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Market Performance of Nordic Initial Public Offerings (IPOs) and Its Determinants

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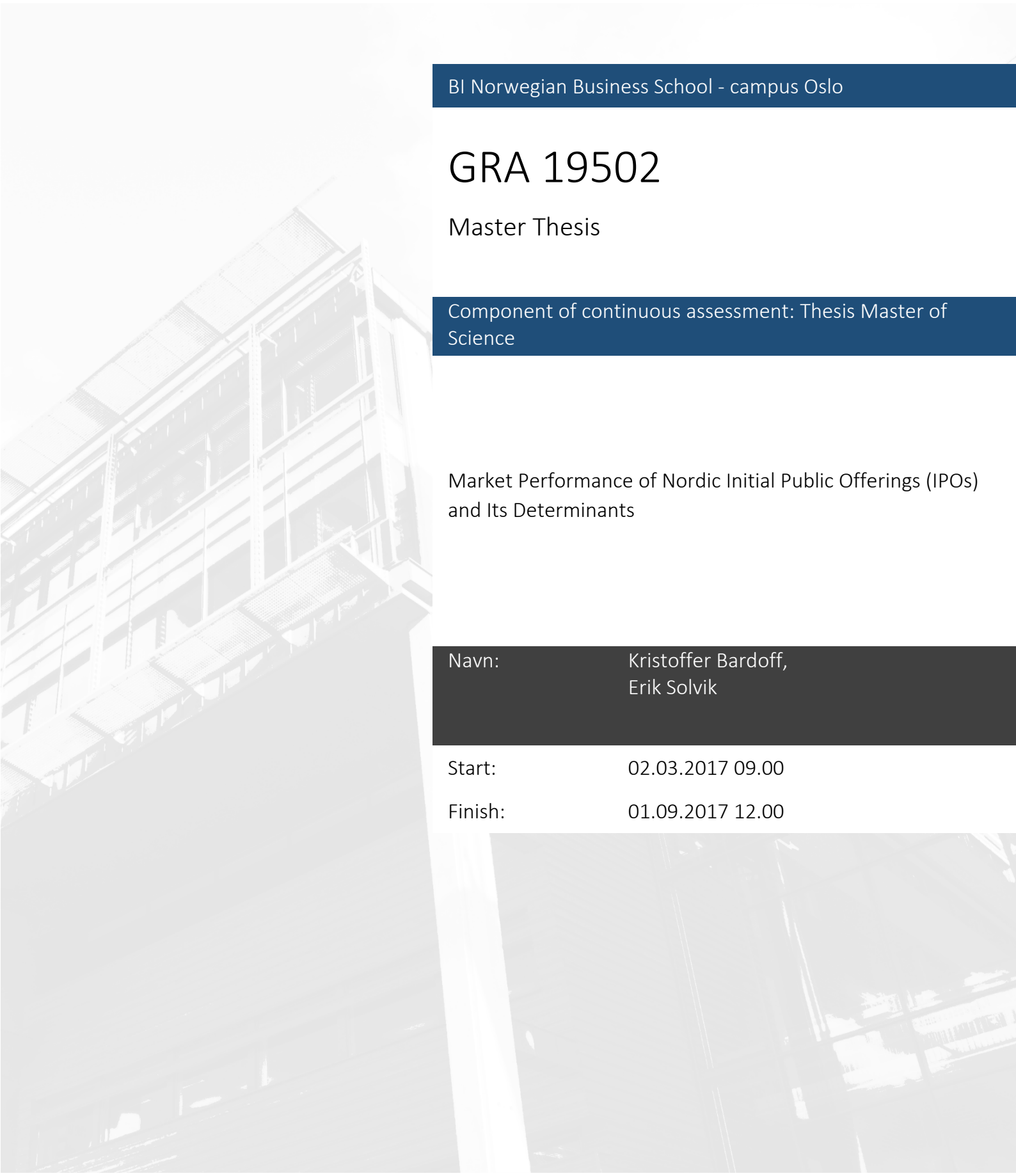

BI Norwegian Business School - Thesis

- Market Performance of Nordic Initial Public Offerings (IPOs) and Its Determinants -

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Abstract

We study the short-run stock market performance of 219 Nordic initial public offerings (IPOs) listed between 2001 and 2016 and its determinants. Short-run stock market performance is measured by the first-day market-adjusted return. In order to identify determinants of short-run market performance we use multiple regression models with firm, market and offer specific variables in accordance with selected theories.

We find that, overall, Nordic IPOs was underpriced with 4.53% on average. However, there are quite large differences in underpricing between the Nordic countries. Swedish IPOs had an average first-day return of 7.35% and Finnish 7.97%, Denmark had 5.58% while in Norway it was 0.60%. These findings suggest a downward sloping trend in the level of underpricing in the Nordics over the past decades. Furthermore, our results indicate that investor sentiment is a determinant of short-run performance of IPOs in the Nordics in general. We further find that hot issue markets, firm age, firm assets, pricing technique, offer price relative to file price range and the reputation of the underwriter are determinants of short-run market performance, but that these results vary by country, suggesting that there are different determinants of short-run performance within the Nordic countries. The overall findings on determinants support the investor sentiment theory, the hot market phenomenon and information revelation theory, while it is conflicting with the main implications of the winner`s curse theory.

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1.0 Introduction

In this part, we introduce the main objective and briefly the motivation of our research. We further formulate our problem statement followed by the limitations of the thesis. Finally, we present the organization of the rest of the thesis.

1.1 Objective

The fundamental objective of this thesis is to provide new knowledge about short-run market performance of Nordic initial public offerings (IPOs) and its determinants. Another goal is to get a broader understanding of the phenomenon of IPO underpricing, and be able to utilize theories and hypotheses to investigate the level and determinants of underpricing. The specific aims of the study are to investigate whether Nordic IPOs are underpriced in the short run, to identify determinants of short-run market performance and to investigate differences and similarities in underpricing between the Nordic countries.

1.2 Motivation

There has been a large interest in the market performance of IPOs over the past decades. The phenomena of IPO underpricing have received great attention in academic research since it was first documented in the early 1970`s, and attempts trying to explain it have resulted in a burgeoning theoretical literature. There are numerous reasons so. The stock market´s capital-raising function is first of all especially important for financing firms and encouraging growth and entrepreneurship. Firms´ access to the stock market is influenced by the roles of financial institutions, institutional investors and the rules by the stock exchanges, and the general institutional arrangements plays a vital part for firms´ efficient access to the stock market. It is therefore desirable to understand how these institutional arrangements influence the access to the capital markets, and how the involved parties affect the valuation of issuing companies and the distribution of wealth across investors. The quite large initial returns on IPOs documented over the years further suggest that the offering prices in these issues are set too low. This systematic pattern

implies that previous shareholders sell their shares to the public too cheaply, which is irrational and violates the efficient market hypothesis.

1.3 Problem statement

To achieve the mentioned objectives of the study we have formulated the following research questions:

1. Have IPOs in the Nordics been underpriced in the short run?
2. What are the determinants of short-run market performance of IPOs in the Nordics?
3. Do the results for research question 1 and 2 vary between the Nordic countries, and for the Nordics as a whole?

1.4 Delimitations

Considering that IPO underpricing is a wide subject with many hypotheses and theories, some limitations to the scope of this thesis is necessary. We will first of all focus only on the particular the stock exchanges in Oslo, Copenhagen, Stockholm and Helsinki. The time period is limited to the years from 2001 to 2016. Our investigation further concerns the short-run performance of IPOs, and do not concern the long-run performance.

1.5 Outline

The rest of the thesis is organized as follows: Part 2 presents background information related to our research problem, empirical evidence on underpricing and a description of the Nordic stock exchanges. In part 3 we present and explain the main theories related to our research question, which is divided into asymmetric information theories, institutional explanations, ownership and control theories, and behavioral theories. This is followed by part 4, where we explain the way we investigate the research problem, based on the background and the theory. This includes how the variables are measured, hypothesis development and predictions. In part 5 we describe the data we use, hereunder how and where it is collected, and what data that has been excluded. In the analysis in part 6

we present descriptive statistics and multiple regression results. The results are further discussed in relation to the theories and our hypotheses, and the validity of the results is discussed considering the assumptions of the classical linear regression model. Finally, we conclude in part 7.

2.0 Background and literature review

This part present background information related to our research, empirical evidence on underpricing, and a description of the Nordic stock exchanges.

2.1 Initial public offerings

An IPO is the procedure of offering the stock of a private company to the public for the first time. An IPO is generally conducted in order to raise capital to finance new projects and investment opportunities, or more generally to grow and expand. The capital can be raised by issuing new shares to the public or by the sale of shares of the existing shareholders. Newly offered shares sold to the public are referred to as primary shares, while secondary shares refer to existing shares that are sold.

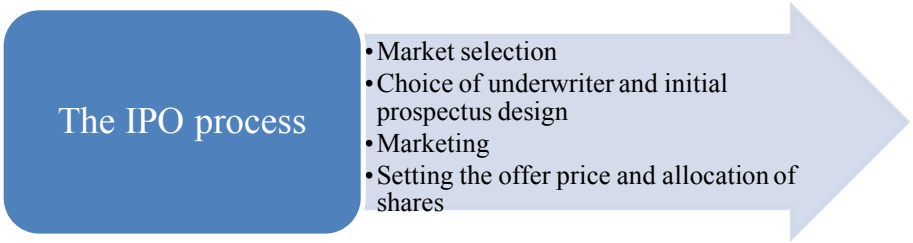
When firms sell their shares to the public for the first time, the puzzling phenomenon of underpricing often occur. Underpricing implies that the shares appreciate the first day of trading, meaning that the first-day listing prices are greater than the offering prices. This systematic pattern suggests that previous shareholders sell their shares to the public too cheaply, which is irrational and violates the efficient market hypothesis. The phenomena of underpricing of IPOs have received great attention from academics since it was first systematically documented in the early 1970`s, and attempts trying to explain it have resulted in a burgeoning theoretical literature. The earliest and most supported are theories based on asymmetric information among the involved parties in the IPO process, while behavioural theories have received increasingly support since the beginning of the century.

2.2 The IPO process

The process of going public is fairly comprehensive and typically takes four to eight months to complete, from the time the underwriters is engaged to the listing of the company´s stock on the stock exchange. Jenkinson and Ljungqvist (2001) describes the IPO process in four stages: Market selection, choice of underwriter, marketing, and setting the offer

price and allocation of shares. These steps are illustrated in Figure 1.

Figure 1: The IPO Process



The process of choosing the market where the company wants to go public is the initial step for the issuing firm. The issuer has to make sure that they meet all the requirements from the stock exchange and the relevant regulations imposed by regulatory bodies. The issuer can either choose to go public on a stock exchange in the company`s home country or decide to list their shares on a foreign stock exchange. Listing the shares on a foreign stock exchange can be desirable if the selected stock exchange has better liquidity, different listing requirements or higher industry relevance. In the latest years, and increasingly, the choice of exchange has been less constrained by national boundaries.

When having decided the exchange to be listed on, the required information for the initial prospectus has to be produced. Firstly, the issuing firm needs to pick an investment bank that will be utilized as the lead underwriter. For large IPOs several underwriters often design a syndicate and cooperate on the same IPO. The issuing firm and its investment bank will set up the most fitting arrangement in regard to the commitment of each actor. The investment bank, in cooperation with other intermediaries such as auditors and lawyers, then perform the due-diligence investigations and produce the required documentation to fulfil the requirements of the exchange and the regulatory authorities. During this step, the investment bank typically also performs some initial valuation of the company based on various techniques and some pre-marketing to get an indication of the interest for the company. This phase

culminates in the publication of an initial prospectus, and often includes an indicative price range for the offering.

In the third stage, the issue is marketed to potential inventors, which can take form in various ways. The most widely recognized activity is “road shows”, where the management of the company visits various locations to make presentations of the company, typically to institutional investors. The key goal of the roads shows is for the investment bank to gather information from potential investors about the demand for the issue, opinions on the company and valuations of the stock. In the case where an indicative price range is set, the marketing phase can help generate information that can be fed into the next stage of the process when the final price is set (Jenkinson & Ljungqvist, 2001). In the case of a fixed price issue, the main purpose of the marketing phase is to get bids from investors, that is, how many shares they would like to buy at the fixed price.

The final step of the IPO process is to set the offer price and decide the allocation of the shares. In the case of fixed price issues, the only remaining decision is the allocation of shares. In the case of an undersubscribed issue, the underwriters usually take up unallocated shares. In the case of an oversubscription, some allocation rule is needed. The rules for over allocation in fixed price issues are in most countries regulated by security regulations or the respective stock exchange. Another and more popular method for allocation is the book-building method, which fixes the price after getting an expression of the demand. The three main steps in book-building involves the investment bank determining which investors will be invited to participate, submission of indications of demand by investors and determining the final price and allocations of shares (Jenkinson & Ljungqvist, 2001). The investment bank and the issuing firm have complete discretion over the final allocation of shares, and can reflect the companies preferred initial inventors. After the IPO, it is usual that the investment bank further stabilizes the price of the shares once they start trading. This is done by

selling shares in the case of high demand, and buying shares in the case of pressure for the price to fall. The investment bank is usually given an over-allotment option (greenshoe) in order to do so.

2.3 Why go public?

There are several reasons and intentions to go public. Ritter and Welch (2002) argue that the main reasons to go public are to raise capital and the desire to trade at a public market place. The principal aim of going public is to gain access to additional capital to grow or to expand. As a result of being listed on a stock exchange, the company will also attract more investors, both in the country of the listing and in foreign countries. There are further some other important advantages of being a publicly traded firm. The fact that the company`s stock price provides a readily available measure of performance, are one of the advantages. Rewarding the management of the issuing firm with stock options in order to align management incentives with those of the owners, is a result of having this available measure of performance (Brealey, 2011). Being listed on a stock exchange also includes increased protection against hostile takeovers, and allows the initial owners to use the IPO as an exit strategy. Some substantial costs are also involved in listing the company´s shares on a stock exchange, hereunder the fee paid to the underwriter, which sometimes can be huge relying upon the size of the IPO. In addition, there is also administrative cost. As the registration statement and prospectus needs to be prepared, costs incur for legal counsel, accountants, advisors and the time and attention of the management. The issuing firm also pay fees to the selected stock exchange for their listing.

2.4 The players

There are three fundamental parties that play a vital part in the process of a firm going public; the issuing firm (the issuer), the underwriter and the investor. These three parties and their main objectives are briefly explained in the following.

2.4.1 The issuer

The issuer is the company, or the company`s management, that is deciding to go public. Cooperating with an underwriter that provides the stock for sale to the public, the issuing firm is still the final decision maker regarding the price at which the shares are offered. The issuer`s fundamental objective with the IPO is to get as high proceeds as possible for the shares they are listing without the IPO failing. This means that if the offer price of the IPO shares is set too low, they won`t receive the full potential value of the shares. In the IPO underpricing literature this is referred to as "leaving money on the table" (Thornton, Adams, & Hall, 2011).

2.4.2 The underwriter

Playing out the IPO on behalf of the issuer is the investment bank, known as the underwriter. These are major investment banks or large commercial banks, and financial muscles and experience is critical factors for their success (Brealey, 2011). Underwriters buy the shares from the issuer at a discount to the offer price in order to make money, which makes a spread referred to as underwriter`s margin. In contradiction to the issuer, the underwriters are repeat players in the IPO market, and if the offer price is set too low, they might lose future business from other issuing companies.

2.4.3 The investor

In addition to the underwriter and the issuer, investors also play an important role for firms going public. In the IPO underpricing literature, the investor's objective is to get as large allocations as possible in underpriced issues. Several authors distinguish between retail and institutional investors within the IPO literature. Retail investors are known as the regular, and usually small, private investors. Institutional investors

are mutual funds, hedge funds, pension funds, banks and insurance companies. Both retail and institutional investors operate with the same objective and incentives when investing in IPO stocks.

2.5 Empirical evidence of underpricing

The empirical evidence of short-run underpricing is to a large extent covered in previous literature. Reilly and Hatfield (1969) was one of the first to document the systematic underpricing of IPOs. They used two small subsamples, one from 1963-1964 and one from 1965, and found an average underpricing of 20.2% in the U.S. Stoll and Curley (1970) found a difference between the offering price and the first market price of 42.4% using data from 1957, 1959 and 1963 in the U.S. Others who early documented systematic underpricing are Logue (1973) and Ibbotson (1975).

The presence of underpricing in the Nordic region is also previously documented. Keloharju (1993) finds an average market-adjusted initial return of 8.7% in the Finish IPO market between 1984 and 1989. Emilsen, Pedersen and Saettem (1997) use data between 1984-1996 and find an average underpricing of 12.5% in the Norwegian market. Similar results by Schuster (2003) documents a short-run average initial return of 18.46% in the Swedish market from 1988-1998. In Denmark, Jakobsen and Sorensen (2001) finds an average initial return of 7.4% in the time period 1984-1988. Loughran, Ritter and Rydqvist (2015) has further extended previous studies, including those mentioned above, with updated data that further confirms the presence of underpricing in countries in the largest part of the world.

2.6 The Nordic stock exchanges

In this section we give a brief overview of the Nordic stock exchanges and the key requirements for listing.

2.6.1 Oslo Stock Exchange

The Oslo Stock Exchange opened for trading in 1881 and is the only independent stock exchange within the Nordic countries. There are two markets for listing equities on the stock exchange, which are Oslo Bors and Oslo Axess. Oslo Bors is the obvious choice for larger companies that have an established track record and a wide distribution of shareholders. Oslo Axess is suitable for companies that have less than three years` history but seek the quality stamp and other benefits associated with listing on a regulated marketplace. Oslo Bors requires a company to have total assets of a minimum of 300 MNOK, a minimum of 1000 shareholders, a minimum of 25% of the shares to be held by the public, and published annual reports for at least three years in order to list on the exchange.

2.6.2 OMX Nordic

In 2006 the stock exchanges in Copenhagen, Stockholm and Helsinki were merged into the common Nordic stock exchange OMX Nordic and common listing requirements were introduced. There are therefore differences in listing requirements before and after 2006 for Danish and Swedish companies. The Stockholm stock exchange (SSE) was founded in 1863, and is considered one of the largest stock exchanges in the Northern Europe. The Copenhagen stock exchange (CSE) was founded in 1808, and in 1998 the CSE and SSE took a step toward forming a joint Nordic exchange called Norex, a joint Nordic alliance, and in 2006 Norex became part of the OMX Nordic. The Helsinki stock exchange was founded in 1912 and has been a part of Nasdaq Nordic since 2003.

A company can be listed on either the main market or the growth market, First North. The main market is regulated and follows EU directives and is suited for companies that can adhere to the highest standards for reporting, transparency and accountability. The main market is divided

into the segments Large, Mid and Small Cap, which refers to the companies' market cap. The key requirements for listing are a minimum market cap of 1 MEUR, a minimum of 500 shareholders, a minimum of 25% of the shares to be held by the public, and published annual reports for the last three years. The growth market, Nasdaq First North, has less extensive reporting requirements and is a starting place for smaller companies to reach the capital markets, to grow and to work towards listing on the main market. Every company on First North has a Certified Advisor to ensure that companies comply with all the requirements and rules. The market provides companies more room to focus on their business and development while still taking advantage of positive aspects of being a listed company.

3.0 Theories of short-run underpricing

This part covers the various theories and suggested determinants of underpricing, and forms the basis for our study. We divide the theories into four groups in accordance with Ljungqvist (2007), which is asymmetric information theories, institutional explanations, ownership and control theories, and behavioral theories.

3.1 Asymmetric information theories

Asymmetric information theories explain IPO underpricing as a result of asymmetric information between the involved parties in the IPO process. This key point in these theories is that the issuer, the underwriter or the investor in some way or another has superior knowledge about the IPO (Ljungqvist, 2007).

3.1.1 The winner´s curse

The winner´s curse (Rock, 1986) assumes that some investors are more informed than others, and that they can be separated into two segments in the market; "informed" and "uninformed" investors. Informed investors are those who have favorable information about the prospects of the IPO, and therefore only bids on the offerings that are priced below their fair value. Uninformed investors, on the other hand, make offers for both underpriced and overpriced offerings. This causes a "winner´s curse" problem for the uninformed investors, because they will be allocated many shares only when there is no demand from the informed investors, that is, when the offering is overpriced. Similarly, they will receive few shares when the offer is underpriced, because there will be a high demand from the informed investors. Thus, conditional upon receiving a share allocation, the expected return for uninformed investors is negative if IPOs are priced at a fair value on average. This will lead to uninformed investors being unwilling to participate in the IPO market, because their conditional expected return from participation is less than zero (Ljungqvist, 2007). Rock (1986) further assumes that that the IPO market is dependent on participation from uninformed investors, because informed demand is insufficient to fill the subscription of the offered

shares. Consequently, to ensure participation from the uninformed investors, shares must be underpriced so that the conditional expected returns are greater than or equal to zero.

