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***Performance of IPOs on the Nordic Market***

***Factors affecting Nordic IPOs before and after the financial crisis***

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## **ABSTRACT**

- Title:** **Performance of IPOs on the Nordic Market** Factors affecting Nordic IPOs before and after the financial crisis
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- Key words:** IPO, First-day return, Long-run performance, BHAR, Private Equity, Venture Capitalist
- Purpose:** This study aims to determine if there are any differences in the long-run performance and first-day returns between IPOs on the Nordic market with different ownership structures before and after the financial crisis of 2008. Furthermore, variables from previous studies have been chosen in order to study if they have an impact on the long-run performance of IPOs on the Nordic market
- Methodology:** The collected secondary data was analyzed through a quantitative method with a deductive approach
- Theoretical perspectives:** The previous studies that have been used in this paper have mainly concentrated on the long-run performance and first-day returns of IPOs on the European and US markets.
- