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Comparing the Efficiency of Pricing Mechanisms in Norwegian IPOs

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Abstract

On Oslo Stock Exchange, there are mainly two pricing mechanisms that are being used when pricing an IPO, these being book-building and fixed-price. As there do not exist much research on which of these two are the more superior pricing mechanism when pricing a Norwegian IPO, we want to test empirically which of these two are the more efficient pricing mechanism regarding the level and variance of underpricing. In our research, we have gathered data from 125 IPOs from February 2000 until June 2017, where we have limited ourselves to only include data from Oslo Stock Exchange (excluding Axess and Merkur). We used a paired t-test to identify a 1 percent significant level of underpricing of 4,29 and 3,9 percent of book-building and fixed-price IPOs, respectively. We also compared the two pricing mechanisms by using Mood's Median Test, Levene's Test of difference in variance and several multivariate regression models. We also compared cross-sectional differences within the subsamples with respect to different firm-, issue- and market characteristics. This research have us concluding that book-building do dominate fixed price regarding pricing efficiency, where we found that it produces lower conditional variance (variance after controlling for firm-, issue-, and market effects) and are better at incorporating market conditions prior to the IPO.

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1. Introduction

An Initial Public Offering, which we will refer to as an "IPO", is the event where a private firm get listed on a stock exchange. The first IPO registered is dated back to 1602, when the Dutch East India Company issued shares to the public. In the United States, the first recorded IPO was around 1783, when the Bank of North America offered shares to the public.

There are both pros and cons of going public, where the biggest argument pro going public is raising capital to expand the business and grow further. An IPO can also be used as an exit strategy for current investor, such as venture capital, mutual funds, angel investors, where they can realize their profit by selling their shares. As firms gets listed, they benefit from increased transparency and a better financial situation, and they can also attract more customers, as well as better and more reliable suppliers. On the other hand, going public is costly, and existing shareholders can also lose shares and voting rights, which potentially could lead to losing control over the company.

Parties involved in a public offering include the issuer, the underwriting investment bank, and the investors. The underwriter's job includes among other to provide professional expertise, such as helping the company to file legal documents, setting the price of share, and to find investors. One of the most challenging jobs the underwriter is facing is determining the accurate offering price.

At the end of the first day of trading, the first day return is observable. A large increase in the share price the first day, indicate that the share is underpriced and that the issuing firm could have gotten a higher price for their shares. This is often referred to as "leaving money on the table". Further, if the price is too high, it could be more damaging as the underwriter might not be able to sell all the shares, thus the public offering fails. However, this phenomenon is less frequent than underpricing.

The phenomenon of underpricing in IPOs is well documented and studied in academic literature. One of the first widespread research concerning IPO underpricing viewed from an international perspective was conducted by Loughran, Ritter, & Rydqvist (1994), where they studied the short-run and long-run performance of IPOs in different countries. The findings suggest that there are in fact underpricing on a short-run basis. Regarding the long-run performance, the evidence is less complete and not as significant as for the short-run performance.

However, the paper suggests that underpricing represent a cost to the issuer, because of the money left on the table.

Other theories on IPO underpricing suggests that the degree of underpricing increases with higher asymmetric information, more valuation uncertainty and higher risk of lawsuit (Fama, 1970). Habib & Ljungqvist (2001) find that certain IPOs have more underpricing simply because managers do not care about underpricing, and that owners who just sell a small fraction of their shares only suffer a marginal loss from the underpricing.

In this paper, we focus on two different pricing mechanism of IPOs; book-building and fixed-price. According to Busaba & Chang (2010), the main difference between these two is whether the price discovery appears before or after the offer price is set. In a book-building process, the underwriter has a roadshow to discover the demand for the issue before they set the offer price, whereas in a fixed-price IPO, the issuer and the underwriter set a fixed-price based on fundamental pricing calculations. Busaba & Chang (2010) argue that both methods require underpricing. In the book-building process, investors require something in return for revealing their demand for the share, whereas for fixed-price IPOs, retail investors need compensation for winner's curse.

Ljungqvist, Jenkinson & Wilhelm (2003), based on their findings, claim that book-building leads to more underpricing than fixed-price in European IPOs. In contrast, Benveniste & Spindt (1989) find that fixed-price is more underpriced than book-building.

To our knowledge, there has not been done any research on this specific topic in the Norwegian market. The objective for this thesis is therefore to study the difference between book-building and fixed-price pricing mechanism in the Norwegian IPO market, and try to determine which of the two are the superior pricing mechanism. The criteria we include in our definition of supremacy is the degree of underpricing, the degree of variance of underpricing and the ability to incorporate market conditions prior to the IPO.

Regarding the structure of this paper, we will start by presenting the relevant theory. After that, we will proceed by presenting the results of previous studies on related topics before we continue by presenting our stated hypotheses. Then, we will give an outline of the methodology we have chosen to address our hypotheses, before we present the main analysis with related results. In this section, we will also discuss the results, relate it to previous studies as well as making our own

inferences. Finally, we will conclude our research with a summary of our main findings and conclusions.

2. Theory

In this section, we will discuss the general theory concerning public offering, reasons why firms go public, as well as theories about how the initial process works from the day a company chooses to go public, till the day it is traded in public. We will further discuss the Norwegian IPO market and its regulations. Lastly, we will talk about IPO underpricing theories such as asymmetric information.

2.1. Why Firms Go Public

The main reason for a firm to go public, is to raise cash needed to follow future growth- and investment opportunities. Other reasons to go public can be to increase the liquidity of the stock, providing visibility or to facilitate acquisition and mergers. Even though IPOs potentially can raise great amounts of capital, it is very expensive for the issuing firm, where the gross spread received by the underwriters is about seven percent (Chen & Ritter, 2000). Other resource demanding elements related to IPO, are the ongoing need to provide financial reports, the legal responsibility and internal resource demand where the operational attention is diverted to the IPO. The literature divide the existing theories concerning why firms choose to go public into the categories; Life Cycle Theories, Market-Timing Theories and Valuation Theories.

Life Cycle Theories suggest that it is much easier for a potential acquirer to spot a potential takeover target when it is public (Zingales, 1995), and that entrepreneurs can use the IPO to regain control from venture capitalists (Black & Gilson, 1998). As Pre-IPO investors hold undiversified portfolios, there will be a diversification gain by going public (Chemmanur & Fulghieri, 1999). This gain, however, would have to be weighed up alongside the fixed cost associated with going public and the cost of revealing private information. Thus, early in its life cycle a firm will be private, but if it grows sufficiently large it becomes optimal to go public. Maksimovic & Pichler (2001) argue that public trading may inspire to more faith in the firm from other investors, customers, creditors and suppliers, especially if the firm has a first mover advantage by being the first in an industry to go public.

Market Timing Theories states that firms issue equity when it is "convenient". According to Lucas & McDonald (1990), a firm should delay their issue if the market is inn a down cycle, as this will lower the value of the IPO. The

company should wait until the market is in an upward cycle, such as a bull market, because it offers a more favorable pricing of the company. According to Choe, Masulis & Nanda (1993), the bull and bear markets appear in trends, were firms avoid issuing in periods where few other good-quality firms issue.

Valuation Theories is based on the argument that going public can increase the firm value. Holmstrom & Tirole (1993) and Bolton & Von Thadden (1998) argue that by going public companies subject themselves to monitoring by outsiders, which may enhance the value of the firm. Amihud & Mendelson (1988) argue that IPOs make shares more liquid, which also increases firm value.

2.2. The Norwegian IPO Market

The Norwegian equity market is considered a small market compared to the rest of the world. When a company choose to go public in Norway, it has three options, ranging from the largest to the smallest measures in total market value of equity: Oslo Stock Exchange (hereafter referred to as OSE), Oslo Axess, and Merkur Market. A company also has the option to be listed on Over-the-Counter (OTC) Exchange, but this is not a stock exchange, thus we will not put emphasize on it.

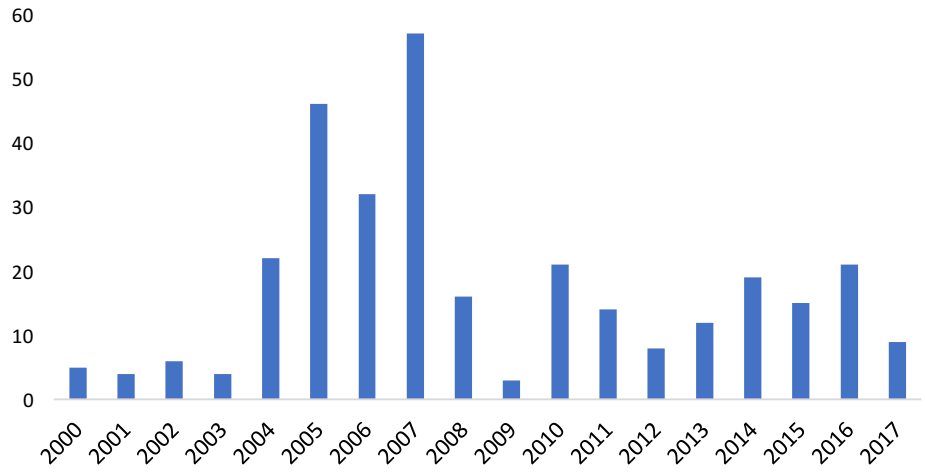
OSE include 189 companies with a total market value of NOK 2.297 billion, while Axess include 22 companies with an approximate total market value of NOK 10 billion. Merkur, which only has existed since 2016 hereafter, consist of 14 companies with a total market value of approximate NOK 9 billion. All numbers are from July 2017 and collected through Oslo Stock Exchange website (Oslo Bors)

As mentioned above, the requirements for being listed in the OSE are more comprehensive compared to Axess and Merkur. Therefore, OSE is a superior marketplace for bigger and more well-established companies seeking capital. Consequently, Axess and Merkur, with less requirements, fits smaller companies. Axess and Merkur are potential starting points for smaller companies because of the lower requirements, where the companies later can seek for transfer between the exchanges.

A summary of the Norwegian public offerings from year 2000 until June 2017 is displayed below. As the diagram shows, the numbers of IPO have had considerable fluctuation throughout the years. Further, one can argue that there is some degree of correlation with the public offerings in the Norwegian Market with the world economy, as we can see low activities around 2000-2001 when the

"dot.com" bubble struck the stock market. After the financial crisis, in 2008, there were no listing on the OSE, and only 3 listing on Axess. The frequency of IPOs is an interesting factor, which we will include in or study, where we look at offerings in "hot" and "cold" IPO markets. We will give our definition of hot and cold markets, as well as an explanation for how we incorporate it in our study in the methodology section later.

Figure 3: Total numbers of IPO in the Norwegian Market from 2000 until mid 2017



2.3. IPO Regulation

The list of IPO regulations concerning Oslo Stock Exchange is comprehensive, and below we will list the most important regulations, and those who differ from Axess and Merkur.

Firstly, the main difference between the regulations of the Norwegian market places is that OSE requires a book value of NOK 300 million, whereas the others only require NOK 8 million. Another difference is that the OSE require that the companies have at least 3 years of operation and annual reports, while Axess and Merkur require less than a year (The 3-year requirement for OSE can be ignored if the company can provide evidence of at least 3 years of existence in the future). Another distinction is that the OSE requires that a minimum of 500 shareholders own shares for a value of NOK 10.000 minimum. On the other hand, Axess requires only 100 shareholders with the same share value per investor.

As described above, we see that the requirements for the OSE is far stricter than Axess and Merkur. In addition to this, the OSE is far more liquid than the other

two, with approximately NOK 3.500 – 4.000 million turnover value each day. Axess and Merkur are more volatile, and their turnover value is generally somewhere between NOK 25–35 million per day in total, where Axess represents 90 percent of this.

2.4. The IPO Players

In an IPO process, there is 3 major players and several trivial players involved, and we will briefly discuss the 3 major players who plays a significant role in the IPO process.

The issuer represents the company going public. The issuer seeks to gain as much capital as possible out of the offering, where the higher proceeds the better for the company. The issuer's job in the IPO process is to work with-, and provide all necessary information to the underwriter, which is presented next.