There are numerous testable implications of the Winner´s curse. If properly adjusting for rationing, uninformed investors will according to the model make zero abnormal returns on average. This is just enough to ensure their participation in the market. Koh and Walter (1989) tests this by using data from Singapore, where oversubscribed IPOs during the 1970s and 1980s where allocated by random ballot. They find that the likelihood of receiving an allocation was negatively related to the degree of underpricing, and that average initial returns fall substantially when adjusted for rationing. Levis (1990) uses data from U.K and finds that rationing reduced the initial returns among small investors. Keloharju (1993) provides similar evidence from Finland, but also finds that investors placing large orders lose money on an allocation-weighted basis. Instefjord, Shen and Coakley (2005) also finds evidence consistent with the theory, however, rationing does not drive the underpricing to zero.

Rock´s model further assumes information heterogeneity among investors. Michaely and Shaw (1994) argue that as this heterogeneity goes to zero, the winner´s curse disappears and so does the reason to underprice. They test this by assuming that institutional investors are informed, while private investors are mainly uninformed, and study IPOs of master limited partnership (MLPs), which are largely avoided by institutional investors. They find evidence consistent with theory, showing that the average underpricing for MLP IPOs were 0.04% between 1984 and 1988, while underpricing among non-MLPs on average was 8.5% over the same period.

Another implication of the model is that the expected underpricing should be increasing in ex ante uncertainty. Ritter (1984) and Beatty and Ritter (1986) provide the rationale of this way of testing. An investor who decides to engage in information production implicitly invests in a call

option on the IPO, that can be exercised if the "true" price exceeds the strike price (the price at which the shares are offered). As all other options it increases with uncertainty, in this case valuation uncertainty. The greater the uncertainty, the more investors will become informed. This raises the required underpricing since an increase in the number of informed investors increases the winner`s curse problem. The changing risk composition hypothesis therefore assumes that riskier IPOs will be underpriced by more than less risky IPOs. A proxy for ex ante uncertainty is therefore needed to test this implication. Lundqvist (2007) divides such proxies into four groups: Company characteristics (such as age, size or industry), offering characteristics (such as gross proceeds), prospectus disclosure (such as number of uses of IPO proceeds as disclosed in the prospectus or number of risk factors listed in the prospectus) and aftermarket variables (such as trading volume or volatility).

The theory further suggests that underwriters that underprice too much (too little) will lose business from issuers (investors). According to Beatty and Ritter (1986), underwriters coerce issuers into underpricing to prevent uninformed investors leaving the IPO market. Nanda and Yun (1997) find that overpricing lead to a decrease in the lead underwriter´s own stock market value, while moderate underpricing increases the stock market value. Dunbar (2000) squarely supports Beatty and Ritter´s claim, providing evidence that banks lose IPO market share if they either underprice or overprice too much.

It can also be tested if reduced information asymmetry between informed and uninformed investors reduces underpricing. As underpricing represents an involuntary cost to the issuer, there are clear incentives to reduce the information asymmetry. Habib and Ljungqvist (2001) uses data from Nasdaq in the 1990s, and finds that issuers optimize, in the sense that spending an additional dollar on reducing underpricing would reduce wealth losses by 98 cents at the margin. Hiring a prestigious underwriter can also reduce information asymmetry. Here it is assumed that prestigious banks will refrain from underwriting low-quality issues. The

information content of the firm´s choice of intermediaries may therefore reduce investors´ incentives to produce their own information, which in turn will mitigate the winner´s curse. Carter and Manaster (1990) provides a ranking of underwriters by advertisements, while Megginson and Weiss (1991) rank underwriters by market share.

3.1.2 Signaling theory

Ibbotson (1975) is credited with the original intuition of signaling theory, and suggested that issuers underprice in order to "leave a good taste in investors´ mouth". The theory assumes that there exist two kinds of issuers, high-quality and low-quality issuers, which raises equity in two stages: first via an IPO and then at a later stage. Since the theory further assumes that the issuer is more informed than investors regarding the present value of cash flows and the associated risk, rational investors fear a lemons problem: The firms that are willing to sell their shares at the average price are firms of low quality. In order to distinguish themselves from low-quality issuers, the high-quality issuers therefore signal the company´s true high value. In these models, this signal is given by deliberately offering the shares below what the market believes they are worth, which deters lower quality issuers from imitating (Ritter & Welch, 2002). The up-front sacrifice from the IPO can at a later stage be recouped in obtaining a higher price at a seasoned offering (Welch, 1989), dividend announcements leading to favorable market responses (Allen & Faulhaber, 1989), or increased information production (Chemmanur, 1993). However, if signaling is used to demonstrate high quality, it is still unclear why underpricing is the best way to do so. As pointed out by Ritter and Welch (2002), it can be just as efficient to spend money on charitable donations or advertising. Lungqvist (2007) further supports this, suggesting that by choosing a reputable underwriter or auditor, or by hiring a high-quality board of directors, high quality can be signaled at a much lower cost.

Welch (1989) tests the theory, and documents substantial post-issuing market activity by IPO firms. There is however no reason to believe that

any underpricing would induce firms to return to the market for a seasoned equity offering (Ritter & Welch, 2002). Jegadeesh, Weinstein and Welch (1993) further finds that the post-IPO price better explain a firm's decision of a SEO than the degree of underpricing. Michaely and Shaw (1994) argues that the decision of how much to underprice and whether to offer equity at a later stage is not independent of each other, and therefore models this in a simultaneous equation model. They find that underpricing and the decision to offer equity at a later stage are not significantly related to each other, strictly rejecting the signaling models. They also find that firm´s who underprice does not have a higher propensity to pay out dividends.

3.1.3 Information revelation theories

Information revelation theories, also referred to as book-building theories, are based on the underwriter´s process of gathering indications of interest from investors. In a book-building process, the underwriter sets a preliminary offer price range, and then goes on a road show to market the company to potential investors. It is assumed that some investors are more informed than others, and possess information that is important for setting the final price. Thus, a key role of the investment bank is to elicit this information before taking the company public (Ljungqvist, 2007). However, investors will not reveal this information unless they get something in return, since showing a high interest will result in a higher offer price. Underwriters therefore induce investors to truthfully reveal their information by offering them some combination of more IPO allocations and underpricing (Ritter & Welch, 2002). According to Benveniste and Spindt (1989), Benveniste and Wilhelm (1990) and Spatt and Srivastava (1991), the book-building process allows the underwriters to gather this information. They do so by allocating no or only little shares to investors who bid conservatively, and a large allocation to investors who bid aggressively and thereby revealing favorable information regarding the issue. The stock is underpriced in order to give incentives to investors for revealing their true interest.

Cornelli and Goldreich (2001) and Jenkinson and Jones (2004) use data from two different investment banks to directly test the book-building theories. Their data contains of both bids from institutional investors and their share allocations. This data is usually confidential, so to test the theory in a similar fashion can be of very limited possibility. They do however find that more aggressive bids lead to higher share allocations than conservative bids, as predicted by the theory. Jenkinson and Jones (2004) find less support for the theory, but in similarity with Cornelli and Goldreich (2001), they find that frequent bidders are treated preferentially. Elsewise, their results provide little evidence of the theory. The differences between the two studies are according to Ljungqvist (2007) related to the differences in the deal flow the two banks has access to, which may have had influence on the underlying assumptions of the models.

The effects from revisions in the offer price during the filing period are a more commonly cited evidence of the theory (Ritter & Welch, 2002). Hanley (1993) was the first to document this, and finds that when there is strong demand, the underwriters does not fully adjust the price upwards in order to hold underpricing constant. The underwriters partially adjust the price to compensate the investors for revealing their information, which allows for an upward revision in the price for the issuer. Thus, underpricing tends to be higher for offerings where the price has been revised upwards, which is an implication that can be tested with publicly available data.

Another theory related to the book-building process is the quality/price trade-off theory suggested by Ljungqvist, Jenkinson and Wilhelm (2003). They study the relationship between the pricing technique and level of underpricing when the IPO is conducted by a U.S. bank and/or targeted at U.S. investors. They find that compared to fixed-price offerings, book-building efforts – though more expensive – produce far less underpricing. It therefore indicates that there exists a quality/price trade-off between gains from lower underpricing and additional costs related to book-

building. As the book-building process involves gathering information from investors about the company and its valuation that are used to set the final offer price, book-built IPOs should produce more accurate prizing. One implication is therefore that fixed-price issues should have a higher degree of underpricing than book-built IPOs, as well as a higher variation in initial returns.

3.1.4 Principal-agent theories

Theories linking agency conflict and IPO underpricing go back more than three decades. Loughran and Ritter (2004) stress the "dark side" of the institutional arrangements in the book-building process, by highlighting the potential for agency problems between the underwriters and the issuing firm. Early models focus on the investment bank´s possibility to exert sub-optimal effort in advertising and distributing the stock due to its informational advantage over the issuing company. When acting as an agent for the issuing firm in selling the stock to the public, investment bank´s find themselves in a moral hazard situation if effort is imperfectly observable and verifiable. Baron and Holmstrom (1980) and Baron (1982) construct screening models which focus on the underwriter`s benefit from underpricing. In these models, the uninformed party offers a schedule of contracts in which the informed party optimally selects given their type and/or hidden action. Baron (1982) further argues that the issuer delegates the pricing decision to the investment bank in order to induce optimal use of the investment bank´s superior information. The investment bank selects a combination of IPO prices and underwriter spreads. The investment bank will select a high spread and a low price if the demand is low, and vice versa if the demand is high, which optimizes the underwriter´s selling effort by making it dependent on market demand. This involves underpricing in equilibrium, since the informational advantage allows the investment bank to capture positive rents in the form of effort costs (Ljungqvist, 2007)

One implication of the theory is that the more uncertainty there is about the value of the firm, the greater the information asymmetry is between

the investment bank and the issuer. This further implies that the services of the investment banker become more valuable, and hence the underpricing greater. Thus, the theory predicts that there should be a direct relationship between underpricing and ex ante uncertainty. Another approach to test whether agency problems causes underpricing was conducted by Muscarella and Vetsuypens (1989). They use data on 38 self-underwritten investment bank IPOs from 1980-1990. In this case there should according to theory be no information asymmetry and therefore no agency problems as the investment banks issues and underwrites by themselves. They do however find that investment banks had just as much underpricing as other new listings. This evidence is clearly not favorable for the theory, but it does not reject it either. It might just be that underwriters want to underprice their own offerings in order to make the case that underpricing is a necessary cost of going public (Ritter & Welch, 2002).

3.2 Institutional explanations / symmetric information theories

The second group of theories is the institutional explanations of underpricing. These theories focus on institutions related to marketplaces, such as lawmakers, banks and tax authorities.

3.2.1 Legal Liability

The idea behind the legal liability model is that companies sell their shares at a discount in order to reduce the likelihood of future lawsuits, or as a form of insurance, as pointed out by Ibbotson (1975). Omitted or mis-stated information in the IPO prospectus might be ground for a lawsuit from investors, especially if the post IPO returns are poor. Tinic (1988) and Hughes and Thakor (1992) argue that the issuer underprices in order to reduce this risk, and both finds support for the theory. Lawsuits are costly to the investment bank directly through damages, legal fees etc., but also indirectly through potential damage to their reputation. Issuers also face the threat of having a higher cost of capital in the future (Ljungqvist, 2007). The theory is however somewhat aimed at countries with strict liability laws, such as the U.S, making it less relevant for our study. This

also provides evidence against the theory, as underpricing is similar in countries in which U.S litigative tendencies are not present. For instance, Keloharju (1993) uses data on the Finnish IPO market in a sample period where there were no strict laws regarding the content of the prospectuses or potential resulting liabilities. However, he still finds an average underpricing of 8.7%. In comparison, Ibbotson, Sindelar and Ritter (1988) find an average underpricing of 16.4% in the U.S. This may suggest that legal liability is a second order driver of underpricing of IPOs. Other authors have also found evidence against the theory in other parts of Europe (Ljungqvist, 2007), including Sweden, which makes this theory of less relevance to our study.

Tinic (1988) proposes several testable implications to the theory. Underpricing should depend negatively on the experience of the underwriter, since experienced investment banks has superior expertise in originating new issues, and has smaller legal liabilities than a less experienced or less capable underwriter. Hughes and Thakor (1992) similarly propose that the degree of underpricing is decreasing in the underwriter´s reputation. Tinic (1988) further suggests that small and risky firms should have a higher degree of underpricing than firms that are less risky to face legal liabilities. Hughes and Thakor (1992) generalize this in their model, with the implication that the underpricing increases with the variance of cash flows.

3.3 Ownership and control

In these theories the issuing firm selects their investors in order to allocate company control as the main strategy.

3.3.1 Underpricing as a means to retain control

By arguing that underpricing gives managers the opportunity to protect their private benefits by allocating shares strategically when taking their company public, Brennan and Franks (1997) investigates how separation of ownership and control evolves as a result of an IPO and how insiders use underpricing to retain control. In their model, underpricing is used to

generate excess demand, which again allows managers to ration investors in order to retain control.

The main testable implication of the model is that underpricing results in excess demand, which further leads to a greater ownership dispersion. By using detailed data on individual bids and allocations in 69 U.K IPOs completed between 1986 and 1989, Brennan and Franks (1997) finds that large bids are discriminated compared to small bids. This finding supports the retained control theory as issuers avoid large owners. Issuing non-voting shares or put in place a takeover defense is another way of protecting private benefits. Field & Karpoff (2002) examines the relation between inside ownership and the use of takeover defense for a majority of IPOs in U.S. They report the presence of at least one takeover defense just before going public for 53 % of the U.S. firms, but these findings are negatively related to the probability of acquisition within the next five years. On the other hand, takeover premiums are not significantly related to the use of takeover defenses. This suggests that issuers do not use takeover defenses to bargain for higher takeover premiums that would benefit all shareholders. Instead, in line with the theory, Field & Karpoff (2002) concludes that managers seem to adopt takeover defenses when their private control benefits are large. However, as Brennan and Franks (1997) argues, protecting private benefits is unlikely to be the only explanation of why managers favor greater dispersion, at least in the U.S market.

3.4 Behavioral theories

In these theories, different parts of behavioral finance are used to explain underpricing of IPOs. In relation to IPO underpricing, the theories assume either the presence of irrational investors or behavioral biases among issuers. Since IPO companies have no earlier share price history, the IPO market is a good setting to study the impact of irrational investors on stock prices (Ljungqvist, 2007).

3.4.1 Cascades

Informational cascades can occur when the shares in an IPO are sold sequentially, where investors optimally ignore their private information and imitate earlier investors (Welch, 1992). This leads investors to request shares only in the IPO when they believe the offering is hot. For the issuing firm, pricing the shares too high will lead to a higher probability of a complete failure, because investors will not subscribe to buy shares, further leading other investors to abstain. The firm therefore underprices, which rewards the early investors for starting a positive cascade, in order to assure the success of the IPO. Amihud, Hauser and Kirsh (2003) finds support in favor of the theory, documenting that there are either an extremely high demand or an undersubscription, while very few offerings are in between. It is however important to notice that in a book-building practice, cascades will likely not be present, since the underwriter can keep secrecy over the demand for the issue. Free communication among investors will also hinder cascades from forming.

Welch (1992) provides several testable implications of the model. He argues that the issuer is better off with cascades than with perfect communication among investors, and further that underwriters with a larger geographical reach more easily can prevent communication among investors than underwriters with a smaller geographical reach. Thus, according to Ljungqvist (2007), it is possible to test whether IPOs managed by national underwriters are less underpriced compared to locally or regionally distributed IPOs. A proxy for the underwriter's geographical reach can for example be their market share or a measure of their reputation. Of the many other testable implications suggested by Welch, it is very few that has been tested, and the theory remains one of the less explored in IPO underpricing (Ljungqvist, 2007).

3.4.2 Investor sentiment

The effect of irrational or sentiment investors was first introduced in IPO underpricing literature by Ljungqvist, Nanda & Singh (2006). This implies that investors do not rationally assess a fundamental value of an investment, but rather follow their sentiment when buying or selling assets. They developed an explanation of overoptimistic investors, assuming some investors have sentimental beliefs about IPOs. This is consistent with the hot markets phenomenon by Ibbotson and Jaffe (1975), as issuers take advantage of periods with high optimism in the market. The issuing firm will seek to take advantage of the investors` behavior, by maximizing the fundamental value of the stock and withhold a larger proportion of shares, creating a higher demand among sentiment investors. Consistent with Ritter (1991), arguing that in the long-run IPO returns are negative, the true value of the stock is revealed by the nature and the price reflects the fundamental value of the stock. That is, since IPO stocks are young, immature and lack historical data and information, they are difficult to value in the short-run. Ljungqvist, Nanda & Singh (2006) argues that issuers sell the stock to institutional investors for subsequent resell to sentiment investors. However, holding the IPO stock over time is risky for the institutional investors since in the event of a cold market, the institutional investors could receive overpriced shares as a punishment for taking the holding period risk. The main idea of Ljungqvist, Nanda and Singh`s (2006) theory of IPO underpricing with investor sentiment, is that institutional investors receive underpriced shares as a reward for taking risk.

Several models have been proposed to test the investor sentiment theory. As indicated by Ibbotson and Jaffe (1975), underpricing is higher in so called “hot markets”. Sentiment theory can explain this phenomenon as issuing firms taking advantage of periods with high optimism in the market. The investor sentiment can to a degree be supported if there is significantly more underpricing during hot markets that cold markets. There may however be different explanations to hot and cold markets than investor sentiment. In this manner, the sentiment theory can at least be

partially supported if there is a huge contrast between the two markets.

Another proxy for testing investor sentiment was developed by Baker & Wurgler (2006). They formed a composite index of sentiment that is based on the common variation in six underlying proxies for sentiment; the close-end fund discount, NYSE share turnover, the number of average first-day returns on IPOs, the equity share in new issues, and the dividend premium. However, as the index is based mostly on US data, it would be more applicable to use a proxy for Nordic sentiment. Furthermore, Ofek and Richardson (2003) show that during the "dot-com" bubble, high initial returns occurred when institutions sold their shares to retail investors on the first day of trading. They explain the rise, and then fall of IT stock prices by large heterogeneity across investors and short sales restrictions on internet stocks. This is consistent with Ljungqvist, Nanda & Singh`s (2006) idea that institutional investors resell their stocks to take advantage of sentiment investors.

3.4.3 Prospect theory and mental accounting

Loughran & Ritter (2002) introduce an explanation to why issuers don`t get upset about leaving lots of money on the table. Using prospect theory and the idea of mental accounting, they explain IPO underpricing with behavioural biases among important decision-makers of the issuing firm rather than among investors. This is linked to Thaler`s (1980) idea of mental accounting. The suggestion is that the issuer only cares about total wealth gains or losses. Money left on the table is perceived as a loss, while a positive price revision from a given reference point is perceived as a gain, given that the decision-maker retains shares after the IPO. Loughran & Ritter (2002) argues that the mean of the indicative price range from the issuing firm`s preliminary prospectus is a good predictor of the decision maker`s initial valuation beliefs, that is, reference point. Hanley (1993) further argues that the positive revisions from the indicative price range are only partially adjusted to the offer price. The decision-makers in an IPO will sum the wealth loss from leaving money on the table with the wealth gain on the retained shares` positive price

revision. In the case the gain is greater than the loss, there will be a net wealth increase which means that the issuer is satisfied with the underwriter`s valuation performance of the IPO.

Following Loughran and Ritter`s (2002) behavioral perspective, Ljungqvist and Wilhelm (2005) tests whether the CEO`s of recent IPO firms make subsequent decisions consistent with a behavior measure of their impression of the IPO`s outcome. This tumbles down to examine whether CEOs are satisfied with their underwriter. They find that IPO firms that were satisfied with their underwriter are less likely to switch underwriters for their seasoned equity offering (SEO). Other than this, there has been quite little research on the behavioral model.

3.5 Theories that will be tested

As a result of the wide range of theories on IPO underpricing outlined above, some theories consequently need to be eliminated from our research due to the scope of this thesis. The basis for eliminating theories are mainly due to unavailability or lack of data, or if a theory has received limited or insufficient academic support in the past. For instance, as there is no clear evidence in favour of the signalling theory, but rather in disfavour of the theory, it has been eliminated. When it comes to testing the principal agent theory with the approach of Muscarella and Vetsuypens (1989) with self-underwritten investment banks, we do not have sufficient data on investment banks going public to produce satisfying results. They also found that investment banks had just as much underpricing as other new listings. The legal liability explanation of underpricing is more applicable for countries with strict liability laws, and is therefore not included. The findings of Keloharju (1993) in Finland further supports that legal liability is not a main driver of underpricing. We are also unable to test the theory of underpricing as a means to retain control as it is strictly limited by data availability, such as detailed data on individual bids and allocations. Lastly, the cascades theory is eliminated from our study due to the fact that the book-building technique of pricing

IPOs is dominant in the Nordics, which is assumed to significantly reduce cascades from forming.

