IPOs.

An interesting pattern is documented at the one year mark as each of the subgroups witness WRs of over 1.00 promoting the superior performance of IPOs over the benchmark indices. When initial returns are incorporated for the one year period, the mean and median performance turn significant at conventional levels for all IPOs and in mean terms for both subgroups. An important notion at the first anniversary is the median WR of R&D intensive companies surpassing that of the R&D unintensive firms for the only time in all of the analyzed periods.

At the three year anniversary in exchanges, the R&D intensive IPOs face adverse performance compared to R&D unintensive companies. The result could stem from the high variation in the payoffs from R&D investments among the sample companies and ensuing negative skew in the cash flows for the R&D intense firms from investing to creating innovations, which does not reflect (positively) in the prices for the 36 month period. The three year examination period may not therefore correctly capture the benefits of R&D investments, which the previous literature documents. Having a longer sample period would most likely bear some correction to the results and the direction of longer run WRs for R&D intensive companies would be clearer in either positive way due to successful innovations or negative direction because of more frequent bankruptcies due to failed to monetize innovations.

Controlling for systematic risk with the CAPM, size and value effects with Fama and French three-factor model (1993), momentum with the Carhart (1997) four-factor model, investment and profitability anomalies with the Fama and French (2015) five-factor model and all of the previous with the Fama and French (2018) six-factor model provides results for and against the event-time analysis. In short-run 6 month calendar-time regressions, portfolios holding all IPOs and R&D intensive IPOs were exposed to value effect with significant and positive factor loadings on HML. Alphas of the 6 month portfolio factor regressions are insignificant from zero in all except for the R&D intensive portfolio with the 4 and 6-factor models. The result is similar to the event-time analysis for the same short-run time period where R&D intensive firms lose to the benchmarks. The calendar-time analysis further shows that the momentum factor drives the R&D intensive portfolio's returns, whereas the R&D unintensive portfolio's risk characteristics are not captured well by the models.

Previous literature documented small size exposure of new issues is recognized for each of the 36 month portfolios in which the returns are significantly driven by small firms. The R&D intensive companies are unexpectedly more inclined towards the SMB factor than R&D unintensive businesses and portfolio holding all IPOs. Also, the R&D unintensive companies have exposure towards investment factor as those companies with no investments towards intangible capital, such as research and development, are more inclined to operate in capital intensive fields and therefore need to invest more in capitalized physical assets.

Even though the results did not reflect the initial assumptions on R&D companies performing better than the unintensive firms, the research topic remains as a subject of interest. Due to the Nordic nations' technology-oriented character and high level of investments towards research and development, compared to the average figures of the rest of the world, it would be interesting to conduct a larger research to see whether R&D intense nations' IPOs return characteristics on aggregate differ significantly from those of R&D unintensive countries. At the moment, the existing literature on R&D and aftermarket performance of IPOs is scarce and is not studied by appointing interest in examining the possible differences in return characteristics of research and development intense and unintense nations' IPOs. The research could offer valuable contributions to utilize on the verge of initial public offerings as well as asset diversification benefits for institutions if the return characteristics of new issues show differences across R&D intense and unintense nations.

REFERENCES

Aharoni, G., Grundy, B. & Q. Zeng (2013). Stock returns and the Miller Modigliani Formula: Revisiting the Fama French analysis. *Journal of Financial Economics* 110:2, 347-357.

Amor, S. B. & M. Kooli (2017). Intended use of proceeds and post-IPO performance. *The Quarterly Review of Economics and Finance* 65, 168-181.

Bachelier, L. (1900). The Theory of Speculation. Annales scientifiques del l'École Normale Supérieure, Sér. 3:17, 21-86. Translated by D. May (2011).

Bancel, F. & U. R. Mittoo (2009). Why Do European Firms Go Public? *European Financial Management* 15: 4, 844-884.

Beatty, R. P. & J.R. Ritter (1986). Investment banking, reputation, and the underpricing of initial public offerings. *Journal of Financial Economics* 15: 1-2, 213-232.

Bernström, S. (2014). *Valuation: The Market Apporach.* Jon Wiley & Sons Ltd. 201 p. ISBN 978-1-1189-03926.

Bodie, Z., Kane, A. & A. J. Marcus (2014). *Investments*. 10th edition. Berkshire: McGraw Hill Education. 1014 p. ISBN 978-0-0771-6114-9.

Brau, J. C. & S. E. Fawcett (2006). Initial Public Offerings: An Analysis of Theory and Practice. *The Journal of Finance* 61:1, 399-436.

Brav, A. & P.A. Gompers (1997). Myth or Reality? The Long-Run Underperformance of Initial Public Offerings: Evidence from Venture and Nonventure Capital-Backed Companies. *The Journal of Finance* 52:5, 1791-1821.

Brav, A., Geczy, C. & P. A. Gompers (2000). Is the abnormal return following equity issuances anomalous? *Journal of Financial Economics* 56:2, 209-249.

Brealey, R. A., Myers, S. C. & F. Allen (2014). *Principles of Corporate Finance.* 11th edition. Maidenead: McGraw Hill Education. 889 p. ISBN 978-0-0771-51560.

Carhart, M. M. (1997). On the Persistence in Mutual Fund Performance. *The Journal of Finance* 52:1, 57-82

Chambers, D., Jennings, R. & R. B. Thompson (2002). Excess Returns to R&D-Intensive Firms. *Review of Accounting Studies* 7: 2-3, 133-158.

Chan, L. K. C., Lakoshnik, J. & T. Sougiannis (2001). The Stock Market Valuation of Research and Development Expenditures. *The Journal of Finance* 56:6, 2431-2456.

Eberhart, A. C., Maxwell, W. F. & A. R. Siddique (2004). An Examination of Long-Term Abnormal Returns and Operating Performance Following R&D Increases. *The Journal of Finance* 59:2, 623-650.

Ehie, I. C. & Olibe, K. (2010). The effect of R&D investment on firm value: An examination of US manufacturing service industries. *International Journal of Production Economics* 128:1, 127,135.

Ellis, K., Michaely, R. & M. O'Hara (2000). When the Underwriter Is the Market Maker: An Examination of Trading in the IPO Aftermarket. *The Journal of Finance* 55:3, 1039-1074.

Espenlaub, S., Gregory, A. & I. Tonks (2000). Re-assessing the long-term underperformance of UK Initial Public Offerings. *European Financial Management* 6:3, 319-342.

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance* 25:2, 383-417.

Fama, E. F. & K.R. French (1993). Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics* 33:1, 3–56.

Fama, E. F. & K.R. French (2015). A five-factor asset pricing model. *Journal of Financial Economics* 116, 1-22.

Fama, E. F. & K.R. French (2018). Choosing factors. *Journal of Financial Economics* 128: 2, 234-252.

Gompers, P. A. & J. Lerner (2003). The Really Long-Run Performance of Initial Public Offerings: The Pre-Nasdaq Evidence. *The Journal of Finance* 58: 4, 1355-1392.

Guo, R., Baruch, L. & C. Shi (2006). Explaining the short-and long-term IPO anomalies in the US by R&D. *Journal of Business Finance & Accounting* 33:3, 550-579.

Hahl, T., Vähämaa, S. & J. Äijö (2014). Value versus growth in IPOs: New evidence from Finland. *Research in International Business and Finance* 31, 17-31.

Hsu, P. (2009). Technological innovations and aggregate risk premiums. *Journal of Financial Economics* 94: 264-279.

Ibbotson, R. G. (1975). Price performance of common new stock issues. *Journal of Financial Economics* 2:3, 235-272.

Ibbotson, R. G. & J. F. Jaffe (1975). ”Hot Issue” Markets. *The Journal of Finance* 30:4, 1027-1042.

Ibbotson, R. G., Sindelar, J. L. & J. R. Ritter (1988). Initial Public Offerings. *Journal of Applied Corporate Finance* 1:2, 37-45.

Kallunki, J. P, Martikainen, M., Martikainen, T. & P. Yli-Olli (1997). The Finnish Stock Market: A Survey of Some Empirical Evidence and its Practical Relevance. *The Finnish Journal of Business Economics* 4:97, 474-495.

Kallunki, J. & J. Niemelä (2012). *Osakkeen Arvonmääritys: Onnistunut Sijoituspäätös.* Talentum Media Oy. 275 p. ISBN 978-952-14-1652-1.

Kang, J., Kim, Y. & R. M. Stulz (1999). The Underreaction Hypothesis and the New Issue Puzzle: Evidence from Japan. *The Review of Financial Studies* 12:3, 519-534.

Keloharju, M. (1993). The winner's curse, legal liability, and the long-run price performance of initial public offerings in Finland. *Journal of Financial Economics* 34: 251-277.

Kim, W. & M. S. Weisbach (2005). Do firms go public to raise capital? NBER Working paper No. 11197.

Kim, W. & M.S. Weisbach (2008). Motivations for public equity offers: An international perspective. *Journal of Financial Economics* 87:2, 281-307.

Koller, T., Goehardt, M. & D. Wessels (2015). *Valuation: Measuring and Managing the Value of Companies.* 6th edition. New Jersey: John Wiley & Sons Inc. 825 p. ISBN 978-1-118-87370-0.

Kothari, S. P., Laguerre, T. E. & A. J. Leone (2002). Capitalization versus Expensing: Evidence on the Uncertainty of Future Earnings from Capital Expenditures versus R&D Outlays. *Review of Accounting Studies* 7:4, 355-382.

Levis, M. (1993). The Long-Run Performance of Initial Public Offerings: The UK Experience 1980-1988. *Financial Management* 22:1, 28-41.

Li, Dongmei (2011). Financial Constraints, R&D Investment, and Stock Returns. *The Review of Financial Studies* 24:9, 2974-3007.

Lin, X. (2012). Endogenous technological progress and the cross-section of stock returns. *Journal of Financial Economics* 103:2, 411-427.

Loughran, T., Ritter, J. R. & K. Rydkvist (1994). Initial Public Offerings: International Insights. *Pacific-Basin Finance Journal* 2: 165-199.

Loughran, T. & J. R. Ritter (1995). The New Issues Puzzle. *The Journal of Finance* 50:1, 23-51.

Loughran, T. & J. R. Ritter (2002). Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs? *The Review of Financial Studies* 15:2, 413-444.

Lowry, M. & W. G. Schwert (2004). Is the IPO pricing process efficient? *Journal of Financial Economics* 71:1, 3-26.

Miller, E. M. (1977). Risk, Uncertainty, and Divergence of Opionion. *The Journal of Finance* 32:4, 1151-1168.

Nasdaq Group (2019). Common Nordic Rules. [online]. [Retrieved 14.2.2019]. Available from the World Wide Web: <URL: https://business.nasdaq.com/list/listing-options/European-Markets/>.

Novy-Marx, R. (2013). The Other Side of Value. *Journal of Financial Economics* 108:1, 1-28.

OECD. (2019). Gross domestic spending on R&D. [online]. [Retrieved 11.2.2019]. Available from the World Wide Web: <URL:httpm://https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm>

Pagano, M., Panetta, F. & L. Zingales (2002). Why Do Companies Go Public? An Empirical Analysis. *The Journal of Finance 53:1, 27-63.*

Palepu, K. G., Healy, P. M. & E. Peek (2016). *Business Analysis and Valuation: IFRS Edition.* 4th edition. United Kingdom: Gengage Learning. 655 p. ISBN 978-1- 4737-2265-1.

Purnanandam, A. K. & B. Swaminathan (2004). Are IPOs Really Underpriced? *The Review of Financial Studies* 17:3, 811-848.

Pörssisäätiö (2016). Listautujan käsikirja. [online]. [Retrieved 1.11.2018]. Available from the World Wide Web: <URL:http://www.porssisaatio.fi/wp-content/uploads/2016/05/porssilistautujan_kasikirja_2016_final_web.pdf>

Pörssisäätiö (2018). Listautumiset Pohjoismaissa viime vuosina. [online] [Retrieved 11.11.2018]. Available from the World Wide Web: <URL:http://www.porssisaatio.fi/blog/statistics/listautumiset-pohjoismaissa-viimevuosina/>

Rajan, R. & H. Servaes (1997). Analyst Following of Initial Public Offerings. *The Journal of Finance* 52:2, 507–529.

Ritter, J. R. (1984). The "Hot Issue" Market of 1980. *The Journal of Business* 57:2, 215-240.

Ritter, J. R. (1991). The Long-Run Performance of Initial Public Offerings. *The Journal of Finance* 46:1, 3-27.

Ritter, J. R & M. Kim (1999). Valuing IPOs. *Journal of Financial Economics* 53:3, 409-437.

Ritter, J.R. & I. Welch, (2002). A Review of IPO Activity, Pricing, and Allocations. *The Journal of Finance* 57:4, 1795-1828.

Rock, K. (1986). Why New Issues Are Underpriced? *Journal of Financial Economics* 15: 1-2, 187-212.

Roosenboom, P. (2012). Valuing and pricing IPOs. *Journal of Banking & Finance* 36:6, 1653-1664.

Schultz, P. (2003). Pseudo Market Timing and the Long-Run Underperformance of IPOs. *The Journal of Finance* 57: 2, 483-517.

Shiller, R. J. (1990). Speculative Prices and Popular Models. *Journal of Economic Perspectives* 4:2, 55-65.

Songur, H. & J. E. Heavilin (2017). Abnormal research and development investments and stock returns. *North American Journal of Economics and Finance* 42: 237-249.

Vaihekoski, M. (1997). The Finnish Stock Market: Recent Trends and Important Events. *The Finnish Journal of Business Economics* 4:97, 526-543.

Westerholm, P. J. (2006). Industry Clustering in Nordic Initial Public Offering Markets. *International Review of Fin*ance 6: 1-2, 25-41.

Yung, C., Çolak, G. & W. Wang (2008). Cycles in the IPO market. *Journal of Financial Economics* 89:1, 192-208.

Zingales, L. (1995). Insider Ownership and the Decision to Go Public. *Review of Economic Studies* 62:3, 425–448.