The underwriter in an IPO process represents the company who is hired by the issuer, and is usually an investment bank or a commercial bank, which is a specialist on IPOs. One of the jobs of the underwriter is to value the company being issued and work out the offer price of the share. The underwriter also helps the company with legal tasks and applications. After everything is in place, the underwriter promotes the company, and efforts to sell the shares to institution investors, corporate investors, private investors etc.

The investor, as mentioned in several forms above, exists in a many different forms. The initial investors are usually large institutional investors which often have a historical relationship with the underwriter. In book-built IPOs, these are the ones that the underwriters visit during the roadshow. Later, when the shares are traded in the aftermarket, we find all kinds of investors, raging from investment funds to small personal investors.

2.5. The Process

In most cases, it is the board of directors and the major stakeholders that decide whether the company should go public. After the decision is made, a long process of various and difficult tasks begins. The companies can choose freely which exchange they want to get listed at, regardless of country, if the requirements of the given exchange are met. The companies then choose the exchange that suit them

best, depending on different critera as requirements, tax-efficient, industry relevance, liquidity, etc.

Figure 4: IPO process

After deciding which exchange to be listed on, the company needs counsels, such as one or more underwriters, lawyers, accountants, etc. The company need these advisors to help them to perform the due diligence, deciding how much capital to raise, filling registration statements, constructing the prospectus and more. This process is extremely comprehensive, and bigger the firm, the more comprehensive the process becomes. Also, bigger companies often have several underwriters who work together, where the company choose one underwriter to be the lead manager, and one or more underwriters to work as syndicates with the lead manager.

The company and the underwriter then must decide which pricing mechanism to choose, how much capital to raise, and then design the prospectus. The prospectus contains information such as background and history of the company, financial statements, description about the historical performance and future potentials, management layout and the current shareholders. The prospectus should also contain the valuation of the company and comparison of similar firms going public. The prospectus is not only a requirement, but also a marketing and advertisement to potential investors.

The underwriters then pitch the IPO to its investors, and if the pricing mechanism is book-building, they do a roadshow to discover the value of the equity. In fixed-price, the underwriter does not go in roadshow to gather information, but they set the share price in collaboration with the company.

The last step is the support of the share price when it is traded in the public. After everything is ready and shares allocation is complete, the issue date is next. This is the day when the company finally is going to be listed at the exchange. In the agreement with the underwriter, the underwriter often demand a green shoe option. This is an agreement where the underwriter can sell or buy up to 15 percent of the total shares offered in the IPO. The meaning with such an agreement is to support the price if it were to fluctuate too much from the initial offering price. This

agreement often expires after some time, and the underwriter can choose to use it or not, depending on the price movements in the aftermarket trading.

2.6. Underpricing Theories

The underpricing of IPOs has been a puzzle for academics as it clearly contradicts the efficient market hypothesis (Fama & Eugene, 1991). Several explanations have been advanced for the phenomenon of positive average initial returns, with different theories focusing on various aspects of the relations between investors, issuers, and the investment bankers taking the firms public. Both fixed-price and book-building require money to be left on the table. Rock (1986) argue that in fixed-price offerings, the selling firm needs to compensate the uninformed investors for the winners curse as informed investors crowd them out of good deals. In book-building, however, winners curse is not present, but investors require a discount to reveal their private information about their willingness to participate in the IPO (Benveniste & Spindt, 1989). Below we will discuss one of the most promising explanation of underpricing, which is asymmetric information.

2.6.1. Asymmetric Information

Theories concerning information asymmetry considers the asymmetric relationship between the information held by the issuers versus the information held by the investors. If the issuer is more informed than the investors, rational investors will fear only issuers with worse than average quality are willing to sell their shares at the average price. To distinguish themselves from the poor-quality issuers, high quality issuers may attempt to signal their quality by selling their shares at a lower price than what the market believes they are worth, which deters lower quality issuers from imitating. The sacrifice made can pay off either in future issuing activity (Welch, 1989), favorable market responses to future dividend announcement (Allen & Faulhaber, 1989) or analyst coverage (Chemmanur, 1993).

If the investors are more informed than the issuers, for example about the general market demand for shares, then the issuer faces a placement problem (Ritter & Welch, 2002). The price the market is willing to pay is not known for the issuer, and the issuer is not informed about the demand for the stock. One assumption for this hypothesis is that all investors are equally informed and thus will only purchase shares if the price is below their common assessment. Another, more realistic

assumption, is that investors are differentially informed. With this assumption, pricing too high might induce investors and issuers to fear a winner's curse (Rock, 1986) or a negative cascade (Welch, 1992).

Benveniste & Spindt (1989), Benveniste & Wilhelm (1990) and Spatt & Srivastava (1991) argue that book-building allows underwriters to obtain information from informed investors. If the book-building result in high demand, the underwriter will set a higher offer price. Potential investors know this, so they need something in return for them to reveal their demand. Hence, underpricing.

3. Literature Review

According to Ljungqvist (2007), Dennis E. Logue was among the first person to document underpricing in back in 1973. Logue (1973) examined American IPOs in the period between 1965-1969, and utilized different regression models to explain the IPO underpricing phenomenon. Logue (1973) studied the first day returns and adjusted for the market return measured by a OTC-index. The result showed an average first day underpricing of 41,7 percent.

Ibbotson (1975) followed up just two years after, documenting irregular returns the first period after American IPOs. Ibbotson (1975) studied the stock price development of numerous newly listed stocks from the time of the IPO until the first turn of the month in the period between 1960-1969. He found that the newly listed stocks on average beat the market by over 11 percent. Ibbotson (1975) also discovered a skewed distribution (with a long right tail) in the data, which meant that a randomly selected IPO would have an equal probability of positive and negative abnormal returns.

In American studies, up to the mid 1980s, mainly weekly and monthly observations were utilized to investigate underpricing. In more recent years, along with the technological development, daily data is more commonly used in empirical studies.

An alternative to measuring the percentage underpricing, we can look at the underpricing in absolute terms, where we can see the amount of money "left on the table". This is defined as the difference between the stocks market value and the price at the IPO, times the number of shares sold at the introduction. This method assumes that the shares could have been sold to the first day's closing price, hence, that the demand is inelastic.

By calculating the absolute value of the underpricing in the US in the years between 1999-2000, when the average underpricing was 71 and 57 percent, respectively, we find a total absolute underpricing of 67 billion dollars (Ritter, 2008b). In the literature, these periods are typically referred to as "hot issue markets". Ritter (2008a) has also ranked American introductions by absolute value of underpricing, and presented the top 227 introductions with the largest dollar value left on the table. On top of the list we find the introduction of Visa, where the initial owners lost an astonishing amount of five billion dollars, where the initial stock price was 28 percent lower than the first day closing price. Although the

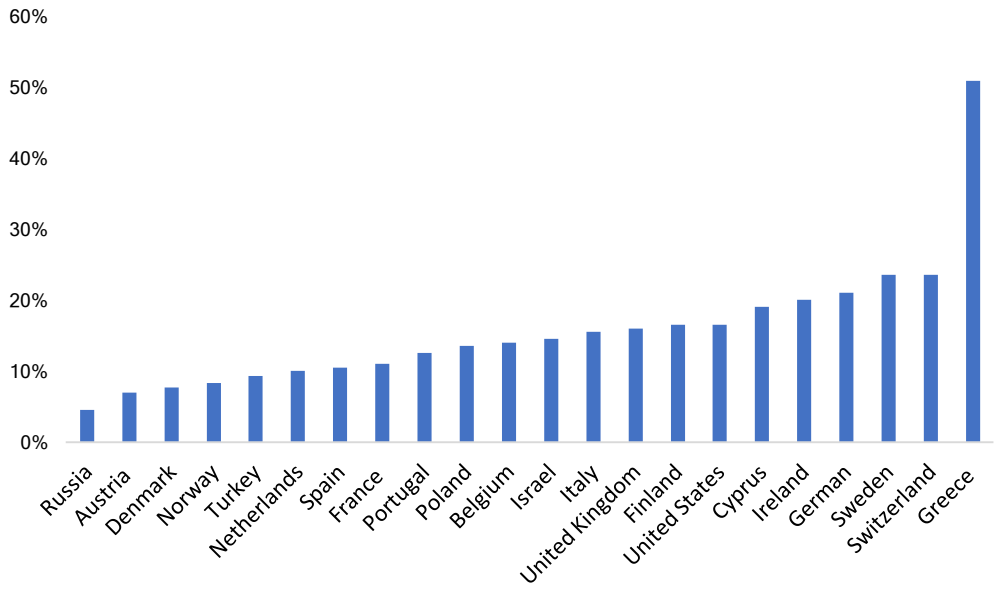
method for calculating "money left on the table" can be discussed, the examples shows that the extent of underpricing is substantial.

In recent years, there has been a substantial amount of research done on the phenomenon of underpricing in IPOs, both in Norway and in the rest of the world. Loughran et al., (1994*)* have summarized a range of studies looking at the short-run and long-run performance of companies going public in 52 countries from all around the world, and the results have been varying among the different continents. The average initial return in Europe, America and Oceania have been around 5-25 percent (Loughran et al., 1994), where Greece (50,8 percent), Bulgaria (36,5 percent) and Brazil (33,1 percent) are the only ones significantly deviating from that interval. In Asia, on the other hand, there have been a wider range of different results regarding the levels of initial underpricing, where the mean is relatively high compared to the rest of the world. Here, Loughran et al., (2015) reports eleven countries showing over 25 percent initial underpricing, where we have Saudi Arabia, Jordan and China as the most extreme cases, reporting an initial underpricing of 239,8 percent, 149 percent and 113,5 percent, respectively.

There have also been substantial differences between the different European countries in terms of level of underpricing. For instance, from Loughran et al., (2015), we see that underpricing are more common in Germany than in France. It is likely that this, to some extent, is caused by the differences in the institutional framework where the IPOs are issued (Ljungqvist, 2007).

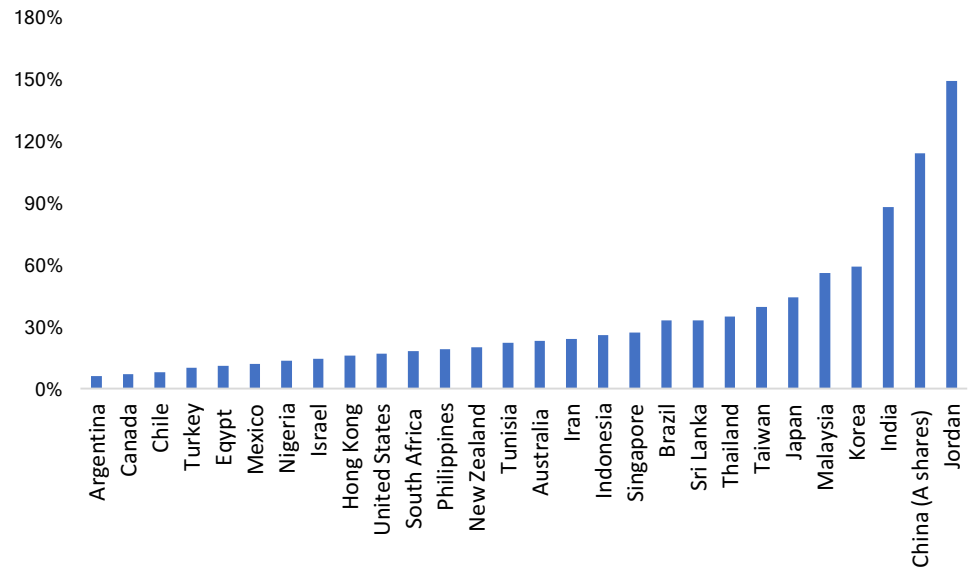
Research done by Ritter (1998) shows that underpricing is more frequent in countries where it is common to utilize a "book-building" strategy compared to countries which commonly utilize a fixed-price for their shares, where the average levels of underpricing are 12 and 37 percent, respectively. This can, however, be due to differences in the company characteristics rather than the choice of pricing method (Loughran et al., 2015).

Figure 1: Average first-day return on (mostly) European IPOs



Loughran et al., (1994)

Figure 2: Average first-day return on non-European IPOs



Loughran et al., (1994)

In addition to variation between countries, research from Loughran & Ritter (2004) shows that there is a difference in underpricing between different periods of time. In the 1980s, the average first-day return on IPOs was seven percent, while it doubled to 15 percent in the period between 1990-98. During the internet bubble, it

jumped to 65 percent, but later reverted to 12 percent in the period between 2001-03.

A study done by Benveniste & Spindt (1989) concerning book-building as a pricing mechanism assumes that the underwriter can achieve information about the true share price from informed investors. Benveniste & Spindt model showed that the IPO underpricing is a compensation to the informed investors, due to their release of private information about the shares to be offered to the public. The underwriter then use the private information to mitigate the information asymmetry trough pricing and allocation of shares. They claim that this, compared to fixed-price mechanism, reduce the underpricing and increase the proceeds to the issuer. However, a year later, Benveniste & Wilhelm (1990) extended the model as they analyzed the consequences of limiting the ability to obtain information from informed investors by the underwriter.

As price discovery becomes unavailable, the uniform price restriction will then increase the information gathering cost, and at the same time as restriction of allocation, the underwriters seem to not be able to reduce information asymmetry and the issuer may face the winner's curse by them self. In this case, the book-building does not provide less underpricing compared to fixed-priced mechanism. However, book-building is claimed to dominate fixed-price as a pricing mechanism argued by Benveniste & Wilhelm (1990). This contrasts with what Rock (1986) discovered.

4. Hypotheses

In our research, we will empirically test the existence of underpricing, and, in that case, if there are characteristically differences between the underpricing caused by the different pricing mechanisms. We will utilize hypothesis testing to statistically determine the significance of our test results. In the following section, we have formulated seven hypotheses that will test the characteristics of underpricing that we are after. Note that all hypothesis is in relation to the period between 2000 – 2017.

4.1. Hypothesis 1:

Efficient market hypothesis states that a stock's price should reflect all available information at all time (Fama, Fisher, Jensen & Roll, 1969). Our first hypothesis is therefore that Norwegian IPOs are valued based on all available information and thus are correctly priced.

H_0: Norwegian IPOs have been correctly priced in the given time-period.

H_A: Norwegian IPOs have been underpriced in the given time-period.

4.2. Hypothesis 2:

Book-building as a pricing mechanism has traditionally been viewed as an efficient form of pricing, whereas the underwriter during a book-building process reduces information asymmetry and weakens the winners curse. This theoretical viewpoint origins from the work of researchers such as Benveniste & Spindt (1989), Benveniste & Wilhelm (1990), Spatt & Srivastava (1991), where they generally agree that the book-building mechanism efficiently dominates the fixed-price method. This research has later been supported by studies of Benveniste & Busaba (1997) and Biais & Faugeron-Crouzet (2002).

H_0: Norwegian IPOs that have been priced using a book-building pricing mechanism are on average equally underpriced compared to IPOs that have been priced using a fixed price.

H_A: Norwegian IPOs that have been priced using a book-building pricing mechanism are on average less underpriced than IPOs that have been priced using a fixed-price.

4.3. Hypothesis 3:

Ljungqvist et al., (2003) have found empirical support that European fixed-price offerings are less underpriced than book-built IPOs (Norwegian IPO excluded). Their research is also supported by Busaba & Chang (2010), which argue that, on average, a fixed-price pricing mechanism produces higher expected proceeds unless the underwriter can target its book-building activity to a small subset of informed investors.

H_0: Norwegian IPOs that have been priced using a fixed-price are on average equally underpriced compared to IPOs that have been priced using a book-building mechanism.

H_A: Norwegian IPOs that have been priced using a fixed-price are on average less underpriced than IPOs that have been priced using a book-building mechanism.

4.4. Hypothesis 4:

To measure efficient and accurate pricing, we take not only the levels of underpricing into account, but also the variability. As Derrien & Womack (2003) argue, aftermarket price variation is a major concern for the underwriters, especially the potential downside. Busaba & Chang (1997) also argue that book-building pricing mechanism is associated with greater aftermarket uncertainty. We therefore formulate the following two competing hypotheses.

H_0: On average, Norwegian IPOs that have been priced using a book-building pricing mechanism have equal variability of underpricing compared to IPOs that have been priced using a fixed-price.

H_A: On average, Norwegian IPOs that have been priced using a book-building pricing mechanism have lower variability of underpricing than IPOs that have been priced using fixed-price.

4.5. Hypothesis 5:

H_0: On average, Norwegian IPOs that have been priced using a fixed-price pricing mechanism have equal variability of underpricing compared to IPOs that have been priced using book-building.

H_A: On average, Norwegian IPOs that have been priced using a fixed-price have lower variability of underpricing than IPOs that have been priced using a book-building mechanism.

4.6. Hypothesis 6:

Derrien & Womack (2003) also argue that fixed-price and book-built IPOs react differently to recent market conditions. We therefore formulate the last two hypotheses concerning the differential impact of the market conditions.

H_0: Norwegian IPOs that have been priced using a book-building pricing mechanism are on average equally sensitive to market conditions than IPOs that have been priced using a fixed price

H_A: Norwegian IPOs that have been priced using a book-building pricing mechanism are on average more sensitive to market conditions than IPOs that have been priced using a fixed-price.

4.7. Hypothesis 7:

H_0: Norwegian IPOs that have been priced using a fixed-price are on average equally sensitive to market conditions compared to IPOs that have been priced using a book-building mechanism.

H_A: Norwegian IPOs that have been priced using a fixed-price are on average more sensitive to market conditions than IPOs that have been priced using a book-building mechanism.

5. Data

We will in this section explain the structure of the analysis we have performed, state our hypothesis, and explain the different variables that we have included. Further we will describe how the data was selected and the process of limiting and narrowing the data to a represented sample of quality IPO data. This is followed by the regression analysis, which will be the last section in this part.

5.1. Structure

The main research of the thesis is to determine which of the two pricing mechanisms, book-building and fixed-price, is the most efficient. To analyze our and to be able to distinguish between the level of underpricing of book-building and fixed-price, we have developed several hypotheses which will be presented first in this section. The necessary data is collected, and used as variables when testing our hypothesis through regression analysis. Our data will be optimized and adjusted for different reasons, and the regression will be calculated by regressing the depended variable upon all the independent variable. After controlling our regression for several econometric problems, the relationship between the underpricing and our explanatory variable will reveal the significance of the analysis and the difference between book-building and fixed-price mechanism.

5.2. Data

Our dataset contains 125 IPOs from the OSE. When we first started collecting data, we used Reuters DataStream because we believed it would provide us with quality data and enough information to start with the analysis. But after going through the dataset, we discover several problems with it. The problems ranging from wrong offer price to wrong pricing mechanism. We then agree to not trust the dataset provided by DataStream, and started to look after other opportunities. After some research, we decided to collect the data by our self, instead of finding a complete dataset. This become more time consuming than we first thought, and we will explain our data selection process below and our exclusion of IPOs in the following section.

5.2.1. Data Selection Process

We first had to determine our sample range, where we aimed to get a range between 10-20 years, and we ended up with 17 years in total. Our main problem with the data was to get enough data, as the Norwegian Stock market has its limitation regarding IPOs, and can be classified as a trivial market. The collection of old data was also challenging. Many company that were listed on the exchange in the 1990´s, had either got bankrupted, merge or got acquired by other companies. This made the data collection difficult as we needed a sample with enough data to do an appropriate research. However, we managed to obtain a complete list from the website to Oslo Stock Exchanges. We then had to work through each of the IPOs, collecting all the information from each respective prospector, such as offer price, total proceeds, pricing techniques, issue date etc. Further, we used Bloomberg's terminal to collect first day closing price, book to market value, industries and market capitalization. In addition, we had to visit every company's website to collect age of the company´s.

We started with a list of 314 public offerings on the OSE from 2000 until May 2017. This includes public offerings on all exchanges available in Norway. Out of the 314 IPOs, we ended up with 125 IPOs, where the rest was cut due to not meeting our requirements or the lack of data. The entire elimination of 189 IPOs may sound like a high number of elimination, and we will explain why these were excluded in the next section.

5.2.2. Excluded Data

Table 1: complete dataset

	Numbers of issue
Initial dataset	314
Excluding of Oslo Axess	78
Excluding of Merkur Market	14
Excluding of transferred IPO´s	14
Excluding of missing data, bankrupt or merger	83
Complete dataset	**125**

When we finally had a dataset, we started with the process of excluding companies that were not representative for our purpose. One of the first thing we did was to exclude companies listed on Oslo Axess and Merkur, leaving our dataset only with

IPOs strictly from OSE. The main reasons are that these marketplaces have less requirements than the OSE, accepts smaller companies, and are therefore less liquid. Smaller companies who do not meet the requirements for listing on OSE often seek for listing on Axess and Merkur. By excluding these markets, we limited our sample from 314 companies down to 222.

As companies listed on Axess and Merkur grow, they often need more capital. In such expansion, they seek for a transferred over to OSE. But as companies already are listed, their equity is traded at a marked value. We have therefore excluded firms who transferred from Axess or Merkur to OSE. The number of observation left is down to 208.

The last removal of 83 observation is due to missing data and company carves-out. Companies who did go public a long time ago, which either has gone bankrupt or merge with another company, leaves it hard to find the necessary information we need. However, finding the prospectus was not a big issue, but first day closing price and book value at the issue date was not available. Similar, we did not include companies that already were listed on the exchange and did a carve-out or a spin-off, because the assets already were traded at a market price. After working with the dataset and the excluding part, our dataset consists of 125 IPOs from 2000 until June 2017.

5.3. Dependent Variables

The dependent variable is the variable being tested in a research, where the dependent variable respond to the independent variable. As the independent variable "depend" on the explanatory variables, the regression analysis will provide us with the relationship between the dependent variable and the explanatory variables.

5.3.1. Level of Underpricing

As one of our goals is to measure which pricing mechanisms provide less underpricing, we choose the level of underpricing as the first dependent variable. We measure this as the difference between the offer price and the first day closing price. We decided to use first day return as our measurement of the level of underpricing because it capture the first day reaction and movement in the market. This allows us to obtain the level of underpricing without making several

adjustments, as longer intervals may be affected by news or other activities that is related to general market movements, not the IPO itself. Those activities might be impossible to adjust for to obtain the actual IPO return.

5.3.2. Unconditional Variance of Underpricing

The unconditional variance of underpricing is the variance *without* controlling for firm-, issue- and market conditions. The unconditional variance of underpricing is calculated as the squared deviation from the mean.

5.3.3. Conditional Variance of Underpricing

The conditional variance is the variance *after* controlling for firm-, issue- and market conditions, leaving us with the variance caused only by the pricing mechanism. This is measured by the squared residuals from the regression analysis.

5.4. Independent Variables

An independent variable is a factor that influence another associated factor, which is the dependent variable. In our research, where the dependent variable is underpricing, variables that is connected to the level of underpricing plays the role of independent variables.

When deciding which explanatory variables to use, we first studied previous research to find relevant variables. Next, we decided which variable to include, and then divided them into company-, issue- and market specific variables. Company specific variables are linked directly to the company, such as market capitalization, age of the firm, industries etc. Issue-specific variables are outside factors such as underwriter, trading volume, etc. Market specific variables are variables related to the general market and include hot/cold market and the level and variability of the OSEBX. Previous studies suggested that these kind of characteristics is found to have a significant influence on the first day return, hence, an impact on the underpricing (Kaneko & Pettway 2003). Another study done by Derrien & Womack (2003) argued that previous market condition is found to have an impact on the initial underpricing, such as hot or cold markets.

5.4.1. Company Specific Variables

Market capitalization, which is the market value of equity, is simply calculated as total numbers of shares outstanding times the price per share. As market capitalization change constantly with the fluctuation in the share price, our representation of market capitalization is based on the offer price. Theories states that there is a negative relationship between market capitalization and the underpricing. When a large corporation is planning an IPO, and the size of the IPO becomes large, it draws attention and get better and more analyst coverage by investment bankers, increased media exposure, etc. This leads to less uncertainty, and therefore reduces the asymmetric information. In contrast, smaller company, who does not get that much attention, suffers from more asymmetric information (Brav & Gompers, 2000). Because of large positive skewness, we have used the natural logarithm of market capitalization to better the distribution characteristics. Further, we have divided market capitalization into 3 different categories; small, medium and big. Since this is an approximation, we contacted a Norwegian investment bank to get some information concerning what to consider as small, medium and big. After consulting with a corporate finance advisor in the Swedish investment bank SEB, we got the following division: small companies from zero to 1 billion kroner, medium from 1 billion to 5 billion kroner, and big above 5 billion kroner.