Our main focus will be on theories related to asymmetric information and behavioural biases. We perform tests on the winner´s curse theory and information revelation theory among the theories based on asymmetric information. We test the winner´s curse theory through the option pricing view of Beatty and Ritter (1986), with the implication that underpricing should increase with ex ante uncertainty. We also test the implication that lead managers with a high reputation reduces underpricing. Furthermore, the information revelation theory is tested through the implication that IPOs is only partially adjusted when positive information is revealed, as first introduced by Hanley (1993), and also known as the partial adjustment theory. We further test the quality/price trade-off theory suggested by Ljungqvist et al. (2003). Among behavioral theories we test the investor sentiment theory by using a European investor sentiment index. We also test the "hot market" hypothesis which was first documented by Ibbotson and Jaffe (1975).

4.0 Methodology

This part covers the details of our research objectives, its scope, and our selected tools and techniques that will be used to determine the short-run market performance and its determinants.

4.1 Measures of short-run market performance

There are two common ways of measuring the short-run performance of IPOs. We will in the following describe these two measures.

4.1.1 Raw initial return

The raw initial return is defined as the percentage difference between the offering price and the closing price on the first day of trading, and is given by

$$\boldsymbol{R_{R,i}} = \frac{\boldsymbol{P_{1,i} - P_{O,i}}}{\boldsymbol{P_{O,i}}} \qquad (1)$$

where $R_{R,i}$ is the raw initial return (RR) on stock *i,* $P_{1,i}$ is the closing price of stock *i* the first day of trading, and $P_{O,i}$ is the offer price of stock *i* at the last day of the offer period. An underpriced stock will have a positive raw initial return, as the offer price is set lower than what the market is willing to pay, and hence appreciates on the first day of trading. Similarly, an overpriced stock will have a negative raw initial return, and depreciates on the first day of trading.

4.1.2 Market-adjusted initial return

The market-adjusted initial return (MAR) is given by

$$\boldsymbol{R_{A,i}} = \frac{\boldsymbol{P_{1,i} - P_{O,i}}}{\boldsymbol{P_{O,1}}} - \frac{\boldsymbol{I_1 - I_O}}{\boldsymbol{I_O}} = \boldsymbol{R_{R,i}} - \frac{\boldsymbol{I_1 - I_O}}{\boldsymbol{I_O}} \qquad (2)$$

where $R_{A,i}$ is the MAR on stock *i,* I_1 is the closing value of the index on the first day of trading of stock *i,* and I_O is the value of the index on the last day of the offering period for stock *i.* MAR is often considered a

better measure of short-run performance, as the effect of the general value appreciation or depreciation in the market is accounted for. There are however a weakness of measuring underpricing this way, because it assumes that all IPOs has a beta-value equal to the average beta-value of the market. Ibbotson (1975) finds that the average beta-value for companies in the U.S was 2.18 at the initial offering. However, the beta-values rapidly fall to one in the months following the IPO. An error will occur if the true beta-value in our sample lies above one, causing the marked-adjusted initial return to be overstated. There are however numerous reasons why we do not estimate the "true" beta-value for each individual company. First of all, there is naturally no time series of the stock values before the IPO that can be compared to the market. Emilsen, Pedersen and Saettem (1997) also argue that estimating the beta-value after the IPO and using this as the "true" beta-value to measure the initial underpricing is far from problematic, as the beta-values fall dramatically the first months of trading. Additionally, fewer companies have significant beta-values in small markets such as in the Nordics, causing the "true" beta-value to lie within a relatively wide confidence interval.

4.2 Hypotheses development

With the theories from part three, we form hypotheses to answer the thesis´ problem statement. Each hypothesis is expressed specifically to answer if we can find support for a selected theory. In addition, we form hypotheses to explore differences or similarities between the countries, both when it comes to the level of underpricing and its determinants. The first hypothesis is as test for general underpricing.

Hypothesis 1: Nordic IPOs have been fairly priced in the short run.

Hypothesis 1 tests the short-run market performance of the IPOs in our sample period. If we find significant over- or underpricing, hypothesis 1 will be rejected. As previous studies, both internationally and in the Nordics, confirm the existence of underpricing, we expect that hypothesis 1 will be rejected. We also expected the mispricing to be in direction of

underpricing. The underpricing will further form the basis for all other hypotheses. The next two hypotheses are related to the winner´s curse.

Hypothesis 2: Underpricing is unaffected by the reputation of the underwriter

Hypothesis 3: Underpricing is unaffected by ex post uncertainty

If hypothesis 2 is rejected, we would in accordance with theory expect that underpricing is decreasing in the reputation of the underwriter. Similarly, if we can reject hypothesis 3, we expect that underpricing is increasing in valuation uncertainty, in accordance with Beatty and Ritter (1986). Rejecting either or both of these hypotheses will support Rock´s (1986) winner´s curse theory. The next hypothesis is related to the information revelation theory.

Hypothesis 4: Underpricing is unaffected by whether the final offer price is above or below the indicative price range

If we are able to reject hypothesis 4, we expect that issues priced above its price range has a higher underpricing, and vice versa, as first documented by Hanley (1993). As previously explained, if an issue is priced above its indicative price range it might suggest that positive information about the offering has been revealed during the book-building process. The underwriters then only partially adjust the price upwards in order to reward the investors with underpricing for truthfully revealing their information. If hypothesis 4 is rejected it will be in favor of the information revelation theory.

Hypothesis 5: Underpricing is unaffected by "hot" or "cold" markets

Hypothesis 6: Underpricing is unaffected by investor sentiment

Hypothesis 5 is related to the hot issue market phenomena. We expect that

during “hot” markets there is higher underpricing, while “cold” markets are associated with less underpricing. A rejection of the hypothesis will be in accordance with Ibbotson´s (1975) hot market theory, and will also support the investor sentiment theory. The investor sentiment theory is further tested with hypothesis 6, and in accordance with theory, we expect that there will be a direct relationship between investor sentiment and underpricing.

Hypothesis 7: Underpricing is unaffected by pricing technique

If we can reject hypothesis 7, we expect that issues with a fixed price have higher average first-day returns than book-built IPOs. This is in accordance with the quality/price trade-off suggested by Ljungqvist et al. (2003), which implies that the book-building process leads to more accurate pricing. In such a case, we would find support for the information revelation theory. We further form some hypotheses aiming to test the differences and/or similarities between the countries covered in the study. Hypothesis 8 is constructed to examine whether the underpricing differs in the Nordic countries.

Hypothesis 8: The level of underpricing is equal in the Nordic countries

Hypothesis 8 will be rejected if the level of underpricing differs significantly between the Nordic countries. We further examine the differences in determinants between the countries.

Hypothesis 9: The underpricing in each country can be explained by the same factors

A rejection of hypothesis 9 means that there are different determinants of underpricing between the Nordic countries. This will be investigated using various regressions.

4.3 Identification and measurement of variables

In this section we identify and describe the variables that will be used to test the hypotheses.

4.3.1 Underpricing

Underpricing is the dependent variable in our regressions, and is directly observable in the data. The variable is measured by the market-adjusted first-day return (MAR). The market is measured by an index that is relevant to each of the countries, and the return on this index in the period between offering and the closing price of first day of trading is subtracted from the raw initial return. We naturally expect that the underpricing is positive. The variable is given the name *MAR* in our model.

4.3.2 Hot and cold markets

We include a variable related to "hot" and "cold" markets, in order to test the hot issue market phenomena and the investor sentiment theory. We define a "hot" market as a year in which the number of IPOs is higher than the average in our sample. It is created as a dummy variable, which denotes 1 for "hot" market and 0 otherwise. We further expect that issuing in hot markets will lead to a higher first-day return on average, and hence, the sign of the coefficient to be positive. The dummy variable is given the name *HC*.

4.3.3 Investor sentiment

We include a proxy for investor sentiment to test the investor sentiment theory. Here we use the European Commission Consumer Confidence Indicator in the Eurozone (EUCCEMU) by the Directorate-General for Economic and Financial Affairs. The EUCCEMU is the arithmetic average of the balances (in percentage points) of the answers to the questions on the financial situation of households, the general economic situation, unemployment expectations (with inverted sign) and savings, all over the next 12 months (Datastream, 2017). The survey targets private investors, which is desirable, because they are arguably subject to a higher degree of sentiment than institutional investors. The theory related to

investor sentiment and IPO underpricing also assumes so. The variable is measured on the monthly basis. We expect that the coefficient of the variable will have a positive sign, as average first-day returns are expected to be higher during periods of high sentiment among investors. The variable is given the name *Sentiment.*

4.3.4 Valuation uncertainty

Ex post uncertainty tests Rock´s (1986) winner´s curse theory. We use firm age, firm size and whether or not they are classified as a tech-company as proxies of ex ante uncertainty. Firm age is defined as the logarithm of one plus the number of years between the year of creation and the time of listing. We add one because some firms went public in the same year they were created. Firm size is measured by the logarithm of total assets before the IPO, denoted in U.S 2016-dollars. Tech-companies are defined by their SIC code, in accordance with Loughran and Ritter (2004). We have assigned a dummy variable equal to 1 for companies classified as a tech-company and 0 otherwise. Further details on how these three variables are measured are explained in appendix 9.1. In accordance with theory, we expect the sign for age and assets to be negative, as increased size and age is associated with less risk. Tech-companies are expected to be associated with higher risk, and thus higher underpricing. The variables are given the names *LN (1+Age), LN (Assets)* and *Tech* in our model.

4.4.5 Pricing technique

To study whether there is a quality/price trade-off in relation to the pricing technique, we include a dummy variable equal to 1 if the pricing technique is fixed, and 0 otherwise. We do so to test whether book-building leads to a more accurate pricing of a company. This would further suggest that issues with a fixed price should have a higher first-day return. In accordance with this theory, we therefore expect that the variable`s coefficient has a positive sign. The variable is given the name *Technique* in our model.

4.3.6 Price range

We test the information revelation theory by including two dummy variables for IPOs where the final price is either above or below its indicative price range. We include a dummy variable equal to 1 if the issue was priced above its price range and 0 otherwise. Similarly, we include a dummy variable equal to 1 if the issue was priced below its price range and 0 otherwise. The expected sign of the coefficient is positive for issues priced above the price range, and negative for issues priced below the price range. The variables in our model is given the names *Above* and *Below*, for issued price above and below their indicative price range, respectively.

4.3.7 Manager reputation

The reputation of the underwriters (managers) is used to test Rock´s (1986) winner´s curse theory, and can be measured in various ways. We rank the lead managers according to their in-sample share of the total gross proceeds per country. We rank per country because the IPO market is typically segmented, whereas the most reputational investment banks differ between the countries. More generally we rank managers by their share of total gross both because the availability of data, but also because we believe that IPO volume, as measured by gross proceeds, is a better proxy than for example the number of IPOs they are a part of. For instance, in most cases would being part of one 1 billion deal rather than five 10 million deals have a substantially larger reputational effect. A manager with higher expertise and experience will naturally in most cases have a better reputation, leading to a higher market share. The variable is measured as a dummy, equal to 1 if one of the lead managers, or the lead manager, is among the two highest ranked in the country, and 0 otherwise. Additionally, we have created a dummy variable equal to 1 if there is an international manager among the lead managers, and 0 otherwise. See appendix 9.2 for details on manager ranks. We expect the sign of the coefficients to be negative. That is, an IPO with high-ranking managers or international managers are expected to have lower underpricing. The

variables for manager reputation in our model are given the names *Rank* and *International.*

4.4.8 Control variables

We introduce two control variables to our regressions. These are mainly included to control for factors that are believed to explain variations in IPO underpricing, other than our research variables. Studying how our regressions changes when introducing the control variables also provides us with a robustness check of our results.

The performance of the general stock market, and its volatility, is factors that have been documented by various authors to have an effect on the first-day returns of IPOs. Butler, Keefe and Kieschnick (2014) provide evidence that including robust control variables produces substantially different estimates than specifications that omit them. They explain that similar studies in the same market have different results since corporate control related variables could be correlated with the omitted and robust explanatory variables. The study documents robust effects of the general stock market performance and its volatility on the level of IPO underpricing. We have therefore included the return and the standard deviation on the main index in each of the countries for the last 30 trading days prior to the IPO. The variables are given the names *Market return* and *Std.dev.*

4.4 Predictions

The predictions related to all the variables` coefficients, and what theory they serve as a proxy for, is summarized in Table 1.

Table 1: Predictions

Explanatory variables	Variable in model	Measure	Expected sign	Proxy for theory
Investor sentiment	*Sentiment*	The level on the consumer confidence index in the month of the IPO	+	Investor sentiment theory
Market condition	*HC*	Denotes 1 for "hot market" and 0 for "otherwise"	+	Hot issue market / investor sentiment theory
Assets	*LN (Assets)*	Natural logarithm of total assets before the IPO for an issuing firm	-	Winner`s curse
Age	*LN (1+Age)*	Natural logarithm of one plus the number of years between the year of creation and the IPO	-	Winner`s curse
Industry	*Tech*	Denotes 1 for "Tech-company" and 0 for "otherwise"	+	Winner`s curse
Pricing technique	*Technique*	Denotes 1 for "fixed price issues" and 0 otherwise	+	Information revelation theory
Price relative to price range	*Above*	Denotes 1 for "issues priced above its price range" and 0 for "otherwise"	+	Information revelation theory
	Below	Denotes 1 for "issues priced below its price range" and 0 for "otherwise"	-	Information revelation theory
Manager reputation	*Rank*	Denotes 1 for "managers ranked among the two highest in their country" and 0 for "otherwise"	-	Winner`s curse
	International	Denotes 1 for "international managers" and 0 for "otherwise"	-	Winner`s curse
Market return	*Market return*	The return in the general market over the last 30 days prior to the IPO	+	Control variable
Market volatility	*Std.dev*	The standard deviation in the general market for the last 30 days prior to the IPO	+	Control variable

4.5 Regression analysis

To identify determinants of short-run underpricing, multiple regression analysis, hereunder the Ordinary Least Squares (OLS), is by far the most commonly used method by researchers in the IPO literature. The multiple regression models identify the linear relationship between the dependent variable (underpricing) and the independent variables (explanatory variables). We will in this subpart discuss the underlying assumptions of the classical linear regression model (CLRM) and the diagnostic tests, and finally specify our regression models.

4.4.1 The classical linear regression model assumptions

There are five main assumptions underlying the CLRM. These assumptions should be fulfilled in order to validly conduct hypothesis tests regarding the coefficient estimates of the models. Violations of these assumptions can cause problems for the interpretation of our results, and ignoring them can among other things potentially lead to wrong estimates of coefficients. Given that the assumptions of the classical linear regression model (CLRM) hold, the OLS estimators are said the be the best linear unbiased estimators (BLUE), which are properties of the Gauss-Markov Theorem (Gujarati & Porter, 2009). We will in the following describe the classical assumptions, consequences of violating them, how violations can be detected and how problems related to them can be dealt with.

- Assumption 1: $\mathrm{E}(\varepsilon) = 0$

The average value of the errors is zero.

- Assumption 2: $\mathrm{var}(\varepsilon) = \sigma^2 < \infty$

The variance of the errors is constant

- Assumption 3: $cov(\varepsilon_i, \varepsilon_j) = 0$ for $i \neq j$

The errors are uncorrelated with one another.

- Assumption 4: $cov(\varepsilon_i, X_i) = 0$

The regressors are uncorrelated with the error term.

- Assumption 5: $\varepsilon \sim N(0, \sigma^2)$

The disturbances are normally distributed.

Another implicit assumption is that there is no multicollinearity. If the necessary assumptions hold, the parameters are said to be BLUE, and will have the following desirable properties (Brooks, 2014):

- Best: The estimated parameters have the minimum variance among the class of linear unbiased estimators.
- Linear: The estimated parameters are linear estimators.
- Unbiased: The estimated parameters will on average be equal to their true values.
- Estimator: The estimated parameters are estimators of their true value.

Assumption 1 will never be violated as long as a constant term is added to the regression equation, and for all natural reasons, a constant should be included in our regression models. Assumption 2 assumes that the variance of the errors is constant, and is often referred to as the assumption of homoscedasticity. A violation of this assumption will cause the OLS estimator to give coefficient estimates that no longer "Best" – that is, they do not have the minimum variance among the class of linear unbiased estimators. Ignoring this problem could potentially lead to drawing wrong conclusions, as the standard errors could be wrong. When considering our kind of data, it is expected that the errors are non-constant, i.e. they are heteroscedastic. We will therefore calculate our t-statistics using White's heteroscedasticity-consistent method, which is a common way of dealing with the issue of heteroscedasticity. This ensures that we do not wrongfully draw conclusions, and makes the hypothesis testing more "conservative" (Brooks, 2014).

Assumption 3 is related to autocorrelation, which is the case if the errors are correlated with one another. As we deal with cross-sectional data, without any time component, we do not consider this an issue[1]. Assumption 4 assumes that none of the independent (explanatory)

[1] We do however realize that autocorrelation may occur due to spatial ordering of observations in the sample.

variables is correlated with the error term. If this assumption is violated, the OLS estimator will be biased and inconsistent. This is due to the estimator assigning explanatory power to the independent variable(s), where in reality it is because of the correlation between the dependent variable and the error term (Brooks, 2014). As the theories of underpricing are many and heavily discussed, and various proxies can be used to test any one of them, it is likely that we have a specification error of an omitted variable. If that is the case, the omitted variable's impact on the first-day returns will be captured by the error term, and if the omitted variable is correlated with any of our independent variables, the independent variable will be correlated with the error term.

The classical normal linear regression model further assumes that the error terms in the regression is normally distributed (assumption 5). A violation of the normality assumption is particularly critical if the sample size if relatively small. It is thus desirable to stick with the OLS if the sample size is sufficiently large. If the error term is not normally distributed, it can be shown that OLS estimators are still best linear unbiased estimators (BLUE). That is, the estimators are unbiased and in the class of linear estimators that have minimum variance. The problem is that is that for the purpose of hypothesis testing we need the probability or distribution of the OLS estimators. Following the central limit theorem, the t and F tests assume that the probability distribution of the error term follows the normal distribution even in the absence of error normality.

One last and implicit assumption is that there is no multicollinearity, which assumes that the independent variables are not correlated with one another. In practice, however, there will be a non-zero correlation between independent variables, but a small degree of association between independent variables will not cause too much loss of precision (Brooks, 2014). In the case of high correlation between the independent variables, omitting or including additional variables from a regression can cause other variables' coefficients to change. Formally testing for multicollinearity is difficult, and unusual, but a visual investigation of the

data is typically a good place to start if one suspects multicollinearity. Looking at a correlation matrix between the independent variables provides an indication of which variable(s) that eventually are causing the issue.

4.4.2 Diagnostic tests

In order to evaluate the validity of our results we will perform certain tests. The tests are related to the significance of our results and explanatory power, in addition to tests regarding the underlying assumptions.

The F-test evaluates the overall significance of the regression models, and tests all the included regression coefficients simultaneously. The null hypothesis of the test is that all the parameters in the model are equal to zero except the constant intercept. The null hypothesis is rejected if the p-value of the f-test statistic are less than or equal to a given significance level, usually set to 5%. A rejection of the null hypothesis will suggest that at least one of the variables in the model can explain some of the variation in underpricing, and will confirm the validity of our model.

The most common goodness of fit statistic is the R-squared, which is a scaled version of the residual sum of squares that the OLS seeks to minimize (Brooks, 2014). How well the regression lines of the developed model approximate the real data points is measured by the R-squared. More formally it is defined as the square of the correlation coefficient between the dependent variables values and the fitted values from the model. A high correlation suggests that the model fits the data well, while a low correlation indicates that the model does not fit the data well. There are however certain properties of the R-squared, such as that it will never fall with the inclusion of an additional variable that suggests that another measure should be used. In order to come around this problem the adjusted R-squared is a better measure, which adds a penalty term for including additional variables. Unlike the R-squared, it takes into account the loss of degrees of freedom from adding an extra variable. It is

therefore considered a more accurate goodness of fit measure than the unadjusted R-squared.

Lastly, we will perform certain tests and experiments regarding the potential issues related to the underlying assumptions of the classical linear regression model, as discussed in part 4.4.1.

4.4.3 Multiple regression models

We use multiple regression analysis to identify the relationship between first-day returns and the explanatory variables. The models are estimated using the OLS method. The following regression equations are used in the analysis:

$$R_{A,i} = \beta_1 + \beta_2 Sentiment + \beta_3 HC_i + \beta_4 LN\,(Assets)_i + \beta_6 LN\,(1 + AGE)_i + \beta_7 Tech_i + \beta_8\, Technique_i + \beta_9\, Above_i + \beta_{10}\, Below_i + \beta_{11} Rank_i + \beta_{12} International_i + \varepsilon_i \quad (3)$$

$$R_{A,i} = \beta_1 + \beta_2 Sentiment + \beta_3 HC_i + \beta_4 LN\,(Assets)_i + \beta_6 LN\,(1 + AGE)_i + \beta_7 Tech_i + \beta_8\, Technique_i + \beta_9\, Above_i + \beta_{10}\, Below_i + \beta_{11} Rank_i + \beta_{12} International_i + + \beta_{13}\, Market\ return_i + \beta_{14}\, Std.Dev_i + \varepsilon_i \quad (4)$$

where $R_{A,i}$ is the MARs, $Sentiment$ is the consumer confidence index, HC is the hot issue market dummy, $LN\,(Assets)_i$ is the natural logarithm of the assets of firm *i,* $LN\,(1 + AGE)_i$ is the natural logarithm of the age of firm *i, Tech* is the dummy for companies having a SIC code classified as tech, *Technique* is the dummy for fixed-price issues, *Above* is the dummy for issues priced above its price range, *Below* is the dummy for issues priced below its price range, *Rank* is the dummy for high-ranking lead managers, *International* is the dummy for international lead managers, *Market Return* is the return on the market over the last 30 days before the first day of trading and *Std.Dev* is the standard deviation of the market return over the 30 days before the first day of trading.

5.0 Data

This part describes how we have collected the data, where it is collected, and what data that is needed in our analysis. We also discuss possible limitations due to the availability of data, and what data that is excluded.

5.1 Data selection

We examine companies going public on the main stock exchanges in Oslo, Copenhagen, Stockholm and Helsinki in the period from January 2001 to December 2016. Our data has been collected by going through financial databases, notifications from the stock exchanges, IPO prospectuses, annual reports and company websites. The largest part of our data is gathered from SDC Platinum. The database is the industry standard for information on bond and new equity issues, and contains most parts of the issue- and company specific information needed in our analysis. However, as identified by various researchers[2], the database is known for containing some errors. All the relevant data that is collected from SDC have therefore been checked for accuracy against other sources. For instance, the first day of trading and the primary exchange where the company is listed is reported by each individual stock exchange. Similarly, the price range, pricing technique, managers/bookrunner(s) and total assets is found in each individual prospectus. In the case where the prospectus is not available, we have used the latest annual or quarterly report for total assets. This is especially the case for IPOs that occurred early in our sample. Bloomberg have further been used for offering prices and closing prices, as well as price ranges, pricing techniques and managers/bookrunner(s) where the prospectus is not available. In the case where the data reported by SDC is conflicting with any of the secondary sources, we rely upon the secondary source. We do so first of all because official reports from companies and notifications from stock exchanges are considered a very reliable source.

[2] See for example Jay R. Ritter's webpage: https://site.warrington.ufl.edu/ritter/ipo-data. He identifies a long list of errors reported by SDC, hereunder mistakes related to the file price range, assets, sales, number of shares, number of underwriters, offer prices, follow-ons from OTC, and more.

Secondly, it is documented and known that SDC have reported wrong numbers and that it might contain errors. There are also obvious mistakes reported by SDC. For instance, the first day of trading are sometimes reported on national holidays or other days where the respective exchange is closed. This further causes the closing price and thereby the initial return to be wrong, as the closing price relies upon the first trading date in SDC. A complete list of all errors, mistakes and missing data from SDC are reported in appendix 9.3.

The return on the general market index for Sweden, Denmark and Finland has been gathered from Nasdaq OMX Nordic. Similar data for Norway have been gathered from Oslo Bors. Data on consumer price indices, exchange rates and the investor sentiment index has been retrieved from Datastream.

5.2 Excluded data

As discussed in part 5.1, we only consider IPOs on the main indices in each specific country. This is mainly because the smaller indices have fewer requirements for companies being accepted for listing, and that the companies that are listed often are small and illiquid. Listing on a small exchange is also often the first step of becoming listed on the main index. We have therefore excluded all companies listing on Oslo Axess, Aktietorget and First North, in addition to companies transferring from any of these indices to a main index. As we are mainly interested in Nordic issuers, investors, underwriters, exchanges and so on in our study, we do not consider foreign companies listed on any of the Nordic exchanges, or Nordic companies listed abroad. Furthermore, companies listing on Nasdaq Iceland have been excluded due to very few observations.

We have also found a number of follow-ons from companies that have been traded OTC, which has been classified by SDC as an IPO. This amounts to 13 observations that have been excluded from our sample. There are further some observations that have been excluded due to data

not being available. With the exception of three observations, this is caused by the closing price being unavailable, which means that it is not reported by SDC nor is it available in Bloomberg. The three exceptions are one issue where total assets are unavailable and two where the pricing technique is not identified. The companies than have been excluded are shown in appendix 9.4. The excluded observations have not been investigated as thoroughly as the rest of the observations, as closing prices have not been identified. This means that there is some probability that these IPOs should not be in our sample anyhow. On the other hand, it might be due to our method and sources of data collection.

6.0 Analysis

This part discusses the descriptive statistics, the evaluation of short-run market performance, the determinants of short-run market performance and the underlying assumptions of the classical linear regression model. The first section discusses detailed descriptive statistics on the first-day market-adjusted returns, and univariate results on the impact of each individual research variable on the average first-day returns. In section two, we identify and describe the determinants of short-run market performance of IPOs in the Nordic region using regression models. These results are further analysed and discussed in relation to the selected theories and hypotheses in section three. Finally, in section four, we discuss the underlying assumptions of the classical linear regression model, and their implication to the presented results.

6.1 Descriptive statistics

Table 2 summarizes detailed descriptive statistics for the average first-day market-adjusted return. The average first-day return in the total sample is 4.53%, and appears significantly greater than zero on the 1% significance level using a simple t-test. This is an important initial result that confirms the presence of underpricing in our sample. The 50^{th} percentile (median) is 2.32%, which together with the positive skewness indicates that our sample is skewed to the right. This is further visualized in the distribution of first-day returns in Figure 2. Figure 2 also shows that our sample has quite fat tails, as indicated by a relatively high kurtosis, and that it peaks in the range between a -2.5% and 2.5% first-day return. The 25^{th} percentile tells us that 75% of the observations have a first-day return that is greater than -1.14%.

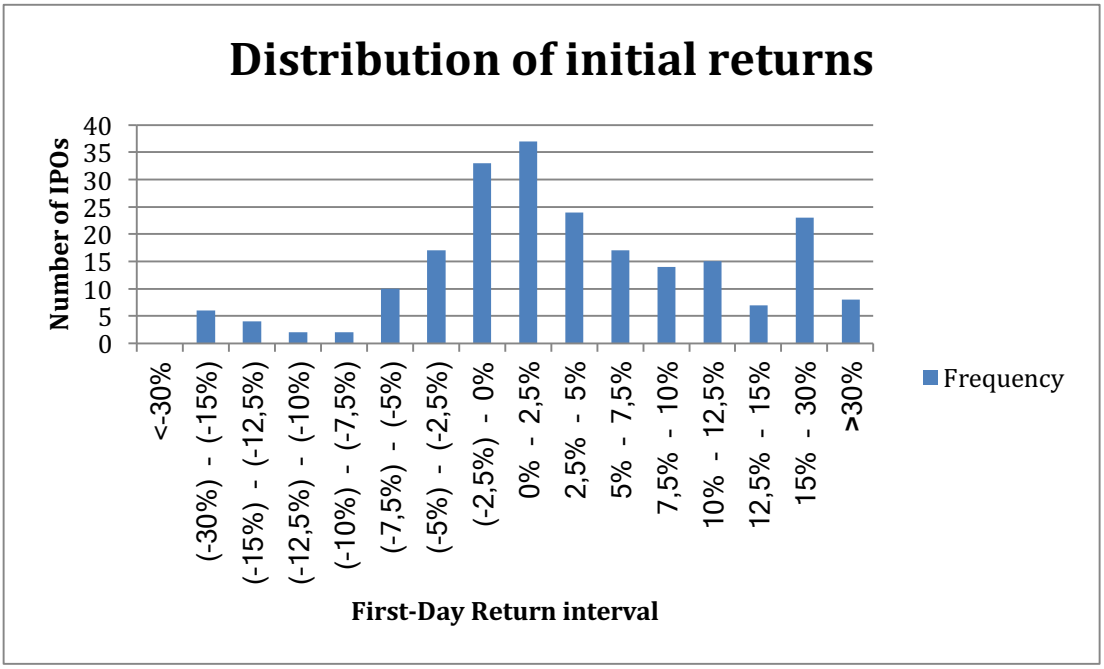
Table 2: Descriptive Statistics

This table reports summary statistics for the first-day market-adjusted return (MAR) in the total sample and for each country separately.

MAR	N	Mean	SD	T-stat	Min	Max	Skew	Kurt	25th p.	50th p.	75th p.
Total	219	0.0453	0.109	6.150	-0.261	0.452	0.773	5.247	-0.0114	0.023	0.098
SE	84	0.0735	0.128	5.263	-0.223	0.452	0.783	4.004	-0.001	0.049	.0140
DK	27	0.0558	0.109	2.660	-0.261	0.256	-0.596	4.255	0.005	0.041	0.121
FI	21	0.0797	0.092	3.970	-0.006	0.381	1.870	6.762	0.011	0.061	0.106
NO	87	0.006	0.0791	0.707	-0.239	0.243	-0.048	5.441	-0.029	0.001	0.0391

Figure 2: Distribution of First-Day Returns

This figure displays the distribution of first-day returns in selected intervals for the sample of 219 IPOs listed in the Nordics between 2001 and 2016.



Furthermore, the mean first-day return is 7.35%, 5.58%, 7.97% and 0.6% in Sweden, Denmark, Finland and Norway, respectively. These are significantly greater than zero at the 1% level in Sweden, Denmark and Finland, while statistically insignificant in Norway. The distribution of initial returns for each country is displayed in Figure 3, where we can see that the distribution of first-day returns for IPOs in Norway are centered around 0%, while in Sweden there is a relatively high frequency of IPOs that have been underpriced to a high degree. In Denmark and Finland, the first-day returns are more evenly distributed, with very few instances of a negative first-day return.

Figure 3: Distribution of First-Day Returns Per Country

The figure displays the distribution of first-day returns in selected intervals for each country for IPOs between 2001 and 2016.

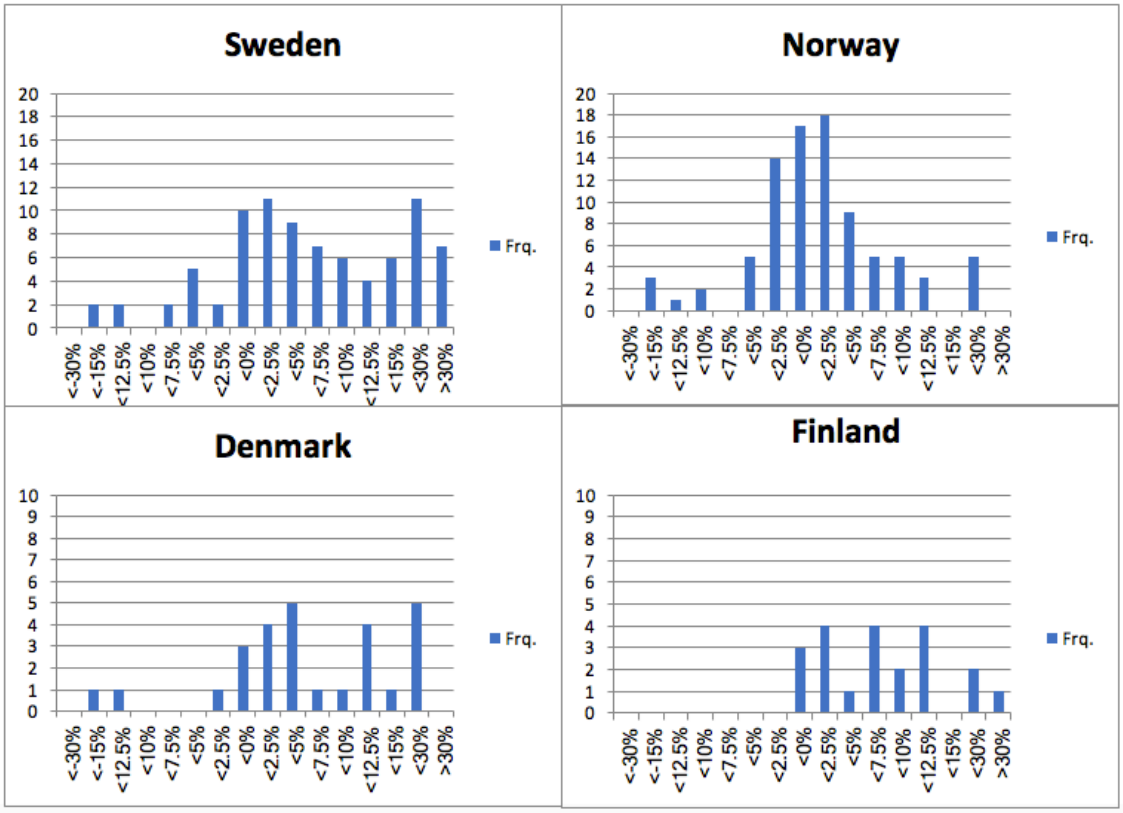


Figure 4 displays the number of IPOs and the average first-day returns per year. The general patters seem to be that periods of high IPO volume on average were associated with higher first-day returns. The number of IPOs per year per country displayed in Figure 5 further shows that the four countries are quite similar in terms of periods with high IPO activity. The large variation in IPO volume over the period might indicate that firms attempt to "time" their IPOs to take advantage of periods with higher sentiment among investors. Obviously, we would expect to see some variation in volume, however, the large variations in volume seems difficult to assign to normal business cycle activity. Additionally, Ibbotson, Seandlar and Ritter (1994) argue that if firms are taking advantage of periods with misevaluations by investors, one would expect to see poor subsequent performance following periods of high IPO activity. In fact, if we look at the period from 2005 to 2007 in Figure 4, defined as "hot markets" and with relatively high average first-day returns, and the following period from 2008 to 2012, a period with relatively low returns and one year barely defined as a "hot market", this pattern seems to some degree to fit.

Table 3 reports univariate results of the impact of each individual research variable on the average first-day return in our whole sample, as well as for each of the four countries. In general, the numbers for the total sample are quite influenced by the numbers in Norway and Sweden, considering that these countries had a much higher IPO volume than Denmark and Finland over the period. We can further see that for the total sample, and as indicated in Figure 4, the average first-day return appears to be higher during "hot" markets than "cold" markets, with an average of 5.5% during hot markets and 0.82% during cold markets. The relationship seems to apply for each individual country, except for Norway where the average first-day return was slightly higher during cold markets.

Figure 4: Number of IPOs (Blue Bars), "Hot Markets" (Blue Dotted Bars) and Average First-Day Returns (Grey Bars)

The figure displays the number of IPOs and the average first-day market-adjusted return per calendar year. "Hot" markets are defined as a calendar year in which the number of IPOs was higher than the average in the sample. "Hot" markets are indicated by a dotted bar in the figure.

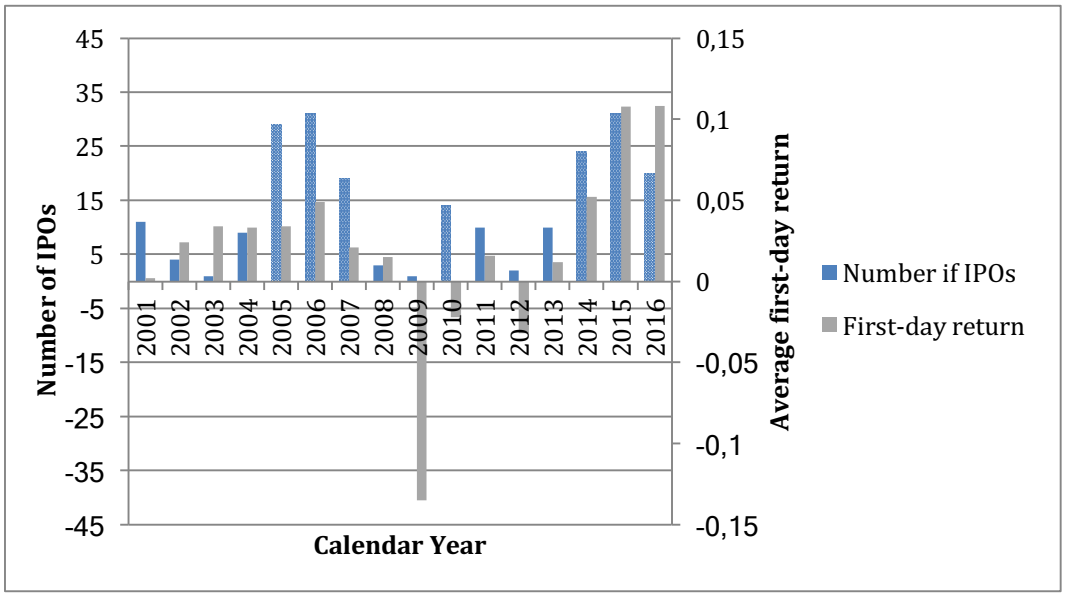


Figure 5: Number of IPOs per Country per Year

This figure displays the number of IPOs per country per year.

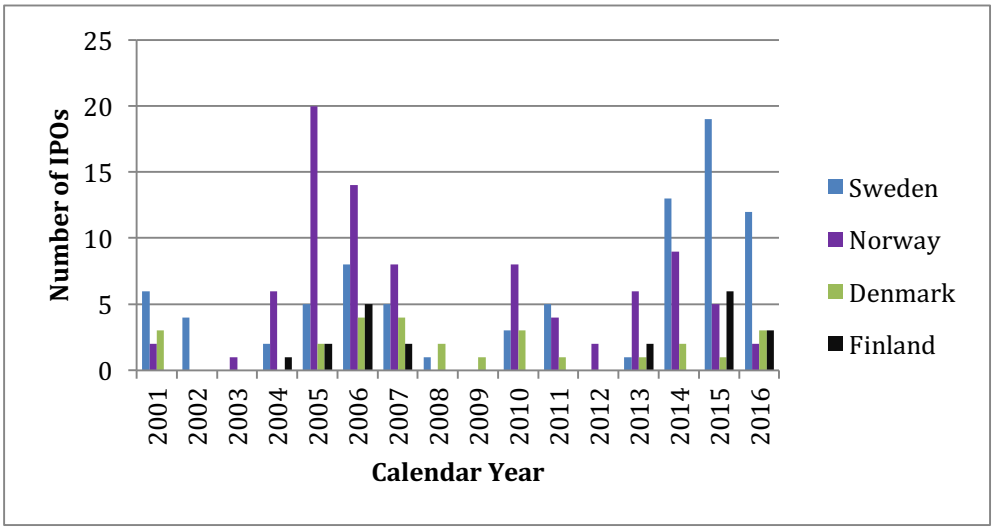


Table 3: Average First-day Returns on IPOs Categorized by Market Condition, Sentiment, Assets, Age, Industry, Pricing Technique, Offer Price Relative to File Price Range and Manager Rank

Sample of 219 firms listed on the main indices in Norway, Sweden, Denmark and Finland in the period from 2001 to 2016. For manager rank, we have not displayed IPOs that had both high ranking and international ranking managers, which amounts to 18 IPOs, because the two are studied separately in this thesis. Firm age is divided into young and old, where young firms are from 0-7 years and old firms are 8 years and older at the time of their IPO. Firm assets and sentiment are divided into larger/smaller than median.

	Total		NO		SE		DK		FI	
Segmented by	**Return**	**N**	**Return**	**N**	**Return**	**N**	**Return**	**N**	**Return**	**N**
All	4.52%	219	0.64%	87	7.34%	84	5.58%	27	7.97%	21
Market condition										
Hot	5.55%	168	0.29%	66	9,59%	65	7.20%	19	8.51%	18
Cold	1.13%	51	1.74%	21	-0.34%	19	1.72%	8	4.73%	3
Sentiment										
High	5.64%	109	0.60%	43	6.60%	42	6.60%	13	11.20%	10
Low	3.41%	110	0.07%	44	8.12%	42	4.50%	14	5.00%	11
Assets										
Small	4.11%	109	0.31%	43	6.51%	42	3.32%	13	8.33%	10
Large	4.93%	110	0.96%	44	8.17%	42	7.68%	14	7.63%	11
Age										
Young (0-7 years old)	2.40%	72	0.20%	33	3.82%	26	6.67%	8	2.73%	5
Old (8 years and older)	5.60%	147	0.90%	54	8.92%	58	5.12%	19	9.61%	16
Industry										
Tech	2.63%	31	0.83%	14	7.65%	10	-0.11%	5	-0.50%	2
Non-tech	4.83%	188	0.60%	73	7,30%	74	7.70%	22	8.86%	19
Pricing technique										
Book-building	3.75%	181	1.07%	80	5.17%	65	8.01%	20	6.07%	16
Fixed	8.19%	38	-4.25%	7	14,76%	19	-1-37%	7	14.04%	5
Price relative to file price										
Above	6.67%	3	0.53%	2	-	0	-	0	9.60%	1
Below	0.14%	18	0.50%	11	-7,67%	3	1.25%	2	8.77%	2
Manager rank										
High	5.94%	138	1.50%	52	9.48%	61	7.25%	18	4.63%	7
International	5.69%	55	3.90%	16	5.64%	22	9.52%	12	2.39%	5
Low	1.84%	71	-1.25%	31	0.79%	19	2.45%	8	10.37%	13

There are also indications that the first-day returns are higher during periods of high sentiment among investors, inn all four markets except Sweden. Furthermore, issues that were priced above its price range had a higher average first-day return than issues that was priced below its price range. The relationship is likely more significant for issues that was priced below, considering there are 18 observations of issues priced below, while only 4 issues priced above the price range.

We further see that for the total sample, IPOs with a fixed price had an average first-day return of 8.19%, while issues with the book-building technique had 3.68%. The high average first-day return on IPOs with a fixed price seems to be quite influenced by Sweden, and to some degree Finland, where the number of IPOs with a fixed price and the returns are high. It also appears that the fixed price technique is more commonly used in Sweden, Denmark and Finland, ranging from approximately 23% to 26% of total IPO volume, while the same number for Norway is 8.04%[3]. Furthermore, in our total sample, IPOs with a high-ranking lead manager(s) and international lead manager(s) had higher average first-day returns than IPOs without a high-ranking lead manager(s) and international lead manager(s). The pattern is the same for Norway and Sweden, while it is opposite in Finland. In Denmark, IPOs with no high-ranking lead manager(s) had higher average first-day returns than those with a high-ranking lead manager(s), while IPOs with an international lead manager(s) had the highest average first-day returns.

The univariate results show that technology IPOs had a lower average first-day return than non-tech IPOs in total. In Norway and Sweden, tech IPOs had a slightly higher first-day return than non-tech IPOs, while in Denmark and Finland tech IPOs had a negative first-day return on average. However, although not reported, tech IPOs had more than twice as high standard deviation than non-tech IPOs, which in isolated terms suggest they are riskier. If we look at company age, we see that young

[3] Calculated as the number of IPOs with a fixed price divided by the total number of IPOs in each respective country.

firms had a lower average first-day return than older firms in the total sample. This pattern is also consistent for each individual country with the exception of Denmark, where younger firms had a higher first-day return than older firms. Average first-day returns were also slightly higher for companies with higher total assets for the total sample, which is also the case for each individual country, with the exception of Finland, where companies with lower total assets had a slightly higher average first-day return. Both company age, size and whether or not a company is classified as a tech company, which are all proxies for uncertainty, have in common that the univariate results contradicts what is suggested from the well-established theories and previous research.

6.2 Regression analysis

In this subpart we identify and analyse which variables that explains variations in short-run market performance of IPOs in the Nordic region. Determinants of short-run market performance are identified with multiple regression analysis. We measure short-run market performance by the first-day market-adjusted return (MAR). All models are estimated using Stata.

6.2.1 Whole sample

We first analyse the total sample of IPOs on all four exchanges. One initial assumption was that there would be no large and significant differences in the level of underpricing or in the determinants of underpricing between the countries, as formalized by hypothesis 8 and 9. The results from running regression (3) and (4) are shown in Table 4, and the coefficients in both regressions are generally consistent with the univariate results reported in Table 3. The adjusted R-squared for regression (3) and for regression (4) implies that the explanatory variables explains 11% and 17.4% of the variation in first-day market-adjusted returns, respectively. The F-statistics implies that the models are significant at the 1% level, and confirms its validity.

Table 4: Estimated Multiple Regression Models for the First-day Market-Adjusted Return in the Nordic Region

This table presents the results from running our main regressions on the whole sample, consisting of 219 firms listed on the main indices in Norway, Sweden, Denmark and Finland in the period from 2001 to 2016. Standard errors (in parentheses) are calculated using White's heteroscedasticity-consistent method. *** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	(1) MAR	(2) MAR
HC	0.0308**	0.0191
	(0.0149)	(0.0148)
Sentiment	0.00308**	0.00306**
	(0.00141)	(0.00129)
LN (Assets)	0.00139	0.00117
	(0.00431)	(0.00404)
LN (1+Age)	0.0173***	0.0186***
	(0.00548)	(0.00501)
Tech	-0.0204	-0.0222
	(0.0296)	(0.0297)
Technique	0.0591**	0.0633**
	(0.0275)	(0.0271)
Above	0.0234**	0.0256
	(0.0113)	(0.0182)
Below	-0.00922	0.00509
	(0.0173)	(0.0175)
Rank	0.0378**	0.0478***
	(0.0159)	(0.0158)
International	-0.00310	-0.00367
	(0.0152)	(0.0137)
Market return		0.419***
		(0.129)
Std.dev		-2.057
		(1.485)
Constant	-0.0317	-0.0136
	(0.0377)	(0.0392)
Observations	219	219
R-squared	0.151	0.220
Adj. R-squared	0.110	0.174
Prob > F	0.000	0.000

The positive and significant coefficients on *HC* and *Sentiment* are consistent with the investor sentiment theory, suggesting that first-day returns are higher during "hot" markets and in periods of high investor sentiment. The coefficient of 0.0308 on *HC* implies that issues during "hot" markets would have a 3.08% higher MAR than issues during cold markets on average. The average coefficient of 0.00308 on *Sentiment* implies that, ceteris paribus, a firm issuing during a period when the consumer confidence index is 10 notches higher would have a 3.08% higher MAR. *Sentiment* is significant at the 5 % significance level and seems robust, while *HC* becomes insignificant when controlling for the general market return and standard deviation.

The positive coefficients on *LN (Assets)* and *LN (1+Age)* and the negative coefficient on *Tech* are not consistent with the changing risk composition hypothesis, as the variables´ relationship with first-day returns are opposite of what was expected. *LN (1+Age)* is significant at a 1% significance level and appears robust when including the control variables. The coefficient of 0.0173 implies that, ceteris paribus, a 10 years old firm would have a MAR that is 2.95% higher than a 1 year old firm on average. *Technique* enters the regression with a positive sign and is statistically significant at the 5% level. This supports the theory of a quality/price trade-off in relation to the pricing technique. The coefficient of 0.0591 implies that, ceteris paribus, IPOs with a fixed pricing technique were associated with a 5.91% higher MAR than issues with the book-building technique.

Both the coefficient for *Above* and *Below* are consistent with the information revelation theory, as underpricing tends to be higher for offerings where the price has been revised upwards. The coefficient for *Below* is not statistically significant at conventional levels, while *Above* is statistically significant at the 5% level in regression (3). The coefficient of 0.0234 on *Above* indicates that, ceteris paribus, issues priced above its price range would have a 2.34% higher MAR. The coefficient on *Rank* is positive and significant at the 5% significant level, and hence not

consistent with the implication of the Winner´s curse theory that prestigious managers reduce underpricing through reduced information asymmetry. Our empirical evidence suggests that hiring a prestigious lead manager, with deal volume as a proxy, is associated with a higher underpricing. The coefficient of 0.0378 implies that, ceteris paribus, issues with a high-ranking manager would have a 3.78% higher MAR. The negative coefficient on *International* is on the other hand consistent with the theory, suggesting that IPOs with an international lead manager, which is considered more prestigious, reduces underpricing. However, the coefficient is statistically insignificant.

6.2.2 Per country

We further analyse each country separately. We do so to identify potential differences in the determinants of first-day returns between the countries, and to get an indication as to what degree the results for the total sample are influenced by individual countries. The results from running regression (3) and (4) in each individual country is reported in Table 5.

From column 1 and 2 we see that the regression model generally performs poorly in Norway. The adjusted R-squared for regression (3) is -0.70% and the F-statistic is not significant, hence we cannot reject that all the parameters in the model are equal to zero. The estimated model shows a direct relationship between underpricing and *Sentiment*. The coefficient of 0.00305 implies that, ceteris paribus, issues during a period where the consumer confidence index is 10 notches higher were on average associated with a 3.05% higher MAR. The coefficient is significant at the 10% level, but becomes insignificant when including the control variables. The estimated model further shows a direct relationship between underpricing and *Above*. The estimated coefficient of 0.0366 implies that, ceteris paribus, issues priced above its price range would have a 3.66% higher MAR. The relationship is significant at the 10 % level, and supports the information revelation theory. However, the coefficient becomes insignificant when including the control variables.

Table 5: Estimated Multiple Regression Models for the First-day Market-Adjusted Return per Country

This table presents the results from running our main regressions in each country separately. Standard errors (in parentheses) are calculated using White's heteroscedasticity-consistent method. *** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	(NO) MAR	(NO) MAR	(SE) MAR	(SE) MAR	(DK) MAR	(DK) MAR	(FI) MAR	(FI) MAR
HC	-0.0199	-0.0198	0.0760***	0.0560**	-0.00567	-0.0378	0.0136	-0.0136
	(0.0195)	(0.0204)	(0.0244)	(0.0276)	(0.0465)	(0.0579)	(0.0819)	(0.0901)
Sentiment	0.00305*	0.00203	0.000964	0.00348	0.00547	0.00483	0.00956	0.00377
	(0.00173)	(0.00151)	(0.00314)	(0.00338)	(0.00465)	(0.00483)	(0.00677)	(0.00467)
LN (Assets)	-0.000672	0.000548	-0.00251	-0.00246	-0.000301	-0.0121	0.0207**	0.0391***
	(0.00387)	(0.00368)	(0.00977)	(0.00915)	(0.0124)	(0.00814)	(0.00917)	(0.0105)
LN (1+Age)	0.00356	0.00551	0.0358***	0.0322***	-0.0275	0.00247	-0.00780	0.000852
	(0.00738)	(0.00721)	(0.00996)	(0.00954)	(0.0220)	(0.0220)	(0.0127)	(0.0192)
Tech	0.0126	0.00903	0.00200	-0.0177	-0.0676	-0.0752	-0.0291	-0.0358
	(0.0307)	(0.0309)	(0.0587)	(0.0621)	(0.0926)	(0.0973)	(0.0321)	(0.0396)
Technique	-0.0431	-0.0433	0.0946**	0.0917**	-0.0853	-0.00920	0.120	0.125
	(0.0348)	(0.0397)	(0.0377)	(0.0371)	(0.0839)	(0.0936)	(0.0758)	(0.0808)
Above	0.0366*	0.0338					0.106	0.0275
	(0.0206)	(0.0246)					(0.0589)	(0.0824)
Below	0.00453	0.0144	-0.0486	-0.0772	-0.0668	-0.108	0.00269	-0.0514
	(0.0184)	(0.0185)	(0.0595)	(0.0492)	(0.0858)	(0.0626)	(0.0291)	(0.0487)
Rank	0.0106	0.0218	0.0737***	0.0740***	0.0128	0.0258	0.00244	0.0102
	(0.0175)	(0.0185)	(0.0266)	(0.0258)	(0.0689)	(0.0778)	(0.0461)	(0.0327)
International	0.0334	0.0269	-0.0368	-0.0373	0.0557	0.0774	-0.1000**	-0.131***
	(0.0249)	(0.0226)	(0.0259)	(0.0243)	(0.0746)	(0.0707)	(0.0364)	(0.0341)
Market return		0.396**		0.501**		0.824**		-0.360
		(0.181)		(0.190)		(0.329)		(0.499)
Std.dev		-0.0225		1.978		-0.228		17.48
		(1.927)		(4.028)		(6.073)		(12.93)
Constant	0.0385	0.00448	-0.129*	-0.102	0.194*	0.163*	0.0538	-0.245*
	(0.0382)	(0.0452)	(0.0708)	(0.0876)	(0.0938)	(0.0893)	(0.145)	(0.128)
Observations	87	87	84	84	27	27	21	21
R-squared	0.110	0.181	0.358	0.400	0.380	0.474	0.562	0.718
Adj. R-Squared	-0.007	0.048	0.280	0.308	0.052	0.087	0.124	0.295
Prob > F	0.509	0.2056	0.000	0.000	0.380	0.3493	0.350	0.2305

In Sweden, the regression model has a high explanatory power and significance. The adjusted R-squared is 28.0% for regression (3) and the null hypothesis of the F-test is rejected, confirming the validity of the model. Column 3 and 4 in Table 5 show that there is a direct relationship between underpricing and *HC*. The economic significance is quite large, as it indicates, ceteris paribus, that issuing during "hot" markets is associated with a 7.60% higher MAR on average. The relationship is significant at the 1% level, and appears robust when including the control variables. There is also a direct relationship between underpricing and *LN (1+ Age)*, suggesting that underpricing is higher for older firms. The coefficient of 0.0358 implies that, ceteris paribus, a 10 years old firm would have a 6.10% higher MAR than a 1 year old firm. The variable is significant at the 1% level and appears robust. Furthermore, the theory of a quality/price trade-off in relation to the pricing technique is supported by the direct relationship between underpricing and *Technique*. The coefficient of 0.0946 is significant at the 5 % significance level and robust when controlling for the general market return and standard deviation, implying that, ceteris paribus, issues with a fixed pricing technique would have a 9.46% higher MAR. The estimated models also show that there is a direct relationship between underpricing and *Rank*. The coefficient of 0.0737 implies that, ceteris paribus, issues with a high-ranking manager would have a 7.37% higher MAR.

The regression model has an acceptable explanatory power in Denmark, where the adjusted R-squared is 5.20% for regression (3). The F-statistic is not significant, meaning that we cannot reject the null hypothesis that all the parameters in the model are equal to zero. The estimated model further shows no significant relationship between underpricing and any of the explanatory variables.

The estimated model performs quite well with an adjusted R-squared of 12.40% for regression (3) in Finland. We do however not reject the null hypothesis of the F-test. The estimated models show that there is a direct relationship between underpricing and *LN (Assets)*. This suggests that,

ceteris paribus, a company with $100 million in assets would have a MAR 4.77% higher than a company with $10 million in assets on average. The relationship is significant at the 5 % level, and appears robust and significant when including the control variables. The models also show that there is an inverse relationship between underpricing and *International*. This suggests that IPOs where there is an international lead manager is associated with lower underpricing. Furthermore, the economic significance is large; the coefficient of -0.10 indicates that, ceteris paribus, issues with an international lead manager would have a 10% lower MAR.

6.3 Discussion of results

In this subpart, we discuss the results presented above in relation to the theories and our hypotheses. This is followed by a summary of our findings.

6.3.1 Underpricing

Our results point towards rejecting hypothesis 1, which means that we reject that Nordic IPOs have been fairly priced between 2001 and 2016. As was expected, we find the mispricing to be in direction of underpricing, with an average first-day MAR of 4.53% for the Nordics as a whole. The underpricing is statistically significant at the 1% level. The 75^{th} percentile of 0.098 implies that 25% of the IPOs are underpriced with 9.8% or more. Thus, a quite high level of underpricing is not at all uncommon in the Nordic IPO market.

We further find that Swedish, Danish and Finish IPOs have been significantly underpriced, all statistically significant at the 1% level, with 7.35%, 5.58% and 7.97% average underpricing, respectively. In each of these three countries, approximately 75% of all IPOs are underpriced. In Norway, the average underpricing is 0.60% and not significant at any conventional levels. Compared to studies conducted over time periods in the 1980 and 1990´s, with similar sample sizes, we find a lower underpricing in the Nordic countries. Earlier studies in these time periods include Keloharju (1993), Emilsen, Pedersen & Saettem (1997), Jakobsen

& Sorensen (2001), and Schuster (2003). Loughran, Ritter and Rydqvist (2015) has further extended previous studies, including those mentioned above, with updated data that further confirms the downwards sloping trend in the level of first-day returns in the Nordics. This indicates that the underpricing have decreased over the time. One potential reason for the changes in IPO underpricing over time could be due to information being more accessible in later years, thus reducing information asymmetry between the involved parties in the IPO. Loughran and Ritter (2004) argue that issuers focusing less on maximising IPO proceeds due to an increased emphasis on research coverage could be another potential reason for the decrease in underpricing over the past decades. The trend could also partially be explained by that the more dynamic pricing technique, book-building, have been more frequently used by investment banks and the issuing firms in later years. Schuster (2003) performed a country-by-country study between 1988 and 1998 of the six largest European capital markets, Sweden included, and found an increasing use of the book-building method where as much as 70% of the offerings were issued by this pricing technique in the mid 1990´s. In our sample, over 80% of the offerings in the Nordics between 2001 and 2016 has been issued by the book-building technique. In Norway, where the underpricing was lowest, almost 92 % of the issues were book-built.

6.3.2 Hot and cold markets

For the Nordics as a whole, we find that underpricing is significantly higher during periods of high IPO activity, or in so called hot markets. This is captured by the variable *HC.* This is in accordance with the hot issue market phenomena introduced by Ibbotson and Jaffe (1975). We therefore reject hypothesis 4 that underpricing is unaffected by "hot" or "cold" markets, and thereby also find some support for the investor sentiment theory. However, as hot markets could also be driven by fundamental factors, and not necessarily by sentiment, we cannot conclude that returns on IPOs in hot markets are driven purely by overoptimistic investors or investor sentiment. We also see that when including the control variables, the coefficient of *HC* becomes

insignificant. This might be related to the fact that the market return usually is high during hot markets, and hence capturing some of the same effect. This also implies that the variable for the market return to some degree work as a proxy for hot markets as well.

We further find that the hot issue market phenomenon is present in Sweden, where *HC* significantly increases underpricing. This result is also robust when controlling for the market return and standard deviation. As the coefficient for *HC* is negative in Norway and Denmark, and dependent upon the control variables in Finland, the result for Sweden seem to influence the significance of the result for the sample as a whole. Regardless of that, it is evident that *HC* is a determinant of underpricing in Sweden. This could partially be explained by Ritter`s (1984) hypothesis that in periods where riskier firms go public there are higher first-day returns. Based on the changing risk composition, it could be that the Swedish hot issue markets are associated with more risky offerings than the rest of the Nordics. Although Ritter (1984) finds some evidence that hot issue markets are associated with riskier offerings, the factor of risk composition explains only a fraction of the hot issue phenomenon.

6.3.3 Investor sentiment

The proxy variable *Sentiment* is included in the regression to test hypothesis 5 that underpricing is unaffected by investor sentiment. The variable refers to the European Commission Consumer Confidence Indicator in the Eurozone (EUCCEMU) which measures sentiment among retail investors. In accordance with the theory of Ljungqvist, Nanda and Singh (2006) we find that underpricing is increasing in investor sentiment, indicating that the average MAR was higher during periods of high investor sentiment, and vice versa. Comparing the results for the total sample with each individual country suggests that no particular country influence the results for the whole sample to a large degree. We therefore reject hypothesis 5, and thereby find support for the investor sentiment theory. One potential reason for the relationship between investor sentiment and underpricing is that issuers “time” their IPOs to take

advantage of periods with excessive sentiment (Loughran, Ritter, & Rydqvist, 1995), which is consistent with the findings of Lee, Shleifer and Thaler (1991) that more companies go public during periods of high investor sentiment. Such a pattern could persist as the possibility for rational investors to implement arbitrage strategies is limited, as well as often extremely costly in the early aftermarket[4]. However, if issuers are rational enough to choose in what market condition to issue their shares, they should also set the offer price higher, which would further lead to a lower underpricing. Ljungqvist, Nanda and Singh (2006) takes this into account in their model, and argues that underpricing emerges as a compensation to institutional investors who gradually sells back the shares to sentiment investors, arising from the possibility that the demand from sentiment investors could cease. Thus, it could be possible for issuers to rationally choose which market to issue their shares in without it being conflicting with investor sentiment as a driver of underpricing.

6.3.4 Valuation uncertainty

To test hypothesis 3, we have included three (firm-specific) variables as proxies for uncertainty: *LN (Assets), LN (1+Age)* and *Tech.* According to theory it would be expected that companies with higher assets and older companies are less underpriced, and that technology companies are more underpriced. This is due to the implication of Beatty and Ritter´s (1986) option pricing view that underpricing should increase with valuation uncertainty. We do however not find support for this in the Nordics, as all three variables enters the regression with the opposite sign of what was expected. While *LN (Assets)* and *Tech* is insignificant, *LN (1+Age)* is significant at the 1% level. Including the control variables does not change the sign or the significance of the coefficients. Carter, Dark and Singh (1998) provides one possible explanation of the positive sign on *LN (1+Age).* They argue that older, more established companies almost exclusively choose prestigious investment banks as underwriters. As reported in our analysis, we find a direct relationship between *Rank* and

[4] Geczy, Musto and Reed (2002) documents high borrowing costs of IPO stock in the early aftermarket, and that the cost is increasing with underpricing.

underpricing suggesting that issues with a high-ranking manager are associated with higher underpricing. This could further influence our results for *LN (1+Age)* if it is the case that older firms more often use prestigious underwriters. We also note that such a relationship between the explanatory variables implies potential econometric issues, which we discuss further in part 6.4. In conclusion, we reject hypothesis 3 that underpricing is unaffected by ex-post uncertainty, but not in favour of Beatty and Ritter´s (1986) implication of the Winner´s curse theory. We do however find that increased uncertainty, as measured by the proxies *LN (Assets), LN (1+Age)* and *Tech,* decreases underpricing.

Individually, in Norway, Sweden and Denmark, the coefficients for *LN (Assets)* generally appears consistent with the prediction from theory. However, they are only marginally negative and also insignificant. When it comes to Finland, the coefficient for *LN (Assets)* is positive and significant, and therefore seems to drive the results for the whole sample. The positive and significant coefficient in Finland tells us that larger companies, as measured by assets, on average are associated with a higher underpricing. Furthermore, the sign of the coefficient for *LN (1+Age)* is generally consistent with the results for the whole sample when looking at each country, but is somewhat dependent upon whether or not the control variables is included for Denmark and Finland. We can also see that the significant coefficient for *LN (1+Age)* in Sweden drives most of the results for the Nordics treated as one, where it is positive and significant at the 1% level. To our surprise we also find that *Tech* is mostly negative for each country, and insignificant, with the exception of Norway where it is positive.

6.3.5 Pricing technique

We include the variable *Technique* to in order to test hypothesis 6, which is related to the quality/price trade-off theory between gains from lower underpricing and additional costs related to book-building, as suggested by Ljungqvist et al. (2003). In the Nordics, we find that fixed-price issues are significantly more underpriced than issues with the book-building

technique. Moreover, the economic significance is quite large: In regression (3), fixed price issues have a 5.91% higher underpricing on average, ceteris paribus. In other words, and as the theory predicts, the book-building method leads to more accurate pricing. This is likely because the offer price is set more accordingly to market demand. More accurate pricing is also reflected in a lower variation in underpricing, where the standard deviation of underpricing is 0.090 for book-building and 0.169 for fixed price issues. These results support the implication of a quality/price trade-off from the information revelation theory that fixed-price issues have a higher degree of underpricing, and variations in underpricing, than book-built IPOs. We therefore reject hypothesis 6.

We further see that the results in each country is highly consistent with the univariate results reported in Table 3, where issues with a fixed price on average were overpriced in Norway and Denmark, while they were on average more than twice as underpriced than issues with the book-building technique in Sweden and Finland. In the regression results we find that the coefficient for *Technique* is positive and significant at the 5% level in Sweden, positive and insignificant in Finland, while it is negative and insignificant in Norway and Denmark. The lack of significance in Finland could be due to that there were only 5 IPOs with the fixed pricing technique. These results also suggest that the statistical significance for the coefficient in the total sample is driven by Sweden and Finland.

6.3.6 Price range

We include two dummy variables to test hypotheses 7 related to the information revelation theory, *Above* and *Below,* denoting 1 if the issue is priced above or below its indicative price range, and 0 otherwise, respectively. As the theory predicts, in issues where the offer price has been set above its price range, indicating that positive information about the offering has been revealed during the book-building process, the underpricing is higher. We also see that the relationship between *Below* and MAR is negative in regression (3). This further supports that the offer price is only partially adjusted when information is revealed during

the book-building process. To summarize, we reject hypothesis 7 as we find that issues priced above its indicative price range have a direct and significant relationship with underpricing in the Nordics.

In Norway, we find a significant and positive relationship between *Above* and underpricing. The coefficient for the variable is positive in Finland as well, but is not statistically significant. In general, we believe that the lack of significance likely is influenced by the few observations for issues priced above the price range. In our sample, there is no offerings in Sweden or Denmark where the final offer price is above the indicative price range.

6.3.7 Manager reputation

In order to test hypothesis 2, we include two variables for reputation of the lead managers; *Rank* and *International. Rank* is a proxy for the most prestigious lead managers within each country, while *International* denotes international lead managers. As we find a direct and statistically significant relationship between *Rank* and underpricing in the total sample, we reject hypothesis 2. The results imply that issues with a high-ranking manager are associated with a higher underpricing. We also find a direct relationship between *Rank* and underpricing in each country, whereas the relationship is statistically significant at the 1% level in Sweden. These results contradict the implication of the winner`s curse theory suggesting that prestigious managers mitigate the winner`s curse problem because they reduce investors` incentives to produce their own information. One potential explanation for the positive coefficients could be that issuing firms have been more willing to accept greater underpricing from prestigious underwriters because of the perceived importance of analyst coverage and higher wealth levels. We would also like to stress that the results related to manager prestige is highly dependent on our ranking methodology. First of all, *Rank* is a proxy for prestige, measured as each manager's deal volume over the period. This assumes that deal volume is synonym with prestige, which is not necessarily the case. Furthermore, in the case where there is more than

one lead manager, we assign each lead manager a share of the gross proceeds equal to 1/number of lead managers. This is clearly not always the case in reality, where each lead manager typically allocates unequal number of shares in each deal. However, in reputational terms, we do not believe this is of major concern[5]. On the other hand, our results are similar to the findings of Henricson (2012), as he finds the same highest-ranking managers, and that IPOs lead by these managers are associated with higher underpricing in Sweden.

With the above in mind, and in nature, it is likely that the variable *International* is a better proxy for prestige. International investment banks, like Goldman Sachs and JP Morgan, are without a doubt considered more prestigious than regional or local investment banks. Furthermore, we see that international investment banks are highly present among the largest deals in our dataset, which are deals that also have received the greatest attention by media and investors. We therefore find it valid that international investment banks are considered more prestigious. The variable`s coefficient enters the regression with a negative sign, and is thus in accordance with the predictions from theory. The variable is not statistically significant in the total sample so we are not able to accept the hypothesis that underpricing is decreasing in the prestige of the underwriter, with *International* as proxy for prestige. However, the sign of the coefficient indicates that international lead managers, with their expertise, experience and geographical reach, are able to more precisely price IPOs. We further see that the coefficient is negative and significant in Finland, indicating that international lead managers significantly reduce underpricing in this market. Consistent with Ljunqvist et al. (2003), we also find that U.S banks underprice less than domestic banks outside the U.S.

[5] We do not believe so because there is always some reputational effect of being part of a deal, regardless of the number of shares the lead manager allocates. Additionally, the number of shares for a lead manager will according to our methodology likely be overestimated in some deals and underestimated in others, which to some degree will be cancelled out on average.

6.3.8 Summary

We find that on average, Nordic IPOs have been underpriced in the period between 2001 and 2016. The result is statistically significant for the Nordics as a whole, as well as each individual country with the exception of Norway. We further find that a quite high level of underpricing is not uncommon in the Nordics, and that the average underpricing varies between the countries. As we find significant differences in underpricing between the Nordic countries, we reject hypothesis 8 that the level of underpricing is equal in the Nordic countries.

In Sweden, we find that company age, pricing technique and manager rank are determinants of underpricing. We further find that issuing during hot markets is associated with higher underpricing. We find that investor sentiment and pricing relative to price range as determinants of underpricing in Norway. The results for Denmark show no significant relationship between any of the included explanatory variables and underpricing. Lastly, in Finland, our results show that company assets and international lead managers are determinants of underpricing. As we find none of the same determinants of underpricing among the Nordic countries, we reject hypothesis 9 that the underpricing in each country can be explained by the same factors.

6.4 Discussion of validity of results

The validity of the results presented and discussed in part 6.2 and 6.3 relies upon the underlying assumptions of the classical linear regression model. Performing regressions where all the regression assumptions perfectly hold is in reality unrealistic, and some assumptions are of greater importance to the validity of the results than others. Therefore, several possible violations of the classical linear regression model are examined. In the following we discuss potential issues related to heteroscedasticity, endogeneity, non-normality and multicollinearity.

6.4.1 Homoscedasticity

Assumption 2 related to homoscedasticity assumes that the variance of the errors is constant. It would be expected that our regressions have error terms subject to a non-constant variance, i.e. expected to be heteroscedastic. Plots of the errors against the variables are shown in appendix 9.5, and we can see some indications that the errors are not constant. This would further cause the t-values to be biased, and hence potentially make the inferences from the regression results and our conclusions to be invalid. We have therefore based all our statistical inferences on White´s Heteroscedasticity-Consistent Standard Errors, which means that the results are corrected for heteroscedasticity. Our statistical findings can therefore be considered valid in terms of homoscedasticity.

6.4.2 Endogeneity

If one or more of the explanatory variables are correlated with the error term, an endogeneity problem occurs. This will result in biased and inconsistent parameter estimates and a fitted line that appears to capture the data better than it does in reality. Model specification errors are among the most common causes of the problem. More specifically, one is likely to commit specification errors by the omission of a relevant variable or the inclusion of an unnecessary variable, referred to as underfitting and overfitting, respectively.

We find it plausible that our regression models are under- or overfitted and thus subject to endogeneity issues. The suggested theories of underpricing are many, and the possible determinants therefore not certain. As only selected theories have been tested there is some probability that we have omitted variables that significantly explains the variations in underpricing. On the other hand, when considering both our research variables and control variables, we have explained a quite large portion of the overall underpricing with our regression models. In isolated terms, this gives less concern about underfitting than if the case were the opposite. It is also possible that we have overfitted our regression models, as some included variables related to the theories not necessarily explain the underpricing. In such a case, the estimated parameters will remain unbiased and consistent, and the usual confidence interval and hypothesis-testing procedures remain valid (Gurajati and Porter 2009). However, the estimated coefficient will generally be inefficient in terms of higher variances. All variables included in our regressions are supported by theory, and as we are exploring potential determinants of underpricing, the inclusion of irrelevant variables or exclusion of relevant variables is part of the research. We do however note that our results could be subject to endogeneity issues.

6.4.3 Normality

The assumption of normality refers to the error terms of the regression being normally distributed. If the errors are normally distributed, they have a skewness of zero, meaning that there is a symmetric distribution, and a kurtosis of three, which is a descriptor of the tails` shape of the distribution (Brooks, 2014). The normality assumption is required in order to validly conduct hypothesis testing, and ensures that the t-tests and F-tests are valid.

A histogram of the distribution of the errors and a kensel density plot, both overlaid with the normal distribution, is shown in appendix 9.5. We see that the distribution of the residuals has marginally fatter tails and is to

some degree more peaked at the mean than the normal distribution. The quantiles of the errors (appendix 9.5) compared to the normal distribution shows a slight deviation from normal at the upper tail. The graph of the standardized normal probability (appendix 9.5) shows a little less sign of non-normality, and is more sensitive in the middle range. From the four graphs the deviation from normality seems to be minor, and at a level that is acceptable. Additionally, according to Gujarati and Porter (2009), the assumption of normality assumes a critical role only when the data set is small, which is usually the case when there are less than 100 observations. In fact, for sufficiently large sample sizes, a violation of the normality assumption is virtually inconsequential. As we have a quite large sample, consisting of 219 observations, it further suggests that the normality assumption is not considered to have a critical effect on the presented results.

6.4.4 Multicollinearity

The implicit assumption of multicollinearity is violated when there is a perfect linear relationship between some or all of the explanatory variables. Less than perfect multicollinearity, where the absolute value of the correlation coefficient is close to 1 also complicates the model. We first visually analyse potential multicollinearity issues by looking at correlation matrices, presented in appendix 9.5. The correlation matrix for all the included variables, and for the total sample, shows that in terms of absolute values the highest correlation coefficient is between the variables *International* and *LN (Assets)*, with a correlation of 0.485. This is not surprising, as larger companies, as measured by assets, would be expected to more often use an international lead manager than smaller companies. The second largest coefficient is between the variables *Tech* and *LN (Assets)*, with a correlation coefficient of -0.358, indicating that tech companies are associated with being smaller in terms of total assets. Other correlation coefficients that should be further investigated are between the variables *LN (1+Age)* and *LN (Assets), Sentiment* and *HC,* and *Rank* and *International.* These variable-pairs are proxies for the same conceptual variables and do therefore potentially capture some of the same effect.

The correlation coefficients are generally not considered to be particularly high or indicate multicollinearity issues in themselves. Gujarati and Porter (2009) argues that multicollinearity is thought to be severe when the absolute value of the correlation coefficient between the independent variables is greater than 0.8. However, to further investigate potential multicollinearity issues we experiment with omitting variables that are highly correlated with other variables. In the case of severe multicollinearity this would most likely change the coefficients dramatically, which could be in terms of signs, sizes and t-statistics of the coefficients. We therefore analyse how and to what degree the various coefficients change when omitting several variables. The results show nothing but small changes in the t-statistics for a few of the coefficients, where some becomes marginally significant. Moreover, our overall conclusions remain unchanged. All the correlation matrices and regression results is shown in appendix 9.5.

There are several other and more formal measures of multicollinearity. One of the most widely used measures of the multicollinearity between independent variables are the variance inflation factor (VIF), which quantifies the severity of multicollinearity in an OLS regression analysis. As a rule of thumb, a variable with a VIF greater than 10 indicates that it could be issues related to multicollinearity. We find the highest VIF to be 1.62, while the average is 1.20. Thus, this measure does not indicate any issues related to multicollinearity. The VIF for all the variables is displayed in appendix 9.5.

7.0 Conclusion

In this thesis, we have analysed and compared the level of underpricing and its determinants in the Nordic region. We have done so by studying in total 219 firms going public on the main stock exchanges in Sweden, Denmark, Finland and Norway in the period between 2001 and 2016. We measure underpricing by the market-adjusted first-day return, which is defined as the percentage difference between the offer price and the closing price on the first day of trading adjusted for the general market return. Determinants of underpricing have further been identified using multiple regression models with firm, market and offer specific variables in accordance with selected theories.

Our analysis showed that Nordic IPOs were underpriced with 4.53% on average. However, the average underpricing varies greatly by country, from 7.97 % and 7.35 % in Finland and Sweden, to 5.58 % and 0.6 % in Denmark and Norway, respectively. Comparing the average first-day returns to previous studies in the same countries also shows that the average level of underpricing have substantially decreased over the past four decades, which further supports a downward sloping trend in the average underpricing in the Nordics. Potential reasons for the decrease in underpricing over time could be due to reduced information asymmetry among the involved parties in the IPO process, increased emphasis on research coverage, or the increased use of the book-building technique in pricing IPOs.

We have found support for the investor sentiment theory in the Nordics in general, and the hot market phenomenon in Sweden. This indicates that first-day returns are higher during periods of high sentiment among investors, and in periods of high IPO activity for Swedish IPOs. We have argued that such a pattern could exist due to limits to arbitrage, and that issuers rationally can “time” their IPOs without it being conflicting with investor sentiment as a driver of underpricing. The implication of a quality/price trade-off from the information revelation theories is further supported in Sweden as our results show that offerings issued by the

fixed-price technique is more underpriced and exhibits higher variations in underpricing than book-built issues, with a great economic significance. This indicates that the book-building technique leads to more accurate pricing than the fixed pricing technique, which is an important implication for companies going public. Our results also support the partial adjustment theory. We find that in issues where the final offer price is above the indicative price range, the underpricing is significantly higher. This result is limited to Norway and Finland. This finding suggests that when information is revealed during the book-building process, the price is only partially adjusted. Such a partial adjustment favours the theory suggesting that investors who reveal their information truthfully are rewarded with underpriced stock.

We have further found evidence that is conflicting with the most supported implications of the Winner`s curse theory. We find that increased uncertainty, as measured by our proxy variables, reduces underpricing, which is a violation of traditional relationships between risk and return. It could however be that our proxy variables do not reflect the true uncertainty related to an issue. The results for uncertainty do also only seem to apply for Sweden and Finland. We further find that high-ranking managers are associated with a significantly higher level of underpricing in Sweden, which is a result consistent with other, recent studies in Sweden. This could potentially be due to issuers accepting greater underpricing from prestigious managers because of the perceived importance of analyst coverage. We do however argue that the variable for international lead managers is a better proxy for prestige, and find that they significantly reduce underpricing in Finland, in accordance with theory. The fact that the coefficient for international lead managers also is negative in Sweden, further indicates that the variable is a better proxy for prestige, consistent with the findings of Ljungqvist et al. (2003) that U.S banks underprice less than domestic banks outside the U.S.

We have found that both the level of underpricing and its determinants varies greatly by country, but given little attention as to why so. As the Nordic countries are quite similar in many terms one might expect that the differences would not be substantial. We therefore find further studies on why such differences exist as an interesting research suggestion for future studies of the Nordic IPO market. We also believe that the quality/price trade-off between pricing techniques could be further researched. One suggestion would be to compare the profitability for the issuing firm, that is, if the reduction in underpricing using the book-building technique outweighs the additional costs related to it. Lastly, we believe it would be interesting to research how the results for investor sentiment vary with its proxy. One could for instance use a Nordic index or a country-specific index, which arguably are better proxies for Nordic sentiment.

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9.0 Appendix

9.1 Measurement of Age, Assets and Tech

Internet and technology firms:

Firms with the following SIC codes are categorized as a "tech" company: 3571, 3572, 3575, 3577, 3578 (computer hardware), 3661, 3663, 3669 (communications equipment), 3671, 3672, 3674, 3675, 3677, 3678, 3679 (electronics), 3812 (navigation equipment), 3823, 3825, 3826, 3827, 3829 (measuring and controlling devices), 3841, 3845 (medical instruments), 4812, 4813 (telephone equipment), 4899 (communications services), and 7371, 7372, 7373, 7374, 7375, 7378, and 7379 (software).

Age:

We define the age of a company as the number of calendar years between the date of its IPO and its original date of incorporation. Thus, a 1-year old firm might be between 1 month and 23 months old, a 2-year old firm between 13 months and 35 months, and so on. We generally use the original date of incorporation.

Assets:

We measure size by a company`s total assets before their IPO in U.S dollars of 2016 purchasing power. This item is usually reported by SDC, with the exception of the companies mentioned in Appendix 9.3. For these IPOs, we have gathered total assets before the offering from each individual prospectus. As SDC reports the item in U.S dollars, we have converted the manually collected data on assets to U.S dollars using exchange rates for each of the currencies, so that they are comparable.

9.2 Manager rank

If an investment bank is part of the lead managers, or is the only lead manager, we assign them a share of total gross proceeds equal to 1/number of lead managers. We are aware that the share of gross proceeds, that is, the number of shares that each manager is allocating, usually not is evenly distributed between the lead managers. The below table displays deal volume per manager per country in local currency (millions), percentage of total deal volume per manager per country, and number of IPOs per manager per country.

	NO			**SE**			**DK**			**FI**		
Underwriter:	Vol.	%	N	Vol.	%	N	Vol.	%	N	Vol.	%	N
SEB	10877	9.2	25	24750	**21.1**	29	2420	3.1	3	406	**15.4**	4
Carnegie	11598	9.8	24	23739	**20.2**	43	1145	1.5	2	95	3.6	2
Nordea	2008	1.7	6	6793	5.8	9	12613	**16.1**	9	476	**18.1**	4
Danske Bank	521	0.4	2	2637	2.2	4	10120	**12.9**	11	372	14.1	4
DNB	34781	**29.4**	21	1099	0.9	4	2250	2.9	1			
Pareto	9748	8.3	26	622	0.5	1				34	1.3	1
Swedbank	2123	1.8	3	2668	2.9	5						
ABG	16495	**14.0**	38	6628	5.7	13						
Handelsbanken				13542	11.6	19	75	0.1	1			
ABN Amro										144	5.5	1
Sydbank							1522	1.9	1			
Formuepleje							1307	1.7	1			
Arctic sec.	2905	2.5	9									
First sec.	1081	0.9	5									
Other	3687	3.12	12	1292	1.1	10	1583	2.0	7	326	12.4	8
International	22314	18.9	14	33394	28.5	21	45235	57.8	12	773	29.4	5

From the above table, we see that DNB and ABG are the highest-ranking managers in Norway, SEB and Carnegie in Sweden, Nordea and Danske Bank in Finland, and SEB and Nordea in Denmark.

9.3 Errors from SDC

Offerings with wrong offering price:
Hoegh LNG Holdings LTD. The price should be NOK 53 per share.

Primary exchange not reported:
Exiqon AS, Zealand Pharma A/S, KlimaInvest A/S, ElectroMagnetic GeoService AS, Norwegian Property AS, Kemira GrowHow OYJ, Neste Oil Corporation OYJ, Oslo Areal AS, Renewable Energy Corp ASA, Exploration Resources ASA, Domstein ASA, NorDiag ASA, Pertra ASA, Revus Energy ASA, Ballingslov International AB, KappAhl AB, Intrum Justitia AB and Vitrolife AB.