Book-to-market ratio (BTM), is the relationship between book value of equity and the market value of equity, and are calculated as book value per share divided by offer price per share.

The *age* of the company is defined as the number of years from the establishing of the company to the year of the IPO. As a company gets older, the company is building up historic data and reputation, which in terms reduces the uncertainty of the firm. Conversely, a newly founded company with no history or reputation faces more uncertainty. The relationship between age and underpricing should therefore be negative, as firms with higher age and with more history should be less underpriced than firms with lower age who faces more uncertainty.

High-Tech. Due to limitation of our dataset, we decided to not include all different industries, but only the high-tech industry, which includes firms who operate within the IT and telecommunication sector. We have created a dummy variable, where high-tech firms get the value 1, and all other firms gets the value 0. We believe that firms in the high-tech industries suffer from higher degree of

asymmetric information because of higher uncertainty related to valuation problems. In the 1990-2000, before the dotcom bubble stroke the financial market, the high-tech industry where priced at unsustainable levels, which resulted in a large peek in high-tech IPO´s with extreme first day returns, much higher than historical average for all industries (Ljungqvist & Wilhelm, Jr, 2003).

5.4.2. Issue Specific Variables

Underwriters reputation is about how large or well-established the underwriter are. The factor is calculated as total proceeds provided by the lead underwriter, followed by a rank of all underwriters. We have decided to create a dummy variable, where we define the top underwriters as the underwriters that have 10 percent market share or more. By doing this, we obtain an overview over the top underwriters in the business, and can test if this has any influence on the IPO underpricing. We believe that the factor has a negative relationship with the underpricing, and the reason is that the top underwriter should be better and more experienced than smaller and less experienced underwriters. Also, top underwriters often have more resources than smaller underwriters, and should therefore provide less underpricing.

Proceeds of the IPO also matters for the underpricing, and we have calculated the size as gross proceeds provided by the IPO, which is calculated as the final offer price multiply with the number of shares outstanding. We expected the relationship between proceeds and the underpricing to be inverse, as higher proceeds requires a greater cover by the underwriters, and therefore less uncertainty prior to the IPO (Ibbotson et al. 1994). Due to distribution characteristics, we have used the natural logarithm of the proceeds. Further, as we did with market capitalization, we have divided proceeds into the same categories; small, medium and big. The respective values for proceeds are as follow: small proceeds from zero to 150 million kroner, medium from 150 million kroner to 1,5 billion kroner, and big is greater than 1,5 billion kroner.

5.4.3. Market Specific Variables

We utilize hot/cold markets as a market specific variable. When a company go public, the market and the state of the world economy can interfere. When we say that a company is doing a public offering in a hot market, it means that the company who is listing their shares, is doing so in a period of several IPOs.

Opposite, when a company is listing their shares in a period of few IPOs, the market is said to be cold. As mention earlier, Derrien & Womack (2003) argued that hot and cold markets influence the exact IPO at that time and therefore have an impact on the degree of underpricing. However, when the market is cold, the underpricing is expected to be more subdued. As there are no set definition of the time span considering hot/cold markets, we created our own model to determine the hotness of the market. We used a 6-month time window, and the maximum number of IPOs within a single window in our dataset is 23. From our model, we decided that to be considered a hot IPO, there would have to be at least 10 IPOs in the same 6-month window. This got us a total of 50 hot IPOs, making 41,6 percent of the IPOs hot.

5.5. Calculation of Underpricing

To measure the level of underpricing, we use the initial return on the IPO stock, where the initial return will be the first days buy and hold gain of the stock. The stock will generate a positive initial return if the stock's closing price is higher than the offer IPO price, and, naturally, a negative gain if the closing price is lower than the offer price. A positive initial return will indicate that the stock was priced below its true market value, hence it was underpriced, while a negative initial return will indicate that the stock was overpriced. When we calculate the initial return, we differentiate between simple return and market adjusted return, where we will utilize both in our analysis.

5.5.1. Simple Initial Return

We calculate the simple initial return as the difference between the first day closing price and the offer price, divided by the offer price.

$$R_i = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

where

R_i = Initial return of stock i

$P_{i,t}$ = Closing price of stock i on the first trading day

$P_{i,t-1}$ = Offer price of stock i on the first trading day

Different studies use different time intervals to measure the underpricing, but as time has progressed and modern technology has made it easier to observe the prices

more frequent, first day closing price has made the general standard for measuring underpricing. This is also in line with Eckbo (2008), who argue that in a well-developed capital market without fluctuation restrictions on the stock prices, all information necessary to decide the full extent of the underpricing should be reflected in the stock price by the closing price on the first day of trading.

The simple return is supposed to capture the movement in the stock price on the first day of trading, but in our case this measure might be biased. As the offer price is often set several days before the actual IPO, the movements in the stock price on the first day of trading might be influenced by market movements in the days prior to the IPO. However, as many academics, such as Lowry & Schwert (2001), Ljungqvist & Wilhelm and Derrien & Womack (2003), we choose to ignore this fact, claiming that it is of marginal importance to our results.

5.5.2. Market Adjusted Return

As previously mentioned, the underpricing we are interested in measuring is the difference between how the market values the stock and the price set by the underwriter. As there might be general market movements that influences this measure, we need to adjust for the market return. We utilize the method of Logue (1973), where we adjust the simple initial return by subtracting the return of the OSEBX in the same period.

$$\alpha_i = R_i - R_m = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} - \frac{OSEBX_{i,t} - OSEBX_{i,t-1}}{OSEBX_{i,t-1}}$$

where

α_I = Abnormal initial return of stock i

R_m = Return on the market index

$OSEBX_{i,t}$ = OSEBX closing value on the first day of trading stock i

$OSEBX_{i,t-1}$ = OSEBX value on the last day of the offer period of stock i

This method of measuring underpricing corrects for market movements during the initial return period by subtracting the return of the OSEBX in the same period, where the OSEBX serves as a proxy for the market return. Selecting the right proxy is essential regarding the calculation of the degree of underpricing (Hunger. 2012). The selected proxy should reflect an alternative investment which has similar

characteristics regarding risk as the IPO. We chose the OSEBX as a proxy for the market return as it is the main index on Oslo Stock Exchange, where it contains a representative selection of all stocks listed on Oslo Stock Exchange – a selection we feel correspond to our sample of IPOs regarding sector and risk characteristics.

The chosen market index should reflect an alternative investment with the same risk as the IPO. For that reason, it would be natural to properly risk adjust the index to match the risk of the IPO. The most common way to do this, is to adjust the return on the market with the beta (measure of systematic risk) of each stock. Naturally, as the IPO stocks have not been publicly traded prior to the IPO, we do not have any historical stock prices from which we can calculate the stocks beta. An alternative way of measuring the stocks systematic risk is looking at the beta of comparable companies, but this way is neither optimal as newly issued companies might have specific properties affecting the beta values. Choosing to use a measure for the beta will very likely have a biased impact on our test results. Instead, in line with common practice of underpricing academics, we choose to assume a beta equal to one, taking us back to the calculation of the adjusted market return as Logue (1973).

When examining the initial underpricing and differences in level and variability, we use raw first day return. We do this to get a picture of the qualities of the underpricing, without being affected by any external factors. However, in our regression analysis, we will utilize market adjusted return as we feel this is the appropriate measure to use.

5.6. Initial Underpricing

To test whether there exists statistical significant underpricing in our sample, we run a paired t-test to determine whether the mean difference between the offer price and the first day closing price is zero. As we are interested in the underpricing (i.e. that the mean of the first day closing price are higher than the offer price), we compare the t-statistics against the one-sided critical value, where we reject the null hypothesis of zero difference in the mean if the t-statistic exceeds the critical value.

As the t-test builds on the assumption that the dependent variable is approximately normally distributed within each group, we perform a Shapiro-Wilks test of normality on the observations of the first day closing price. If we end up rejecting the null hypothesis of normality, we will run a Wilcoxon Signed-Rank

test. The Wilcoxon Signed-Rank test is a non-parametric statistical hypothesis test which is used as an alternative to the paired t-test when the population cannot be assumed to be normally distributed. The null hypothesis of the Wilcoxon Signed-Rank test states that the difference between the pairs follows a symmetric distribution around zero. The tests outlined above will be performed on the sub-samples of book-built and fixed-price IPOs, as well as the total combined sample of IPOs.

5.7. Subsample Differences

To test whether the level of underpricing differs between the sub-samples of book-building and fixed-price, we perform the chi-squared Mood's Median Test. Mood's test is a special case of Pearson's chi-squared test, which is a non-parametric test that tests the null hypothesis that the medians of the populations from which two or more samples are drawn are identical. If we find support to reject the null, we can state that there is difference between the medians of book-building and fixed-price IPOs.

We also test to see if there are difference in the variances between the sub-samples of book-building and fixed-price. To do this, we use Levene's Test, which is an inferential statistic used to assess the equality of variances for a variable calculated for two or more groups (Levene, 1960). The tested null hypothesis is that the population variances are equal, and if we find support to reject this null, we can infer that the two pricing mechanisms are not equally precise in their pricing.

5.8. Cross-Sectional Differences

After having conducted the initial test whether we have a case of underpricing and whether there are differences between the underpricing of book-built and fixed-price IPOs, we want to find out what characteristics and properties of the IPO that affects the underpricing. In this stage, we keep the subsamples of book-building and fixed-price IPOs separated, where we split the subsamples into subgroups based on different criteria. For each pre-defined criterion, we first perform a F-test of equality in the variance, where the null hypothesis is equality in the variance between the two samples. Then, based on the prior F-test, we conduct a T-test assuming equal or unequal variance, to determine if there are differences in the means of underpricing.

We have chosen nine criteria which we believe could have an impact on the underpricing, and these are market capitalization (above or below median), book-to-market ratio (above or below median), age (above or below median), issue size (above or below median), market return prior to the IPO (above or below median), market volatility prior to the IPO (above or below median), high-tech (high-tech or non-high-tech), underwriter rank (top 4 or non-top 4) and hot market (hot or cold market).

5.9. Multivariate Regression Analysis

In this stage of our analysis, we will run several multivariate regressions, where we will use first day market adjusted return and the unconditional variance as dependent variables. First, we will use several independent variables which we believe will have explanatory value to the return and volatility of the underpricing. From these results, we may be able to identify which variables affect the underpricing and how the underpricing of the difference pricing mechanisms respond to each variable. The first two regressions will be regressed on each subsample, and they will be:

$$\begin{aligned} &First\ day\ market\ adjusted\ return \\ &= \beta_0 + \beta_1 MCAP_i + \beta_2 BTM_i + \beta_3 Age_i + \beta_4 Hightech_i + \beta_5 Reputation_i \\ &\quad + \beta_6 Proceeds_i + \beta_7 HOT_i + \beta_8 Osebx\_Return_i \\ &\quad + \beta_9 Osebx\_Volatility_i + \varepsilon_i \end{aligned}$$

$$\begin{aligned} &Unconditional\ variance \\ &= \beta_0 + \beta_1 MCAP_i + \beta_2 BTM_i + \beta_3 Age_i + \beta_4 Hightech_i + \beta_5 Reputation_i \\ &\quad + \beta_6 Proceeds_i + \beta_7 HOT_i + \beta_8 Osebx\_Return_i \\ &\quad + \beta_9 Osebx\_Volatility_i + \varepsilon_i \end{aligned}$$

In addition to make inferences about which variables have explanatory power over the underpricing, we will also look closer into the residuals of the first regression. As the residuals are the difference between the observed value and the estimated value of the regression, we will use the squared residuals as a measure of conditional variance, in other words, the variance of the underpricing after controlling for the effects caused by the different variables. After saving and

squaring the residuals, we will use Mood´s Median Test and Levene's Test (as described above) to see if there are differences in the unconditional variance between the pricing mechanisms.