Wrong date for first day of trading:
Danionics A/S, Dimension AB, Thrane & Thrane A/S, BTS Group AB, Bioinvent International AB, Danware Data A/S, RNB Retail & Brands AB, Domstein ASA, Intrum Justitia AB, Nobia AB, Norwegian Air Shuttle ASA, Kemira GrowHow OYJ, Exploration Resources ASA, VIA Travel Group ASA, Aker American Shipping ASA, Bluewater Insurance ASA, ODIM ASA, Funcom A/S, Wirtek A/S, Biovitrum AB, Formuepleje Merkur A/S, Eitzen Chemical ASA, BE Group AB, Faktor Eiendom ASA, Tilgin AB, Nederman Holding AB, Grieg Seafood ASA,. East Capital Explorer AB, Global Health Partner AB, NetConnect ASA, Oppstartsfase I ASA, Zealand Pharma A/S, Aker Drilling ASA, Sevan Drilling ASA, Odfjell Drilling AS, Havyard Group AS, XXL ASA, Pihlajalinna OYJ and DNA Oyj.

Wrong pricing technique:
Havyard Group AS, XXL ASA, Pihlajalinna OYJ, Tilgin AB, Wirtek A/S, BTS Group AB, Arcus ASA, Tokmanni Group Oy, Lehto Group Oyj, Camurus AB, Scandic Hotels Group AB, Kid ASA, Skandiabanken ASA, Bravida Holding AB, Europris ASA, Nordax Group AB, Biotie Therapies Oyj, Multiconsult AS, Asiakastieto Group Oyj, Troax Group AB, Eltel AB, Thule Group AB, Serendex Pharmaceuticals A/S, cXense AS,

Bactiguard Holding AB, Hemfosa Fastigheter AB, Platzer Fastigheter AB, Norway Royal Salmon ASA, Gjensidige Forsikring ASA, Melker Schorling AB and Dios Fastigheter AB. In addition, the pricing technique of Orexo AB was not reported at all by SDC.

Not reported total assets before the offering:
NOTE AB, Probi AB, Hemtex AB, TradeDoubler AB, Gant Co AB, Moberg Derma AB, Platzer Fastigheter AB, Thule Group AB, Attendo AB, AcadeMedia AB, Edgeware AB, BTS Group AB, East Capital Explorer AB, TrygVesta A/S, Curalogic AS, LifeCycle Pharma A/S, KlimaInvest A/S, Trifork A/S, FormueEvolution II A/S, Prime Office A/S, Danware Data A/S, Wirtek A/S, Ahlstrom Paper Group Oy, Pihlajalinna Oy, Findexa AS, Polimoon ASA, Oslo Areal AS, Allianse ASA, Kongsberg Automotive ASA, Revus Energy ASA, Biotec Pharmacon ASA, NorDiag ASA, Block Watne AS, Renewable Energy Corp ASA, Ability Group ASA, Cellcura ASA, Borregaard ASA, Serendex Pharmaceuticals A/S, Arcus ASA, Exploration Resources ASA, VIA Travel Group AS, Bluewater Insurance ASA and NetConnect ASA.

9.4 Excluded data

These are observations excluded due to unavailability of data. These are mainly excluded due to the closing price not being available, unless otherwise indicated. We would like to point out that these are offerings that have been classified by SDC as an IPO, which means that there is some probability that some of the observations should not have been present in our dataset anyhow, as both we and other authors have documented several errors from the database. An example of that could be that they are a follow-up from an OTC offering. On the other hand, some of the observations could possibly be relatively easily available from other data sources. However, due to the scope of this thesis, and our limited time and resources, we find it reasonable to not go further in to these observations.

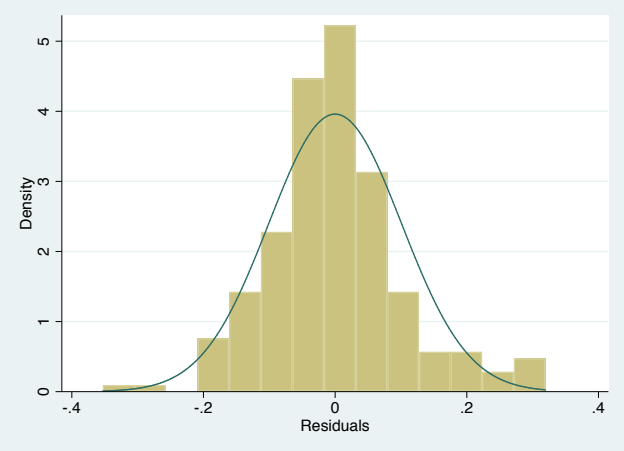
The companies that have been excluded due to the closing price being unavailable is:

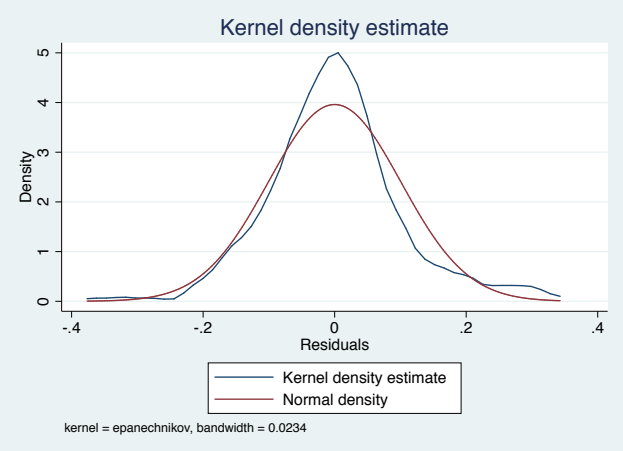
Gudme Raaschou Vision A/S, Mondo A/S, Eik Bank Danmark A/S, FirstFarms A/S, Eirikuva Digital Image Oyj Abp, Zepto Computers A/S, European lifecare group A/S, Esoft Systems A/S, IT Intergroup AS, Investea Sweden Properties A/S, EuroInvestor.com A/S, Deltaq A/S, Kontakt East Holding AB, NAXS Nordic Access Buyout Fund, Dannemora Mineral AB, Electra Gruppen AB, Sanitec Oyj, Texas Onshore AB, DTG Sweden AB, Soprano Oyj, Technopolis Oyj, Simtronics ASA, Natural ASA, Pulpros Oy, Comendo A/S, Vinovo AB, Oslo Bors Holding ASA, Fiba, Awilco ASA, Advanced Production & Loading, Sevan Marine ASA, Arthur Gurholt A/S.

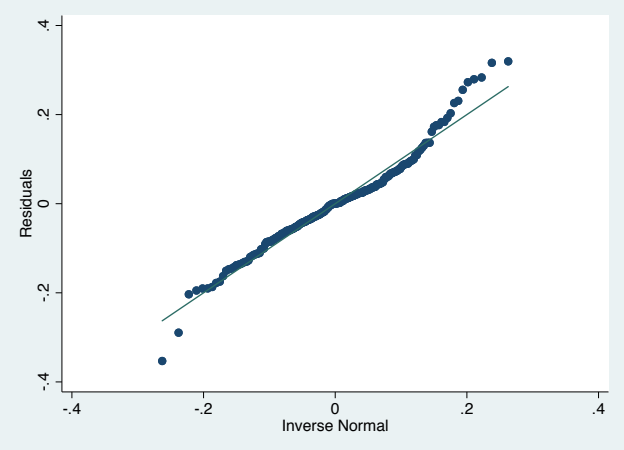
Companies that have been excluded due to other reasons are: Havila Shipping ASA (pricing technique), QPR software Oyj (assets) and Eastern Drilling ASA (pricing technique).

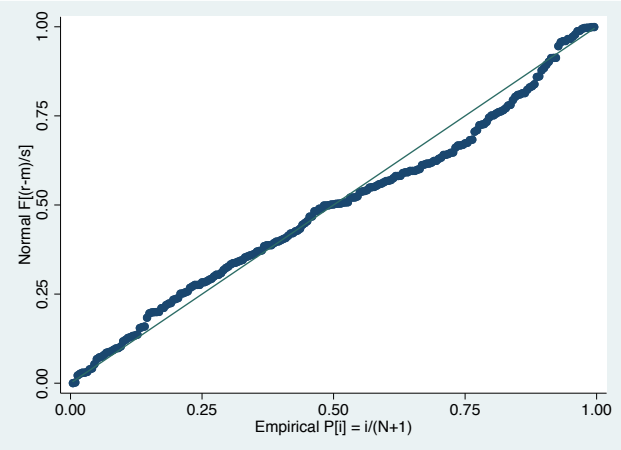
9.5 CLRM assumptions

9.5.1 Normality

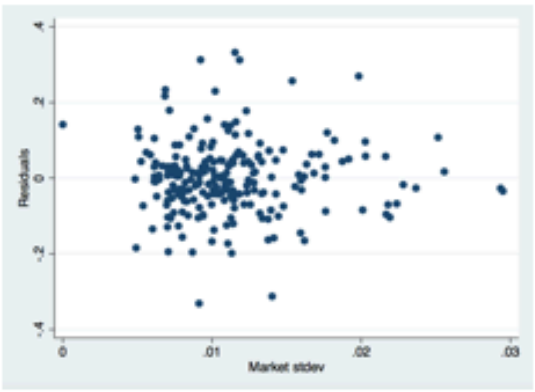


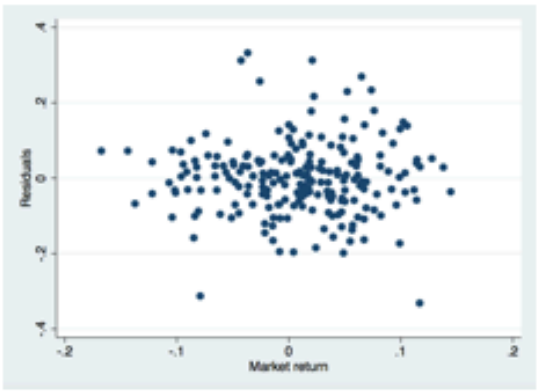


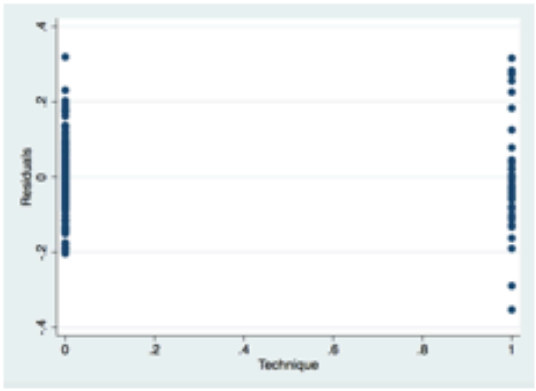


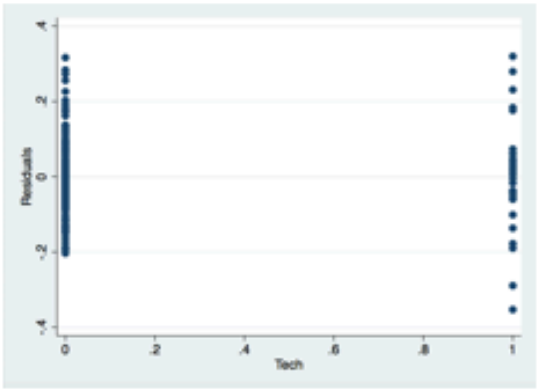


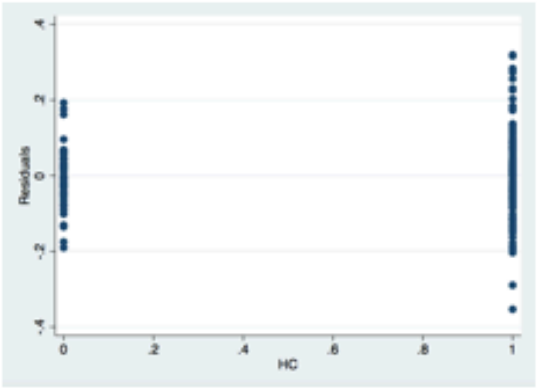
9.5.2 Homoscedasticity

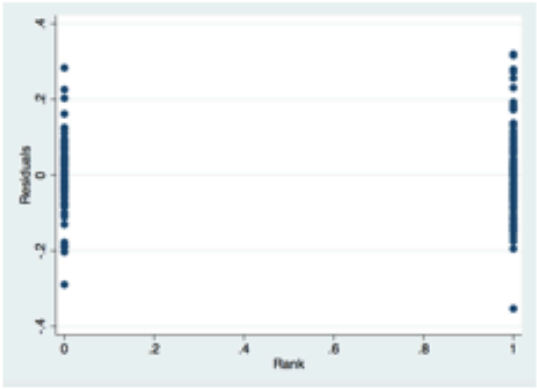


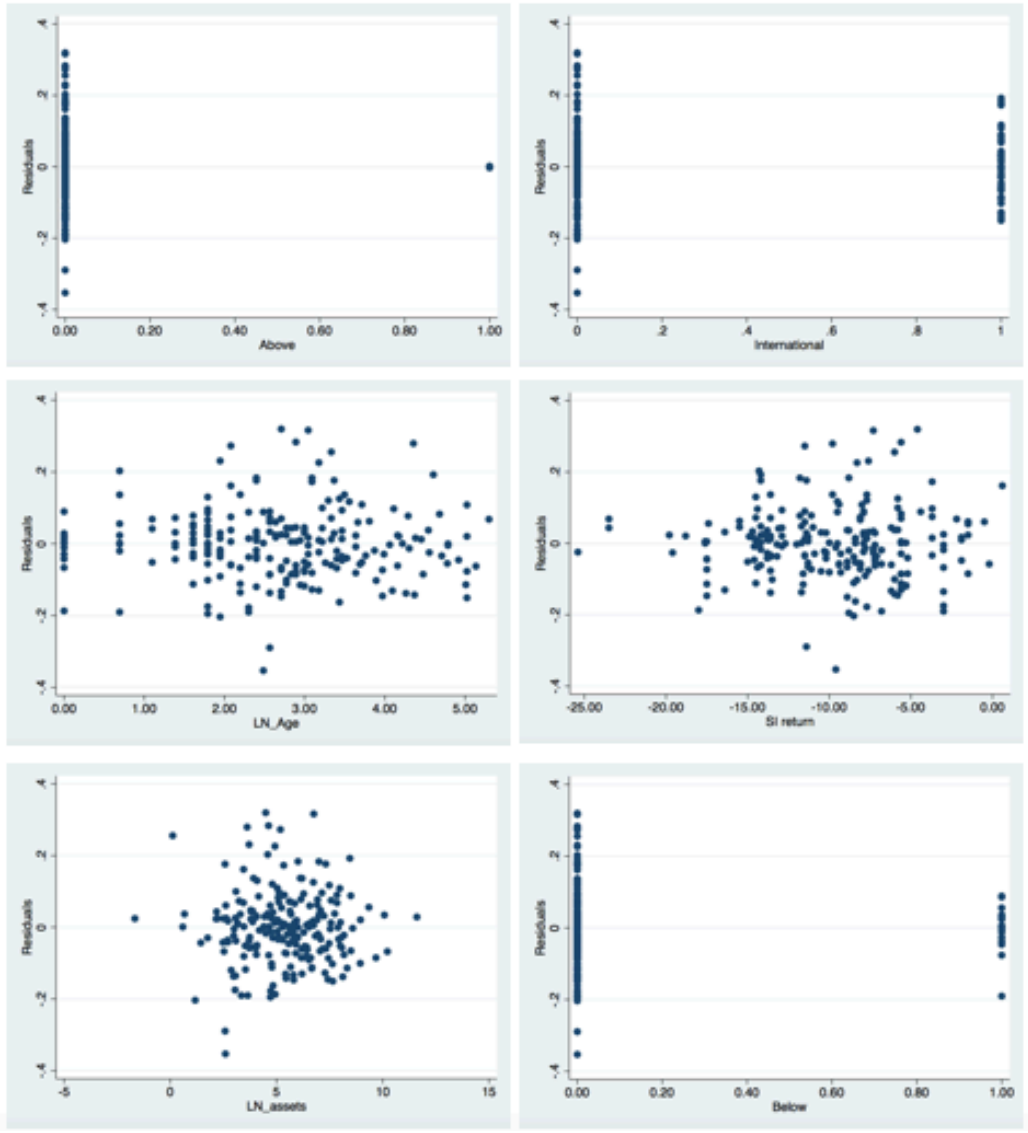











Residuals
Above
International
LN_Age
SI return
LN_assets
Below

9.5.3 Multicollinearity

VIF:

Variable	VIF	SQRT VIF	Tolerance
MAR	1.18	1.08	0.8495
HC	1.09	1.04	0.9192
Sentiment	1.08	1.04	0.9294
LN_assets	1.62	1.27	0.6168
LN_Age	1.16	1.08	0.8629
Tech	1.21	1.10	0.8256
Technique	1.16	1.08	0.8615
Above	1.04	1.02	0.9641
Below	1.08	1.04	0.9238
Rank	1.21	1.10	0.8284
International	1.36	1.17	0.7334
Mean VIF	1.20		

Experiments:

1. Total sample:

	HC	Sentiment	LN (Assets)	LN (1+Age)	Tech	Technique	Above	Below	Rank	International	Market return	Std.
HC	1											
Sentiment	0.199**	1										
LN (Assets)	0.0346	-0.0340	1									
LN (1+Age)	-0.0014	0.0643	0.273***	1								
Tech	-0.0862	0.0055	-0.358***	-0.0743	1							
Technique	0.0242	0.0124	-0.195**	-0.116	0.0561	1						
Above	0.0649	-0.0300	0.0543	-0.0713	-0.0479	-0.0540	1					
Below	-0.110	-0.0568	-0.0969	-0.103	0.0216	-0.137*	-0.0353	1				
Rank	0.0702	0.0583	0.232***	0.102	0.0940	-0.173*	0.0903	-0.150*	1			
International	0.0700	0.0277	0.485***	0.191**	-0.145*	-0.182**	0.113	-0.0583	0.226***	1		
Market return	0.208**	0.00613	-0.0369	-0.0601	0.00871	0.0111	-0.0177	-0.0881	-0.134*	-0.0176	1	
Std.dev.	0.0265	-0.0794	-0.0592	-0.0243	0.0751	0.0291	-0.0451	0.131	0.0251	-0.0277	-0.356***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

VARIABLES	(1) MAR	(6) MAR	(2) MAR	(4) MAR	(3) MAR	(5) MAR
Sentiment	0.00308** (0.00141)	0.00306** (0.00129)	0.00363*** (0.00133)	0.00342*** (0.00126)		
HC	0.0308** (0.0149)	0.0191 (0.0148)			0.0372*** (0.0141)	0.0263* (0.0146)
LN (Assets)	0.00139 (0.00431)	0.00117 (0.00404)	0.00120 (0.00438)	0.00109 (0.00406)	0.000738 (0.00432)	0.000507 (0.00401)
LN (1+Age)	0.0173*** (0.00548)	0.0186*** (0.00501)	0.0170*** (0.00552)	0.0185*** (0.00503)	0.0181*** (0.00558)	0.0193*** (0.00509)
Tech	-0.0204 (0.0296)	-0.0222 (0.0297)	-0.0239 (0.0290)	-0.0247 (0.0290)	-0.0206 (0.0298)	-0.0221 (0.0299)
Technique	0.0591** (0.0275)	0.0633** (0.0271)	0.0600** (0.0278)	0.0639** (0.0273)	0.0594** (0.0276)	0.0636** (0.0272)
Above	0.0234** (0.0113)	0.0256 (0.0182)	0.0293*** (0.0113)	0.0300 (0.0184)	0.0183 (0.0143)	0.0197 (0.0227)
Below	-0.00922 (0.0173)	0.00509 (0.0175)	-0.0133 (0.0186)	0.00288 (0.0187)	-0.0106 (0.0171)	0.00417 (0.0172)
Rank	0.0378** (0.0159)	0.0478*** (0.0158)	0.0392** (0.0159)	0.0493*** (0.0158)	0.0393** (0.0159)	0.0492*** (0.0158)
International	-0.00310 (0.0152)	-0.00367 (0.0137)	-0.00153 (0.0153)	-0.00283 (0.0137)	-0.00191 (0.0154)	-0.00247 (0.0139)
Market return		0.419*** (0.129)		0.456*** (0.125)		0.401*** (0.133)
Std.dev		-2.057 (1.485)		-1.780 (1.432)		-2.418 (1.552)
Constant	-0.0317 (0.0377)	-0.0136 (0.0392)	-0.00160 (0.0322)	0.00103 (0.0374)	-0.0668** (0.0311)	-0.0446 (0.0362)
Observations	219	219	219	219	219	219
R-squared	0.151	0.220	0.137	0.215	0.135	0.204
Adj. R-square						
Prob > F						

White's Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(1) MAR	(2) MAR	(3) MAR	(4) MAR	(5) MAR	(6) MAR
HC	0.0308**	0.0191	0.0306**	0.0190	0.0329**	0.0236
	(0.0149)	(0.0148)	(0.0149)	(0.0148)	(0.0149)	(0.0147)
Sentiment	0.00308**	0.00306**	0.00305**	0.00303**	0.00327**	0.00328**
	(0.00141)	(0.00129)	(0.00141)	(0.00128)	(0.00139)	(0.00127)
LN (Assets)	0.00139	0.00117			0.00342	0.00370
	(0.00431)	(0.00404)			(0.00393)	(0.00376)
LN (1+Age)	0.0173***	0.0186***	0.0176***	0.0189***	0.0175***	0.0186***
	(0.00548)	(0.00501)	(0.00536)	(0.00491)	(0.00566)	(0.00532)
Tech	-0.0204	-0.0222	-0.0228	-0.0242	-0.00977	-0.00864
	(0.0296)	(0.0297)	(0.0281)	(0.0284)	(0.0299)	(0.0302)
Technique	0.0591**	0.0633**	0.0585**	0.0628**	0.0521*	0.0543**
	(0.0275)	(0.0271)	(0.0274)	(0.0270)	(0.0275)	(0.0275)
Above	0.0234**	0.0256	0.0231**	0.0253	0.0338***	0.0376**
	(0.0113)	(0.0182)	(0.0113)	(0.0178)	(0.0108)	(0.0146)
Below	-0.00922	0.00509	-0.00969	0.00472	-0.0183	-0.00739
	(0.0173)	(0.0175)	(0.0172)	(0.0175)	(0.0170)	(0.0165)
Rank	0.0378**	0.0478***	0.0387**	0.0486***		
	(0.0159)	(0.0158)	(0.0152)	(0.0153)		
International	-0.00310	-0.00367	-0.000787	-0.00172		
	(0.0152)	(0.0137)	(0.0141)	(0.0125)		
Market return		0.419***		0.419***		0.359***
		(0.129)		(0.129)		(0.127)
Std.dev		-2.057		-2.071		-2.074
		(1.485)		(1.481)		(1.549)
Constant	-0.0317	-0.0136	-0.0261	-0.00877	-0.0196	0.00157
	(0.0377)	(0.0392)	(0.0322)	(0.0351)	(0.0359)	(0.0378)
Observations	219	219	219	219	219	219
R-squared	0.151	0.220	0.150	0.219	0.127	0.182

White's Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

2. Per country:

Sweden:

	HC	Sentiment	LN (Assets)	LN (1+Age)	Tech	Technique	Below	Rank	International	Market return	Std. dev
HC	1										
Sentiment	-0.0759	1									
LN (Assets)	0.239*	-0.0278	1								
LN (1+Age)	0.0773	0.0447	0.286**	1							
Tech	-0.0649	0.132	-0.307**	-0.0992	1						
Technique	0.0883	-0.0284	-0.170	-0.135	0.0649	1					
Below	-0.203	0.215*	-0.232*	-0.186	-0.0707	-0.104	1				
Rank	0.115	0.122	0.0998	0.0213	-0.0216	-0.0509	-0.170	1			
International	0.0632	0.153	0.506***	0.212	-0.135	-0.193	-0.115	0.123	1		
Market return	0.336**	-0.281**	0.0343	0.0810	0.0873	0.0621	-0.0426	-0.0782	-0.0431	1	
Std.dev	-0.324**	0.132	-0.140	-0.00796	0.168	-0.0548	0.220*	0.156	-0.0314	-0.325**	1

$^{*}\ p < 0.05,\ ^{**}\ p < 0.01,\ ^{***}\ p < 0.00$

VARIABLES	(1) MAR	(2) MAR	(3) MAR	(4) MAR
HC	0.0760***	0.0560**	0.0744***	0.0544**
	(0.0244)	(0.0276)	(0.0236)	(0.0271)
Sentiment	0.000964	0.00348	0.000989	0.00351
	(0.00314)	(0.00338)	(0.00311)	(0.00334)
LN (Assets)	-0.00251	-0.00246		
	(0.00977)	(0.00915)		
LN (1+Age)	0.0358***	0.0322***	0.0353***	0.0317***
	(0.00996)	(0.00954)	(0.00948)	(0.00922)
Tech	0.00200	-0.0177	0.00499	-0.0148
	(0.0587)	(0.0621)	(0.0576)	(0.0607)
Technique	0.0946**	0.0917**	0.0955**	0.0926**
	(0.0377)	(0.0371)	(0.0373)	(0.0364)
Below	-0.0486	-0.0772	-0.0452	-0.0738
	(0.0595)	(0.0492)	(0.0584)	(0.0456)
Rank	0.0737***	0.0740***	0.0738***	0.0740***
	(0.0266)	(0.0258)	(0.0265)	(0.0257)
International	-0.0368	-0.0373	-0.0407*	-0.0411*
	(0.0259)	(0.0243)	(0.0221)	(0.0207)
Market return		0.501**		0.501***
		(0.190)		(0.189)
Std.dev		1.978		1.982
		(4.028)		(4.003)
Constant	-0.129*	-0.102	-0.140**	-0.112
	(0.0708)	(0.0876)	(0.0565)	(0.0792)
Observations	84	84	84	84
R-squared	0.358	0.400	0.357	0.399
Adj. R-squared	0.280	0.308	0.289	0.317
Prob > F	0.000	0.000	0.000	0.000

White's Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Denmark:

	HC	Sentiment	LN (Assets)	LN (1+Age)	Tech	Technique	Below	Rank	International	Market return	Std.dev
HC	1										
Sentiment	0.116	1									
LN (Assets)	0.141	-0.248	1								
LN (1+Age)	0.0299	-0.141	0.603***	1							
Tech	-0.108	0.415*	-0.556**	-0.0629	1						
Technique	-0.171	-0.218	-0.428*	-0.570**	0.153	1					
Below	-0.126	0.147	-0.246	0.00146	0.229	-0.167	1				
Rank	0.401*	0.160	0.373	0.418*	0.135	-0.478*	-0.100	1			
International	0.417*	-0.212	0.679***	0.501**	-0.426*	-0.529**	0.0316	0.474*	1		
Market return	0.303	0.290	0.127	-0.219	-0.186	-0.376	0.177	0.0952	0.164	1	
Std.dev	0.134	-0.465*	0.0203	0.193	0.0616	0.353	-0.122	0.0558	0.103	-0.553**	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

VARIABLES	(1) MAR	(2) MAR	(3) MAR	(4) MAR	(5) MAR	(6) MAR	(7) MAR	(8) MAR
HC	-0.0057	-0.0378	-0.0054	-0.0252	-0.0015	-0.0375	0.0120	-0.0124
	(0.0465)	(0.0579)	(0.0476)	(0.0597)	(0.0451)	(0.0578)	(0.0525)	(0.0674)
Sentiment	0.0055	0.0048	0.0055	0.0045	0.0072	0.0048	0.0045	0.0038
	(0.00465)	(0.00483)	(0.00454)	(0.00503)	(0.00465)	(0.00483)	(0.00395)	(0.00440)
LN (Assets)	-0.0003	-0.0121			-0.0092	-0.0113	0.0044	-0.0045
	(0.0124)	(0.00814)			(0.00972)	(0.0109)	(0.0101)	(0.00868)
LN (1+Age)	-0.0275	0.0025	-0.028	-0.0103			-0.0268	-0.0004
	(0.0220)	(0.0220)	(0.0216)	(0.0223)			(0.0206)	(0.0231)
Tech	-0.0676	-0.0752	-0.0667	-0.0459	-0.1100	-0.0726	-0.0770	-0.0877
	(0.0926)	(0.0973)	(0.0965)	(0.103)	(0.0969)	(0.102)	(0.0950)	(0.0995)
Technique	-0.0853	-0.0092	-0.0855	-0.0292	-0.0485	-0.0138	-0.0973	-0.0363
	(0.0839)	(0.0936)	(0.0827)	(0.0919)	(0.0725)	(0.0771)	(0.0756)	(0.0871)
Below	-0.0668	-0.108	-0.0664	-0.0875	-0.0657	-0.1070	-0.0445	-0.0742
	(0.0858)	(0.0626)	(0.0784)	(0.0551)	(0.0877)	(0.0627)	(0.0632)	(0.0540)
Rank	0.0128	0.0258	0.0125	0.0141	0.0159	0.0252	0.0227	0.0372
	(0.0689)	(0.0778)	(0.0699)	(0.0803)	(0.0691)	(0.0773)	(0.0683)	(0.0803)
International	0.0557	0.0774	0.0552	0.0568	0.0527	0.0769		
	(0.0746)	(0.0707)	(0.0645)	(0.0665)	(0.0765)	(0.0704)		
Market return		0.8240**		0.6930*		0.8040**		0.7480*
		(0.329)		(0.358)		(0.340)		(0.403)
Std.dev		-0.2280		-0.0012		-0.1300		0.3750
		(6.073)		(5.943)		(5.620)		(6.075)
Constant	0.1940*	0.1630*	0.1930**	0.1340	0.1770**	0.1650*	0.1670*	0.1300
	(0.0938)	(0.0893)	(0.0790)	(0.0835)	(0.0793)	(0.0805)	(0.0882)	(0.0890)
Observations	27	27	27	27	27	27	27	27
R-squared	0.380	0.474	0.380	0.458	0.338	0.473	0.360	0.436
Adj. R-squared	0.052	0.087	0.104	0.119	0.044	0.144	0.075	0.083
Prob > F	0.380	0.349	0.271	0.289	0.379	0.249	0.321	0.340

White's Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finland:

(1)

	HC	Sentiment	LN (Assets)	LN (1+Age)	Tech	Technique	Above	Below	Rank	International	Market return	Std.dev
HC	1											
Sentiment	0.609**	1										
LN (Assets)	0.158	-0.0181	1									
LN (1+Age)	0.341	0.174	0.174	1								
Tech	0.132	-0.0986	0.0702	-0.147	1							
Technique	-0.411	-0.199	-0.330	-0.0910	-0.181	1						
Above	0.0913	-0.240	0.535*	0.254	-0.0725	-0.125	1					
Below	0.132	0.267	-0.236	0.0121	-0.105	-0.181	-0.0725	1				
Rank	0.289	-0.0440	0.604**	-0.0474	0.459*	-0.395	0.316	-0.229	1			
International	-0.0913	-0.193	0.432	-0.299	0.200	-0.0500	0.400	-0.181	0.553**	1		
Market return	-0.351	-0.351	0.0978	-0.0343	-0.0697	0.297	-0.298	-0.380	-0.0619	-0.0973	1	
Std.dev	0.314	0.472*	-0.312	-0.150	-0.0559	-0.0275	-0.133	0.475*	-0.153	0.0229	-0.618**	1

$^{*}\, p < 0.05, \; ^{**}\, p < 0.01, \; ^{***}\, p < 0.00$

VARIABLES	(1) MAR	(2) MAR	(3) MAR	(4) MAR	(5) MAR	(6) MAR	(7) MAR	(8) MAR
HC	0.0136	-0.0136	0.0145	-0.00954			0.0866	0.00879
	(0.0819)	(0.0901)	(0.0743)	(0.0858)			(0.0647)	(0.0728)
Sentiment	0.00956	0.00377	0.00952	0.00362	0.0103*	0.00312		
	(0.00677)	(0.00467)	(0.00595)	(0.00393)	(0.00479)	(0.00269)		
LN (Assets)	0.0207**	0.0391***	0.0210**	0.0405***	0.0199**	0.0398***	0.0269***	0.0436***
	(0.00917)	(0.0105)	(0.00817)	(0.0103)	(0.00806)	(0.00921)	(0.00492)	(0.00931)
LN (1+Age)	-0.00780	0.000852	-0.00784	0.000611	-0.00695	-0.000103	-0.00771	0.00158
	(0.0127)	(0.0192)	(0.0127)	(0.0192)	(0.0116)	(0.0126)	(0.0102)	(0.0199)
Tech	-0.0291	-0.0358	-0.0281	-0.0316	-0.0277	-0.0376	-0.0475*	-0.0439
	(0.0321)	(0.0396)	(0.0283)	(0.0397)	(0.0326)	(0.0256)	(0.0232)	(0.0361)
Technique	0.120	0.125	0.119	0.124	0.118*	0.128*	0.123	0.129
	(0.0758)	(0.0808)	(0.0751)	(0.0812)	(0.0653)	(0.0665)	(0.0822)	(0.0793)
Above	0.106	0.0275	0.106*	0.0253	0.111*	0.0211	0.0378	-0.0103
	(0.0589)	(0.0824)	(0.0541)	(0.0791)	(0.0578)	(0.0549)	(0.0295)	(0.0572)
Below	0.00269	-0.0514	0.00235	-0.0525	0.00218	-0.0500	0.0240	-0.0492
	(0.0291)	(0.0487)	(0.0272)	(0.0481)	(0.0290)	(0.0456)	(0.0248)	(0.0484)
Rank	0.00244	0.0102			0.00577	0.00680	-0.0115	0.00591
	(0.0461)	(0.0327)			(0.0390)	(0.0260)	(0.0267)	(0.0230)
International	-0.1000**	-0.131***	-0.0991***	-0.127***	-0.102**	-0.129***	-0.0917***	-0.130***
	(0.0364)	(0.0341)	(0.0277)	(0.0335)	(0.0373)	(0.0302)	(0.0260)	(0.0334)
Market return		-0.360		-0.365		-0.373		-0.450
		(0.499)		(0.498)		(0.426)		(0.457)
Std.dev		17.48		17.27		16.91*		18.18
		(12.93)		(12.85)		(8.873)		(13.62)
Constant	0.0538	-0.245*	0.0516	-0.252*	0.0731	-0.257*	-0.125**	-0.327**
	(0.145)	(0.128)	(0.118)	(0.112)	(0.0903)	(0.133)	(0.0405)	(0.126)
Observations	21	21	21	21	21	21	21	21
R-squared	0.562	0.718	0.562	0.717	0.561	0.717	0.483	0.708
Adj. R-squared	0.124	0.295	0.204	0.371	0.202	0.371	0.068	0.351
Prob > F	0.350	0.230	0.237	0.148	0.239	0.142	0.410	0.156

White's Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Norway:

(1)

	HC	Sentiment	LN (Assets)	LN (1+Age)	Tech	Technique	Above	Below	Rank	International	Market return	Std.dev
HC	1											
Sentiment	0.370**	1										
LN (Assets)	-0.168	0.0116	1									
LN (1+Age)	-0.147	0.0342	0.156	1								
Tech	-0.118	-0.176	-0.367**	-0.0287	1							
Technique	0.167	0.0814	-0.143	0.00141	0.100	1						
Above	0.0865	0.0465	-0.00954	-0.189	-0.0672	-0.0454	1					
Below	-0.109	-0.212*	0.0177	-0.0743	0.0216	-0.113	-0.058	1				
Rank	-0.0793	-0.0350	0.248*	0.0871	0.104	-0.188	0.126	-0.111	1			
International	-0.00956	0.00511	0.439**	0.123	-0.127	-0.140	0.125	-0.002	0.147	1		
Market return	0.142	0.238*	-0.167	-0.118	0.0230	0.0875	0.0370	-0.156	-0.245*	0.00675	1	
Std.dev	0.233*	-0.0139	-0.00893	-0.0134	0.0120	0.115	-0.0614	0.0941	-0.0651	-0.0321	-0.356**	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

VARIABLES	(1) MAR	(2) MAR	(3) MAR	(4) MAR	(5) MAR	(6) MAR	(7) MAR	(8) MAR
HC	-0.0199	-0.0198	-0.0192	-0.0204			-0.00793	-0.0121
	(0.0195)	(0.0204)	(0.0189)	(0.0201)			(0.0185)	(0.0201)
Sentiment	0.00305*	0.00203	0.00304*	0.00205	0.00246	0.00149		
	(0.00173)	(0.00151)	(0.00171)	(0.00149)	(0.00162)	(0.00150)		
LN (Assets)	-0.000672	0.000548			0.000234	0.00142	-0.000399	0.000827
	(0.00387)	(0.00368)			(0.00373)	(0.00366)	(0.00380)	(0.00356)
LN (1+Age)	0.00356	0.00551	0.00351	0.00554	0.00451	0.00634	0.00442	0.00623
	(0.00738)	(0.00721)	(0.00734)	(0.00720)	(0.00766)	(0.00733)	(0.00776)	(0.00742)
Tech	0.0126	0.00903	0.0141	0.00783	0.0161	0.0127	0.00798	0.00582
	(0.0307)	(0.0309)	(0.0291)	(0.0289)	(0.0301)	(0.0302)	(0.0311)	(0.0315)
Technique	-0.0431	-0.0433	-0.0432	-0.0432	-0.0474	-0.0466	-0.0424	-0.0428
	(0.0348)	(0.0397)	(0.0349)	(0.0396)	(0.0348)	(0.0403)	(0.0356)	(0.0404)
Above	0.0366*	0.0338	0.0374*	0.0332	0.0354*	0.0320	0.0386*	0.0349
	(0.0206)	(0.0246)	(0.0193)	(0.0228)	(0.0193)	(0.0269)	(0.0210)	(0.0329)
Below	0.00453	0.0144	0.00436	0.0145	0.00506	0.0152	-0.00285	0.0105
	(0.0184)	(0.0185)	(0.0183)	(0.0184)	(0.0178)	(0.0178)	(0.0172)	(0.0181)
Rank	0.0106	0.0218	0.00993	0.0223	0.0102	0.0208	0.00987	0.0222
	(0.0175)	(0.0185)	(0.0164)	(0.0179)	(0.0172)	(0.0179)	(0.0172)	(0.0186)
International	0.0334	0.0269	0.0320	0.0280	0.0312	0.0248	0.0323	0.0256
	(0.0249)	(0.0226)	(0.0243)	(0.0218)	(0.0244)	(0.0219)	(0.0256)	(0.0228)
Market return		0.396**		0.394**		0.378**		0.428**
		(0.181)		(0.178)		(0.177)		(0.184)
Std.dev		-0.0225		-0.0147		-0.476		-0.0390
		(1.927)		(1.929)		(1.736)		(1.917)
Constant	0.0385	0.00448	0.0349	0.00744	0.0100	-0.0169	-0.00639	-0.0269
	(0.0382)	(0.0452)	(0.0282)	(0.0356)	(0.0358)	(0.0500)	(0.0358)	(0.0421)
Observations	87	87	87	87	87	87	87	87
R-squared	0.110	0.181	0.110	0.180	0.101	0.172	0.082	0.169
Adj. R-squared	-0.007	0.048	0.005	0.060	-0.004	0.051	-0.026	0.047
Prob > F	0.505	0.207	0.407	0.149	0.481	0.182	0.652	0.199

White's Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For the total sample, we look at the response on other coefficients when omitting one of the variables *HC, Sentiment, LN (Assets), Rank* and *International.* We see that omitting either *HC* or *Sentiment* slightly increases the significance of the other variable, as well as the size of its coefficient. No other variables change significantly. As both variables are included as proxies for investor sentiment, and are significant regardless of whether both or only one is included in the regression, our conclusions and findings related to this theory remains unchanged, and it is therefore not considered as an issue related to multicollinearity. Omitting either *LN (Assets)* or *Rank* and *International* have no notable impact on the overall results other than a slight increase in the significance of the variable *Above* when omitting *Rank* and *International*.

In Sweden, we look at the response from omitting the variable *LN (Assets)*, which is the only variable significantly correlated to other variables. The main results remain unchanged. However, the t-statistic of the coefficient for *international* decreases from -1.41 to -1.98 and thus becomes significant at the 10% level. This suggests that the insignificance for *International* reported in the regression with all the included variables to some degree are driven by correlation with *LN (Assets).*

In Denmark, we experiment with omitting the variables *LN (Assets), LN (1+Age)* and *International,* which is the variables with the highest correlation among them and with other variables. It shows that the results remain unchanged, both when it comes to the signs, sizes and significance of the regression coefficients.

The highest correlated variables in Finland are *Rank, HC* and *Sentiment.* When omitting *Rank*, our results remains unchanged in terms of signs and sizes of the coefficients. We also see that the variable *Above* becomes slightly significant at the 10% level, but insignificant again when including the control variables. When omitting *HC,* the t-statistics for *Sentiment, Technique* and *Above* marginally increases making them significant at a 10% level, but only *Technique* remains so after controlling

for the market return and standard deviation. Omitting *Sentiment* leads to *Tech* becoming slightly significant at the 10%, but becomes insignificant again when including the control variables.

We experiment with the variables *HC, Sentiment* and *LN (Assets)* in Norway. Other than the t-statistic of the coefficient for *Sentiment* decreasing from 1.76 to 1.52, and thus making it insignificant at the 10% level, the results remains unchanged.