In the section of subsample differences, we have examined the underpricing unconditionally, where we did not control for the external factors. However, in the next regressions, we will examine the level and variability of the underpricing *after* controlling for the external factors. We will run regressions on the full sample of IPOs, where we will use a dummy variable approach. The regressions will be equal to the previous regressions regressed on the subsample, only they will include an additional dummy variable indicating which pricing mechanism has been used. We will include only one dummy variable at a time to avoid multicollinearity, where we will run each regression twice (one with a book-building dummy and one with a fixed-price dummy). The regressions will be as followed:

$$
\begin{aligned}
&First\ day\ market\ adjusted\ return \\
&= \beta_0 + \beta_1 MCAP_i + \beta_2 BTM_i + \beta_3 Age_i + \beta_4 Hightech_i + \beta_5 Reputation_i \\
&\quad + \beta_6 Proceeds_i + \beta_7 HOT_i + \beta_8 Osebx\_Return_i \\
&\quad + \beta_9 Osebx\_Volatility_i + \beta_{10} Pricing\_Mechanism\_Dummy_i \\
&\quad + \varepsilon_i
\end{aligned}
$$

$$
\begin{aligned}
&Unconditional\ variance \\
&= \beta_0 + \beta_1 MCAP_i + \beta_2 BTM_i + \beta_3 Age_i + \beta_4 Hightech_i + \beta_5 Reputation_i \\
&\quad + \beta_6 Proceeds_i + \beta_7 HOT_i + \beta_8 Osebx\_Return_i \\
&\quad + \beta_9 Osebx\_Volatility_i + \beta_{10} Pricing\_Mechanism\_Dummy_i \\
&\quad + \varepsilon_i
\end{aligned}
$$

5.10. Reliability of the Multivariate Regression Analysis

In the main part of our analysis, we perform multivariate regression analysis, using an ordinary least squares (OLS) procedure. For this procedure to be reliable, there are certain assumptions that must be met. To test if these assumptions hold, we perform a set of tests, which we will briefly outline here.

To identify the presence of potential heteroscedasticity, we perform White´s test of heteroscedasticity, which is a statistical test that establishes whether the variance of the errors in a regression model is constant. In the presence of

heteroscedasticity, we correct the standard errors using White´s algorithm. This will make the hypothesis testing more conservative, where the rejection of the null hypothesis is stricter. In published articles and research papers, we have noticed that there has been more and more common to report heteroscedasticity-consistent t-statistics and standard errors. Throughout the paper, we will therefor report heteroscedasticity-consistent t-statistics.

Autocorrelation is a problem that is not relevant to our testing, as our data is cross-sectional data without any time component. Hence, we do not perform any testing of this matter.

We also examine bivariate correlation between the independent variables to detect if there exist multicollinearity issues. The correlation matrix reveal that there exists a high correlation between issue size and market capitalization (0,85), which was expected from looking at the distribution features. In the early stage of our regression analysis, we tried altering our variables in different settings to reduce this problem. We tried different approaches, where we used the original monetary value and the logarithmic value. We also tried dividing the issue size and market capitalization in brackets with respect to size; small, medium and big. None of these approaches helped decrease the problem, and we chose to go with the logarithmic value. However, as the theory are divided in which variables that have explanatory power over the first day return, we chose not to exclude any of the variables, to avoid the omitted variable bias.

Finally, we assess the distribution of the residuals, to see if they are approximately normally distributed. To do this, we run the Jarqe-Bera test for normality. Despite having applied logarithmic transformation to several of the variables to deal with positive skewness, we still reject the null hypothesis of normality with all our regressions. Other data mining techniques will only artificially improve the fit of the model. We therefore proceed with our analysis despite this fact, knowing that non-strict normality of the residuals might influence the regression estimates.

6. Analysis and Result

In this section, we will present the results of our analysis, as well as relate this to theory and previous studies. First, we examine the descriptive statistics and determine whether there exists fundamental underpricing in our dataset. Secondly, we test if there are significant differences in the mean level and variance of underpricing between book-building and fixed-price. Thirdly, we divide the subsamples of book-building and fixed-price IPOs into different categories, where we see if there are cross-sectional differences within the groups. In the end of the analysis, we run several multivariate regressions. Firstly, we find out which variables explain the first day return and variance of the two subsamples, and, thus, if there are differences in explanatory variables between the two. Secondly, we examine the conditional variance, where we compare the squared residuals of the regressions. Finally, we run a regression on the full sample, with a dummy variable approach, to see in there are subsample differences after controlling for various external factors.

6.1. Descriptive Statistics

From our full sample of book-building and fixed-price combined, we get an average simple initial return of 4,19 percent, while the market adjusted return is only 0,02 percent lower with its 4,17 percent. Full descriptive statistics are outlined in table 2.

Table 2: Descriptive statistics

Descriptive Statistics	Raw IPO Underpricing	Adjusted IPO Underpricing
Observaions	125	125
Mean	4,19 %	4,17 %
Median	2,49 %	1,69 %
Variance	0,0070	0,0071
Standard deviation	0,0838	0,0843
Max	47,58 %	47,07 %
Min	-16,35 %	-16,92 %
Skewness	1,89	1,77
Kurtosis	6,582	5,876

The output from the table confirms our expectation that the difference between the simple raw underpricing and the market adjusted underpricing is negligible. While both the mean and the variance only are marginally different, we notice that the

median of the raw underpricing is 0,8 percent higher than the adjusted underpricing. We also see from the skewness and the kurtosis that the distribution of the two measures are not equal. This is probably caused by the market return, where some of the IPOs have experienced a large gain (loss) despite the negative (positive) market return. Intuitively, this fact contradicts our belief that the IPOs perform well in well performing markets. However, this fact will be tested more appropriately in our regression model later.

Figure 5: Raw IPO underpricing

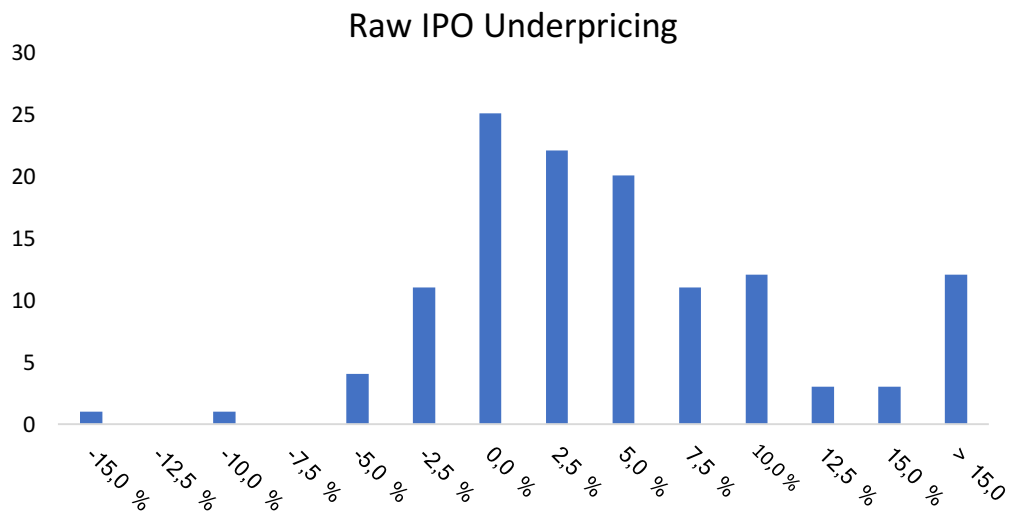


Figure 5 shows the distribution of the raw IPO underpricing, where we clearly can see that there is positive skewness. Looking closer into the numbers, we only have two IPOs showing an overpricing of 7,5 percent or more, while we have 41 IPOs showing an underpricing of 7,5 percent or more, with 12 of them showing more than 15 percent. As we saw from table 2, we have excess kurtosis, which characterizes our distribution as leptokurtic. The kurtosis of our distribution is 3,58 higher than the mesokurtic normal distribution, which has a kurtosis of 3. Based on these observations, we are pessimistic concerning the fact that our sample follows a normal distribution. However, we will test this more formally later.

6.2. Initial Underpricing

From the paired t-test, we find that our initial raw underpricing of 4,19 percent for the full sample is statistically significant on a 1 percent level. As described in the methodology, the t-test assumes normality in the sample, and we will therefore test

this formally with the Shapiro-Wilks test. As expected, the Shapiro-Wilks test rejects the null of normality in all conventional significance levels. However, as explained by the central limit theorem, means of samples from a population approach a normal distribution when the sample size increases (Gujarati & Porter, 2009). As the t-test does not make assumptions about the *population* being normally distributed, non-normality can be ignored if the sample size is big enough. Our total sample size of 125 should be more than enough to fulfil the criteria of a "big enough" sample. However, this may be an issue when testing the subsample of fixed-price IPOs, which only contains 32 observations. In any case, to confirm our results, we also conducted a Wilcoxon Signed Rank test, a test that does not rely on the assumption of normality (Israel, 2009). This test also reject the null on all levels of significance, that the difference between the offer price and the closing price follows a symmetric distribution around zero. We can thereby safely state that the underpricing in our sample is significantly proved.

6.3. Subsample Differences

Table 3: Subsample differences

Descriptive Statistics, First Day Return	Book-Building	Fixed Price
Observaions	93	32
Mean	4,29 %	3,90 %
t-stat	4,25	2,58
Median	2,56 %	2,42 %
Variance	0,0065	0,0086
Standard deviation	0,0804	0,0929
Max	47,58 %	35,07 %
Min	-10,54 %	-16,35 %
Skewness	2,16	1,45
Kurtosis	8,42	3,96

Table 3 shows the descriptive statistics of the two separate samples of book-building and fixed-price IPOs, both presenting significant underpricing on a 1 percent level, with 4,25 and 3,9 percent, respectively. As for the full set, both subsamples reject the null of normality when running the Sharpio-Wilks, and the underpricing of both subsets are statistically confirmed by the Wilcoxon Signed Rank test. We notice that the book-built IPOs have a slightly higher mean underpricing than the fixed-price, while the variance are slightly lower. The lower variance would be in line with Benveniste & Spindt (1989) and Benveniste &

Wilhelm (1990), where the role of the underwriter is to mitigate the information asymmetry, making it easier to price more accurately.

Looking at the overall descriptive statistics of the two methods, we suspect that there will be no significant difference in the mean/median nor the variance of the two. To formally test this, we did a chi-squared Mood's Median Test and a Levene's Test of equality in variance. For neither of these two test we found enough support to reject the null of equality in the variance or mean, hence we cannot formally state that book-built and fixed-price IPOs produce different levels of underpricing, nor different levels of variance in the underpricing. This is a major finding in our study, which contradicts previous study that there are differences in the quality of the pricing mechanisms.

6.4. Cross-Sectional Differences

In this section, we analyze the cross-sectional differences within the subsamples of book-building and fixed-price IPOs. We have divided the subsamples into different categories, where we aim to see if there are statistically differences within each category. To statistically test the significance of our findings, we first performed a F-test of equality in variance

6.4.1. Book-Building IPOs

Table 4: Book-building IPOs.

	N	Mean first-day return	Variance of first-day return
Market capitalization >= Median	47	0,0385	0,0051
Market capitalization < Median	46	0,0460	0,0082
P-Value		0,659	**0,051***
High-Tech	14	0,0550	0,0080
Non High-Tech	79	0,0400	0,0064
P-Value		0,527	0,267
Book-to-Market Ratio >= Median	47	0,0379	0,0050
Book-to-Market Ratio < Median	46	0,0467	0,0084
P-Value		0,606	**0,040****
Age >= Median	52	0,0345	0,0049
Age < Median	41	0,0521	0,0088
P-Value		0,318	**0,025****
Underwriter rank >= Top 4	46	0,0368	0,0049
Underwriter rank < Top 4	47	0,0476	0,0083
P-Value		0,523	**0,042****
Issue Size >= Median	47	0,0424	0,0081
Issue Size < Median	46	0,0421	0,0052
P-Value		0,983	**0,068***
Market Return Prior to IPO >= Median	47	0,0545	0,0068
Market Return Prior to IPO < Median	46	0,0297	0,0062
P-Value		0,14	0,382
Market Volatility Prior to IPO >= Median	47	0,0410	0,0047
Market Volatility Prior to IPO < Median	46	0,0435	0,0087
P-Value		0,883	**0,019****
Hot Market	42	0,0459	0,0061
Cold Market	51	0,0392	0,0072
P-Value		0,696	0,293

*, **, *** indicate significance at 10 percent, 5 percent and 1 percent level, respectively.

From table 4, we see that there are no differences in the means of any of the categories. This suggest that the underpricing of book-built IPOs on average are equally underpriced regardless of the defined sub-categories.

When dividing the book-built IPOs into above or below median market capitalization, we find that the variance of the below-median IPOs is significantly higher (at a 10 percent level) than the above-median IPOs. This is in line with the theory that states that the big firms get more coverage and attention than what the small firms does, which leads to a mitigation of the information asymmetry and more accurate pricing.

Book-built IPOs with below-median BTM ratio have significantly higher (at a 5 percent level) variance than the IPOs with above-median BTM ratio. This is in line with the theory stating that lower BTM is associated with higher information

asymmetry (Brav & Gompers, 2000), and in line with the findings of Brav & Gompers (2000).

The IPOs with above-median age have on average lower variance (significant on a 5 percent level) than the below-median IPOs. This is in line with the work of Beatty & Ritter (1986), which suggest that older companies are considered less ex-ante uncertain.

If one of the top four underwriters has been the lead underwriter of the IPO, the variance, on average, are significantly lower (on a 5 percent level) than if one of the top four underwriters was not the lead underwriter. As Carter, Dark & Sing (1998) argue, an underwriter's reputation provides a credible ex-ante uncertainty signal to new investors about the quality of the issue and its embedded risk. Our finding, of lower variance of the top four underwriters, supports this claim.

Contrary to the research of Beatty & Ritter (1986) and Ibbotson (et al., 1994) which finds that the issue size should have an inverse relationship with information asymmetry, we find the opposite. Our findings show that the above-median sized IPOs have a significant (on a 10 percent level) larger variance then the below-median IPOs. One possible reason for this is that lager and more complex firms can be more complicated to value, thus have lager variance, than the smaller firms.

Another contradicting result in our analysis, compared to theory, is the significant (on a 5 percent level) lower variance of the above-median market volatility IPOs. Ritter (1984), Ibbotson (et al. 1994) and Beneveniste, Ljungqvist, Wilhelm & Yu (2003) that the underpricing is affected by the market conditions prior to the IPO. However, we had expected it to be positively correlated, where more stable markets would lead to more stable IPO pricing. A possible explanation for this is that the market could be more passive towards new public offerings in volatile and uncertain times, where the IPO could experience less demand.

6.4.2. Fixed-Price IPOs

Table 5: Fixed-price IPOs.

	N	Mean first-day return	Variance of first-day return
Market capitalization >= Median	16	0,0335	0,0042
Market capitalization < Median	16	0,0474	0,0152
P-Value		0,698	**0,008*** **
High-Tech	2	0,0252	0,0010
Non High-Tech	30	0,0410	0,0096
P-Value		0,825	0,245
Book to market ratio >= Median	16	0,0624	0,0085
Book to market ratio < Median	16	0,0177	0,0092
P-Value		0,188	0,439
Age >= Median	16	0,0200	0,0087
Age < Median	16	0,0601	0,0091
P-Value		0,239	**0,009*** **
Underwriters rank >= 4	14	0,0434	0,0105
Underwriters rank < 4	18	0,0375	0,0084
P-Value		0,865	0,327
Issue size >= Median	16	0,0224	0,0039
Issue size < Median	16	0,0585	0,0143
P-Value		0,296	**0,009*** **
Market Return Prior to IPO >= Median	16	0,0443	0,0123
Market Return Prior to IPO < Median	16	0,0358	0,0063
P-Value		0,804	0,105
Market Volatility Prior to IPO >= Median	16	0,0319	0,0066
Market Volatility Prior to IPO < Median	16	0,0482	0,0120
P-Value		0,637	0,127
Hot market	8	0,0543	0,0143
Cold Market	24	0,0353	0,0078
P-Value		0,632	0,129

*, **, *** indicate significance at 10 percent, 5 percent and 1 percent level, respectively.

As with book-built IPOs, we neither find any significant differences in the means of the different sub-categories of fixed-priced IPOs. However, as we did with the book-built IPOs, we do find some significant results regarding the variance of the sub-categories.

As with the book-built IPOs, we also here find that the above-median market capitalization IPOs have lower variance than the below-median market capitalization, and that the above-median aged IPOs have lower variance than the below-median aged IPOs. Both these findings are significant on a 1 percent level.

Also, as for book-built IPOs, IPOs with above-median age have on average lower variance (significant on a 1 percent level) than the below-median IPOs. This is in line with the work of Beatty and Ritter (1986), which suggest that older companies are considered less ex-ante uncertain.

Contrary to what we found with the book-built IPOs, the above-median issue sized IPOs display a significant (on a 1 percent level) lower variance than the

below-median IPOs. As described previously, this is in line with common research, contrary to what we found with the book-built IPOs.

6.4.3. Cross-Sectional Summary

After splitting the subsamples into categories based on different criteria, we find significant differences regarding the variance within several of the different categories. Most of these findings are supported by the research of acknowledged academics. However, we also found that for book-built IPOs, the above-median sized IPOs have significant lager variance than the below-median IPOs, while the above-median market volatility IPOs have significant lower variance than the below-median market volatility IPOs. This is not supported by acknowledged theories, but we have tried to find explanations using our own intuition.

6.5. Multivariate Regression Analysis

In this section, we perform our multivariate regression analysis, where we aim to find differences between the two pricing mechanisms *after* controlling for various external effects. Notice that we utilize market adjusted return (not raw initial return) and unconditional variance as dependent variables.

6.5.1. Factors Explaining First Day Return

In this section, we will try to identify which factors influence the first day return of the IPOs, and if there are differences in the explanatory variables concerning which pricing mechanism that has been used. We run a regression on both subsamples separately, with first day return as the dependent variable, where we use the same explanatory variables as before. The result from these two regressions are reported in table 6.

Table 6: Factors explaining first day return in Book-building and Fixed-price.

Dependent variable	Book-building First Day Return	Fixed Price First Day Return
Intercept / Constant	0,0153442 (0,17)	0,0018808 (0,01)
Book-to-Market Ratio	0,0116483 (-0,49)	0,0534084 (0,64)
Ln (Proceeds)	0,000578 (-0,06)	-0,0460688 **(-2,20)****
LN (Market Capitalization)	0,0021367 (-0,22)	0,0463657 **(2,23)****
LN (Age)	-0,009055 (-1,36)	-0,0223681 (-1,61)
Top 4 Rank	-0,0183319 (-1,07)	-0,0214011 (-0,57)
Hot Market Index	-0,0726423 **(-2,11)****	0,042072 (0,48)
Osebx 3mnt Average Return	1,27835 **(-3,38)*****	0,3570907 (0,44)
Osebx Corrected Variance	141,1193 (-1,75)	86,85022 (0,61)
Adjusted R-Squared	**0,152**	**0,2797**
F-Value	-1,65	0,95
P-Value	0,1138	0,5048

White heteroscedasticity-consistent t-statistics are given in parentheses. *, **, *** indicate significance at 10 percent, 5 percent and 1 percent level, respectively.

As we can see from table x, there are in fact different variables that influence the first day return from the two different subsamples. Even though the P-values of the regressions are high (especially concerning fixed-price IPOs), we will try to make some comments on the individual factors that do turn up significant.

Ceteris paribus, book-built IPOs that are timed to hit a hot IPO market are significantly (at a 5 percent level) less underpriced. However, this is not the case with fixed-priced IPOs, where our hot market index proves insignificant. As in Ljungqvist (et al. 2006), investors are overly exuberant in certain periods and drive demand for IPO shares in the aftermarket. Ceteris paribus, firms prefer to go public in these periods because they can set offer prices above fundamental value, exploiting sentiment-driven investors´ over-valuations. Since the excess demand in these periods are driven by the sentiment of investors, our findings may be a result of the demand assessment in the book-building period, where book-built IPOs may manage to exploit this fact better than fixed-price IPOs does.

Other things equal, the three-month weighted average on the OSEBX-index also have a significant (on a 1 percent level) impact on book-built IPOs. Contrary

to a hot IPO market, which reduces the first day return, the first day return increases along with the three-month weighted average return of the OSEBX, where they have a direct, positive relationship. More specifically, if the three-month average increases by 1 percent, the first day return will on average increase by 1,28 percent. Theories of asymmetric information states that in a book-building process, underpricing is a necessity to reduce the winners curse and rewarding investors who reveal their demand for the stock. In periods where the general market preforms well, investors may demand a higher reward for their demand disclosure in form of higher underpricing.

Where the book-built IPOs seem to be influenced by market conditions, the fixed-price IPOs seem to be influenced by issue specific characteristics. Both proceeds and market capitalization have a significant (both on a 5 percent level) impact on the level of first day return on fixed-priced IPOs, but in opposite directions. Whereas an increase (decrease) in market capitalization will have a positive (negative) effect on the first day return, an increase (decrease) in the proceeds will have a negative (positive) effect. These results are a bit surprising, as we found earlier that these two variables are highly positive correlated. We also notice that the effect of the two variables offset each other. As we mentioned earlier, we may have a case of multicollinearity in our dataset. The solution to this would be to remove one or more of the variables, but we choose to ignore this as we believe both variables are important predicators in our regression model.

6.5.2. Factors Explaining the Unconditional Variance of First Day Return

Table 7: Factors explaining the unconditional variance of first day return

Dependent variable	Book-building Unconditional Variance	Fixed Price Unconditional Variance
Intercept / Constant	0,0004129	0,0528456
	(0,02)	**(1,72)***
Book-to-Market Ratio	-0,0004711	-0,0104705
	(-0,07)	(-0,60)
Ln (Proceeds)	0,0028879	-0,0071083
	(1,06)	(-1,61)
LN (Market Capitalization)	-0,0017549	0,003294
	(-0,69)	(0,75)
LN (Age)	-0,0015908	0,0014109
	(-0,91)	(0,48)
Top 4 Rank	-0,0065757	0,0063345
	(-1,47)	(0,81)
Hot Market Index	-0,0121098	0,0164899
	(-1,34)	(0,89)
OSEBX 3mnt Weighted Average Return	0,1568187	-0,0004455
	-1,58	(-0,00)
OSEBX Corrected Variance	16,82226	-21,17018
	(0,79)	(1,72)
Adjusted R-Squared	**0,0772**	**0,1721**
F-Value	0,77	0,92
P-Value	0,6424	0,5278

White heteroscedasticity-consistent t-statistics are given in parentheses. *, **, *** indicate significance at 10 percent, 5 percent and 1 percent level, respectively.

From an analytical point of view, our results from the regression of unconditional variance is rather disappointing. None of the given variables proves significant (except the intercept of fixed-price IPOs, on a 10 percent level) and the p-values of the regressions are very high. We can thereby only conclude that none of the given variables are significantly affecting the variability of the first day return.

6.5.3. Conditional Variance

As earlier described, the residuals are the difference between the observed value and the estimated value of the regression, and we are using this as a measure for the conditional variance. To test for differences in the conditional variance, that is, the variance of the two subsamples *after* controlling for the variance caused by issue - , company – or market effects, we use the residuals from the regressions using market adjusted return as dependent variable.

We have run Mood´s Median Test and Levene's Test, as described earlier, on the squared residuals, to see if there are differences in the level of median and/or variance of the two subsamples of book-building and fixed-price.

With Mood´s Median test, we do not find enough evidence to reject the null hypothesis of identical medians. We can thereby not state that the two different pricing mechanisms produce different levels of conditional variance.

However, this is not the case with Levene's test, where we do in fact find evidence to reject the null of equality in the variance. This result is significant on a 1 percent level, which makes us confident that there are differences in the variation of the conditional variance. Our results show that the conditional variance related to fixed-price IPOs are about twice as high as the conditional variance of book-built IPOs. Hence, this result tells us (other things equal and controlled for external factors) that the book-building mechanism is more precise in its valuation than the fixed-price mechanism.

6.5.4. Pricing Mechanism Dummy-Approach

In this section, we have run the same set of regressions as earlier, but now on the full sample of combined book-building and fixed-price IPOs, in addition to including a pricing mechanism dummy.

Unlike the Levene´s and Mood´s test, where we tested the difference between book-building and fixed-price without controlling for any various external effects, we now test the difference between the two *after* controlling for firm-, issue-, and market effects.

To avoid multicollinearity, we only include one dummy. This dummy takes the value of 1 if it is a book-building IPO and zero otherwise. The results of our regression should not discriminate between which pricing mechanism we choose (book-building or fixed-price), hence the result will be the same for either of the two (we also double-checked this by testing with fixed-price).

Table 8: Pricing mechanism dummy-approach

Dependent variable	First Day Return	Unconditional Variance
Intercept / Constant	-0,0037831	0,0213819
	(-0,05)	(1,17)
Book-to-Market Ratio	0,0121974	-0,002459
	(0,53)	(-0,42)
Ln (Proceeds)	-0,0093747	-0,0010025
	-(1,06)	(-0,45)
LN (Market Capitalization)	0,0128791	0,0000244
	(1,51)	(0,01)
LN (Age)	-0,0083548	-0,0002484
	(-1,44)	(-0,17)
Top 4 Rank	-0,019719	0,0041802
	(-1,21)	(1,02)
Hot Market Index	-0,0588621	-0,0060543
	(-1,85)	(-0,76)
OSEBX 3mnt Weighted Average Return	0,9697853	0,1102462
	(2,9)* **	(1,32)
OSEBX Corrected Variance	117,0199	0,8029122
	(1,78)	(0,05)
Pricing Mechanism Dummy	0,0018361	-0,0016992
(Book-building = 1, Fixed Price = 0)	(0,10)	(-0,37)
Adjusted R-Squared	**0,1208**	**0,0362**
F-Value	1,57	0,43
P-Value	0,1256	0,9301

White heteroscedasticity-consistent t-statistics are given in parentheses. *, **, *** indicate significance at 10 percent, 5 percent and 1 percent level, respectively.

As we can see from table 8, the only variable that turns out significant is the OSEBX three month weighted average return. We see that it has a positive relationship with the first day return, and this result makes us more confident that book-building as a pricing mechanism is better suited to fully incorporate and exploit the general market conditions. Our pricing mechanism dummy turns out highly insignificant, something that is not surprising considering our previous results. This result also confirms our previous findings, that there is no difference in the average level of underpricing, nor the average level of variance between the two pricing mechanism.

7. Conclusion

In our research, we have analyzed and compared the efficiency of initial public offering pricing mechanisms in Norway. As Norwegian IPO´s mainly are priced using a book-building or fixed-price pricing mechanism, we have empirically tested which of these two are more efficient. In our definition of efficient pricing, we look at the pricing mechanism that on average has the lowest level and variance of underpricing, and that best manage to incorporate the recent market conditions in its pricing.

Our research covers a total of 125 initial public offerings on Oslo Stock Exchange in the period from February 2000 to June 2017. Out of these IPOs, 93 were book-built and 32 were fixed-price offerings. Both subsamples of IPOs showed significant initial raw underpricing of 4,29 percent and 3,9 percent, respectively. We can thereby reject our first hypothesis, that Norwegian IPOs have been correctly priced in the given period.

After a thorough and consistent analysis, where we have used a range of different tests and models, we find that the difference in the level of underpricing between the two pricing mechanisms are too small to conclude that one is superior to the other. As already stated, the difference in underpricing between the two pricing mechanisms was only 0,39 percent, and we neither found any support to reject the null in our regression analysis, where the pricing mechanism-dummy proved insignificant. We thereby conclude that we do not possess the evidence to reject the null hypothesis of hypothesis 2 and 3, that the two pricing mechanisms on average are equally underpriced.

In our initial test of the unconditional variance between the two pricing mechanisms, we did not find evidence against the hypothesis that the variance of the two pricing mechanisms are equal. We neither found any evidence for this in our regression of the unconditional variance. However, with the conditional variance, where we controlled for market-, issue- and firm specific effects, we found that the variance was significantly different on a one percent level. This research showed that the conditional variance was twice as high for fixed-price IPOs than for book-built IPOs. As the insignificant initial results could be caused by other factors, we do believe that the result of the conditional variance test provides us with enough evidence to reject the null hypotheses of hypothesis 4 and 5, whereas Norwegian IPOs that have been priced using a book-building pricing

mechanism have lower variability of underpricing than IPOs that have been priced using a fixed-price.

From the regression analysis, we also found that the book-building mechanism better incorporates "hot"-IPO markets, where, other thing equal, book-built IPOs in hot markets underprice less. However, book-built IPOs seem to underprice more when the three-month weighted average on the OSEBX increases. We believe this is caused by the information revealing, where investors demand more compensation in times where their alternative cost is higher. Fixed-price IPOs, however, proves insignificant against the market conditions, where we believe that the two significant results we got from market capitalization and proceeds are biased because of multicollinearity issues and thereby not conclusive. Altogether, we firmly believe we have enough evidence to reject the null of hypothesis 6 and 7, where book-built IPOs on average *are* more sensitive to market conditions than IPOs that have been priced using a fixed-price.

Lastly, in our cross-sectional testing, we found that when dividing the subsamples of book-building and fixed-price into different categories, the subsample of book-building responded more toward established theory than what the subsample of fixed-price did. With book-building, 4 of the categories responds as expected by theory, while 3 of the categories does the same with fixed-price IPOs. We interpret this as a sign that book-built IPOs act more predictably than fixed-price IPOs, which will reduce the ex-ante uncertainty.

All factors considered, we do believe throughout this analysis that we have found support in the claim that book-building is a more efficient pricing mechanism than the fixed-price mechanism, whereas book-building IPOs provides less ex-ante uncertainty and lower levels of variability.

As our research suffer from the lack of observations, we recommend doing the same research on a larger sample size when and if the data is obtainable, to conclude the results with more confidence. Together with this, we also struggle to find any real motivation for firms to choose to go public using fixed-price over book-building, other than lower direct costs. Hence, another suggestion for further research is a formal implementation of direct costs into the models.

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Appendix

T-Test: Paired Two Sample for Means, Full Sample

	Variable 1	*Variable 2*
Mean	43,38428632	41,5124
Variance	1417,95925	1294,91377
Observations	125	125
Pearson Correlation	0,994360571	
Hypothesized Mean Differen	0	
df	124	
t Stat	4,922584117	
P(T<=t) one-tail	1,33114E-06	
t Critical one-tail	2,356796593	
P(T<=t) two-tail	2,66228E-06	
t Critical two-tail	2,616059883	

T-Test: Paired Two Sample for Means, Fixed Price

	Variable 1	*Variable 2*
Mean	49,5584509	47,9465625
Variance	2363,95112	2207,504668
Observations	32	32
Pearson Correlation	0,99785274	
Hypothesized Mean Difference	0	
df	31	
t Stat	2,58024632	
P(T<=t) one-tail	0,00741677	
t Critical one-tail	2,45282419	
P(T<=t) two-tail	0,01483355	
t Critical two-tail	2,74404192	

Shapiro-Wilk Test for Normal Data

Variable	Obs	W	V	z	Prob>z
ipo_return	**125**	**0.85746**	**14.198**	**5.957**	**0.00000**

Wilcoxon Signed-Rank Test

sign	obs	sum ranks	expected
positive	**36**	**1843**	**3927**
negative	**83**	**6011**	**3927**
zero	**6**	**21**	**21**
all	**125**	**7875**	**7875**

unadjusted variance	**164718.75**
adjustment for ties	**-71.00**
adjustment for zeros	**-22.75**
adjusted variance	**164625.00**

Ho: offerprice = closingprice
z = **-5.136**
Prob > |z| = **0.0000**

Levene´s Test: Book-Building vs. Fixed-Price

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	93	5,23663	0,056308	0,003402
Column 2	32	1,640182	0,051256	0,002801

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,000608	1	0,000608	0,186966	0,666211	3,918178
Within Groups	0,399778	123	0,00325			
Total	0,400386	124				

Mood´s Median Test: Book-Building vs. Fixed-Price

N=	125
Position of median:	63
Median:	1,54 %

	Book	Fixed	Sum
Above median	50	12	62
Not above median	43	20	63
Sum	93	32	125

	f0	fe	f0-fe	(f0-fe)^2	(f0-fe)^2/fe
UL	50	46,128	3,872	14,992384	0,325016996
UR	12	15,872	-3,872	14,992384	0,944580645
LL	43	46,872	-3,872	14,992384	0,319857996
LR	20	16,128	3,872	14,992384	0,929587302
Sum	125	125			**2,519042939**

df	1
Test stat	**2,519**
crit value (0,10)	2,706
crit value (0,05)	3,841
crit value (0,01)	6,635

Levenes´s Test: Conditional Variance

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	93	0,22214598	0,00238867	4,3982E-06
Column 2	32	0,12101371	0,00378168	8,6467E-06

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4,6199E-05	1	4,6199E-05	8,44749117	0,0043369	3,91817751
Within Groups	0,00067268	123	5,469E-06			
Total	0,00071888	124				

Mood´s Median Test: Conditional Variance

N=	125
Position of median:	63
Median:	0,15 %

	Book	Fixed	Sum
Above median	45	17	62
Not above median	48	15	63
Sum	93	32	125

	f0	fe	f0-fe	(f0-fe)^2	(f0-fe)^2/fe
UL	45	46,128	-1,128	1,272384	0,02758377
UR	17	15,872	1,128	1,272384	0,08016532
LL	48	46,872	1,128	1,272384	0,02714593
LR	15	16,128	-1,128	1,272384	0,07889286
Sum	125	125			**0,21378788**

df	1
Test stat	**0,214**
crit value (0,10)	2,706
crit value (0,05)	3,841
crit value (0,01)	6,635

Correlation Matrix

	ipo_ma~n	btm	ln_pro~s	ln_age	ln_mcap	dummy_~h	topp4r~k	hotindex	osebxr~t	os~rcorr
ipo_mareturn	1.0000									
btm	0.0493	1.0000								
ln_proceeds	-0.0216	-0.0431	1.0000							
ln_age	-0.1413	-0.0366	0.1258	1.0000						
ln_mcap	0.0243	-0.0123	0.8535	0.0846	1.0000					
dummy_hitech	0.0437	-0.1339	-0.1817	0.0309	-0.2035	1.0000				
topp4rank	-0.1399	-0.0629	0.2822	0.2458	0.2844	0.0019	1.0000			
hotindex	-0.0532	0.1076	-0.2336	-0.1401	-0.1545	0.0255	-0.1591	1.0000		
osebxretur~t	0.1944	-0.0252	-0.0719	-0.0292	-0.1339	0.1802	-0.1520	0.1774	1.0000	
osebx_varc~r	-0.0085	0.0790	-0.1306	0.0263	-0.0829	-0.0662	0.0429	0.1208	-0.5410	1.0000

Jarque-Bera, Full Sample

Skewness/Kurtosis tests for Normality

				joint	
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
myresiduals	**125**	**0.0000**	**0.0000**	**49.78**	**0.0000**

Jarque-Bera, Book-Building

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
myresiduals	**93**	**0.0000**	**0.0000**	**38.87**	**0.0000**

Jarque-Bera, Fixed-Price

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
myresiduals	**32**	**0.0020**	**0.0216**	**11.72**	**0.0029**

Preliminary Thesis Report

ID-number: 0924046

ID-number: 0914761

- Which IPO pricing mechanism provides the smallest amount of underpricing between - book-building and fixed-price -

Supervisor:

Kjell Jørgensen

Students:

Christoffer Myklevold

Haakon Kise

Hand-in date:

15.01.2017

Examination code and name:

GRA19503 – Master Thesis

Program:

Master of Science in Business – Major

Table of content

Introduction

To start this introduction, we should define what an Initial Public Offering is. An Initial Public Offering, hereafter referred to as IPO, is when a private firm is listed on the stock exchange for the first time to be offered to the public. The most obvious reason is to raise capital in order to create growth opportunity, and the possibility of creating a public market where the shareholders in the future can convert their shares into cash. It also allows the firm to be more flexible if they would have to raise more capital in the future, and the opportunity of merge or acquisition. Another reason might be that raising cash whiteout an IPO can be difficult due to strict bank regulations and limited ability for venture capital.

The history of IPO goes way back in time, and the first modern IPO was in 1602 when the Dutch East India Company issued shares to the public to raise cash, and the first IPO registered in the United States was around 1783 when the Back of North America.

The process of an IPO is large and complex, as it usually takes about 4 months before the firm is listed, and it is also quite expensive. When company decide to go public, and an investment bank is usually hired in order to do the process with the Financial Supervisory Authority and all the financial and other documents. Initially, the Investment banks ambition should be to price the firm as close to the market price as possible, so that the firm receive the highest possible amount. There is a lot of studies on the field of mispricing or underpricing of IPOs and why they occur, which we do not cover in this research paper.

In this study, we will focus on the Norwegian market, which was founded back in 1818, and where the first trade was made the year after. Further, we have concluded that we are not including Oslo Axess and Merkur Market, because those markets are more limited to liquidity and are traded over the counter (OTC). It is 181 listed firms on Oslo Stock Exchange, and it has been 173 IPOs over the last 15 years. We believe that this provide us with enough data to do a proper study on our research question.

The purpose of this is research is to observe the possibility of making profit by exploring the underpricing of IPOs in the Norwegian market. We will examine IPOs on the Oslo Stock Exchange for the past 10-15 years in order to determine whether there is a mispricing in form of underpricing, where it is possible to achieve abnormal profit. Because of high volatility in the stock market, and due

to the uncertainty about the true market value of an IPO, we consider a timeframe from 1 to 30 days.

Literature review

According to Ljungqvist (2007), Dennis E. Logue was among the first to document underpricing. Logue (1973) looked at American IPOs in the period between 1965-1969 and utilized different regression models to explain the phenomenon. Logue (1973) studied the first day returns and adjusted for the market return measured by a OTC-index. The result showed an average first day underpricing of 41,7 percent.

Roger G. Ibbotson (1975) followed up just two years after, documenting irregular returns the first period after American IPOs. Ibbotson (1975) studied the stock price development of numerous newly listed stocks from the time of the IPO until the first turn of the month in the period between 1960-196. Here, he found that the newly listed stocks on average beat the market by over eleven percent. Ibbotson (1975) also discovered a skewed distribution (with a long right tail) in the data, which meant that a randomly selected IPO would have an equal probability of positive and negative abnormal returns.

In the American studies up to the mid 1980s, mainly weekly and monthly observations were utilized to investigate underpricing. In more recent years, along with the technological development, daily data is more commonly used in empirical studies.

An alternative to measuring the percentage underpricing, we can look at the underpricing in absolute terms, where we can see the amount of "money left on the table". This is defined as the difference between the stocks market value and the price at the IPO, times the number of shares sold at the introduction. This method assumes that the shares could have been sold to the first day's closing price (hence, that the demand is inelastic).

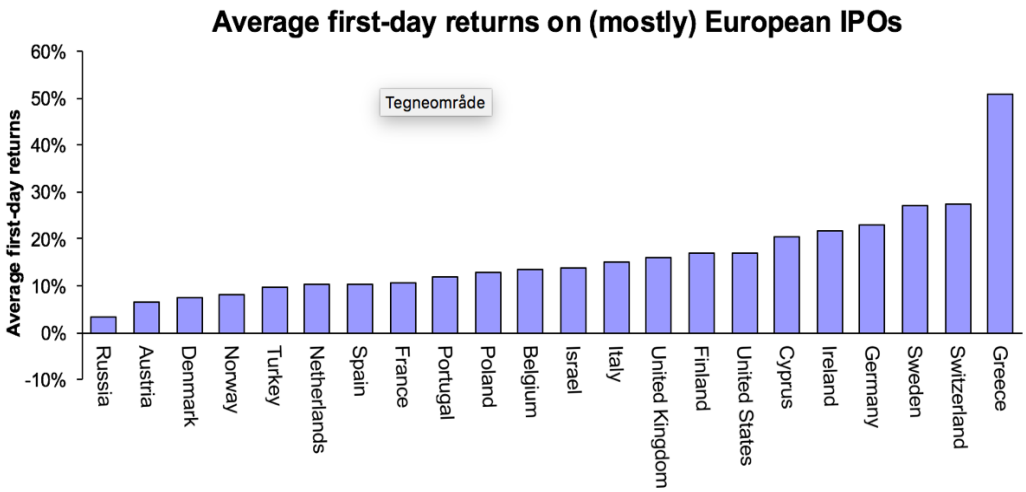
By calculating the absolute value of the underpricing in the US in the years between 1999-200, when the average underpricing was 71 and 57 percent, respectively, we find a total absolute underpricing of 67 billion dollars (Ritter 2008b). In the literature, these periods are typically referred to as "hot issue markets".

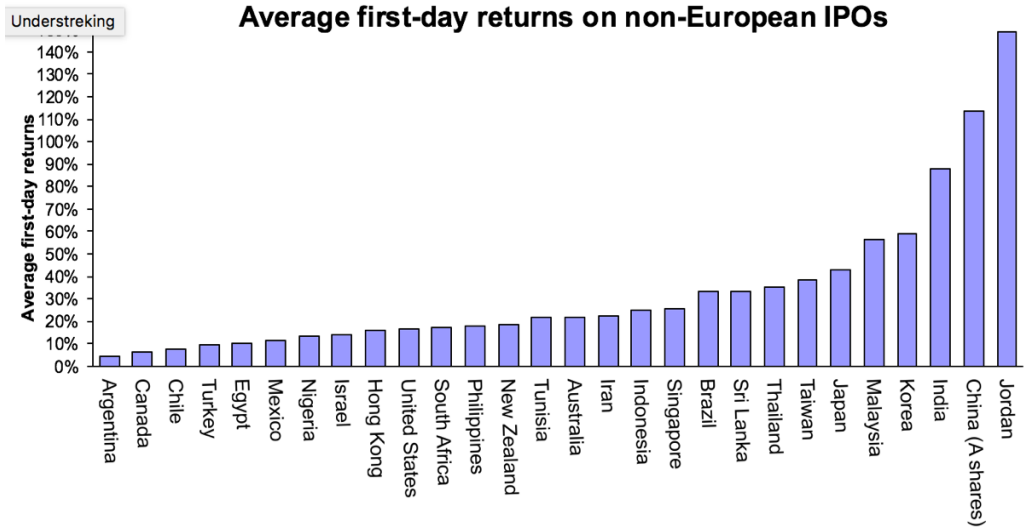
Ritter (2008a) has also ranked American introductions by absolute value of underpricing, and presented the top 227 introductions with the largest dollar value left on the table. On top of the list we find the introduction of Visa, where the initial owners lost an astonishing amount of five billion dollars, where the initial stock price was 28 percent lower than the first day closing price. Although the method for calculating "money left on the table" can be discussed, the examples shows that the extent of underpricing is substantial.

In recent years, there has been a substantial amount of research done on the phenomenon of underpricing in IPOs, both in Norway and in the rest of the world. Loughran and colleges (2015) have summarized a range of studies looking at the short-run and long-run performance of companies going public in 52 countries from all around the world, and the results have been varying among the different continents. The average initial return in Europe, America and Oceania have been around 5-25 percent (Loughran et al., 2015), where Greece (50,8%), Bulgaria (36,5%) and Brazil (33,1%) are the only ones significantly deviating from that interval. In Asia, on the other hand, there have been a wider range of different results regarding the levels of initial underpricing, where the mean is relatively high compared to the rest of the world. Here, Loughran and colleges (2015) reports eleven countries showing over 25 percent initial underpricing, where we have Saudi Arabia, Jordan and China as the most extreme cases, reporting an initial underpricing of 239,8%, 149% and 113,5%, respectively.

There have also been substantial differences between the different European countries in terms of level of underpricing. For instance, from Loughran (et al., 2015), we see that underpricing are more common in Germany than in France. It is likely that this, to some extent, is caused by the differences in the institutional framework where the IPOs are issued (Ljungqvist, 2007).

Research by Ritter (1998) shows that underpricing is more frequent in countries where it is common to utilize a "book-building" strategy compared to countries which commonly utilize a fixed price for their shares, where the average levels of underpricing are 12 and 37 percent, respectively. This can, however, be due to differences in the company characteristics rather than the choice of pricing method (Loughran et al., 2015).





In addition to variation between countries, research from Loughran and Ritter (2004) shows that there is a difference in underpricing between different periods of time. In the 1980s, the average first-day return on IPOs was seven percent, while it doubled to 15 percent in the period between 1990-98. During the internet bubble, it jumped to 65 percent, but later reverted to 12 percent in the period between 2001-03.

Theory

In this study, we are not only trying to understand the underpricing of IPOs, but also exploding it, and to exploit the IPO we need to understand the concept of "underpricing of IPOs", is it persistent and does is happen systematically over time, and how it is performed.

First, an IPO is said to be underpriced if the closing price at the very first day of the offering is higher than the initial public offering price. Further, as mention earlier, Jay R. Ritter has done some statistic review of IPO activities and pricing in the US market where he acknowledged an average first day return of 7,3% in the period 1980-1989, 14,8% in 1990-1998, 64,5% in 1999-2000 and 13,9% in the period 2001-2015. This average first day return can be considered as the underpricing of the IPOs as Ritter and Welch (2002) concluded that academics use these terms interchangeably. The average over the entire period 1980-2015 is 18%, with an aggregated amount left on the table of 153,15 billion dollars, which is a ridicules high amount. This information can be considering as evidence that in fact, IPOs seemed to be systematic underpriced over time. This gives us indicators of possible opportunities to exploit the IPOs in order to gain extraordinary profit from investing in IPOs.

The next to be discussed is what causes this underpricing, and who is profiting from it. As mention before, in most cases companies does an IPOs because of the desire of raising equity capital, so the primary goal would be to raise as much as possible. At first sight, an underpriced IPO would result in lower capital raised to the company, which would look bad for the company as the initial encouragement to an IPO would be to raise as much capital as possible.

There are several proposed reasons to why the IPO seem to be underpriced, one of the most noticeable explanation with the most empirical support to underpricing is asymmetric information (Leland & Pyle, 1977).

Asymmetric information in general terms means that one of the party has more information than the other party. As George Akerlof (1970) stated in his paper "the market for lemons", where the terms peace and lemons was used for good quality cars and poor quality cars. He explained that there was asymmetric information between the seller and the buyer, where the seller had better information about the quality of the car, and the buyer only had limited information. This lead to adverse selection, which is a consequence of asymmetric information,

where the sellers with good quality cars did not sell because the price was lower than the intrinsic value. As this can be converted to the IPO case, where the informed investors only will bid if there are superior returns, and uninformed investors would bid regardless of the quality of the IPO. After some time, losses would be superior and the uninformed investor would leave the IPO market. Because of limited informed and rational investors, the underwriter needs the uninformed investors to do a complete and successful IPO, the result is then to offer a premium to the uninformed investors, which causes the underpricing of the IPO.

Others reasons have been tested over the past decades with some results. Jay Ritter (1998) did a review over reasons for IPO underpricing, where he discussed the winners curse, the market feedback, the investment banking's monopoly power and the lawsuit avoiders as possible reasons for underpricing of IPOs. All those have in common that they involve rational strategies by buyers, which have been criticized on behalf of extreme assumptions or unnecessarily complex stories, even there is some degree of truth in them.

Data

As we have decided to focus on the Norwegian market, we are going to use the website of Oslo Stock Exchange (www.oslobors.no) in order to obtain information about companies that has done an IPO. The timeframe is not set yet, however, we are aiming for 10-20 years depending on how much data that are available. Further, website as Nordnet (www.nordnet.no) and Pareto (www.paretosec.com) will provide us with data such as trading price and volume, which will be recorded on a daily basis in order to observe daily return. The data will be at closing time. We will additionally use the website of the companies to gain information about their respectively IPO and the offering price.

As our research is based on the Norwegian market, a reasonable benchmark would be the Norwegian Stock Exchange Index "OBX". the OBX index which is consider as the most liquid index on Oslo Stock Exchange, seems as a proper proxy for a benchmark. This is due to the fact that it includes the 25 most liquid companies, which is restated every 6 months in order to include those 25 most liquid companies.

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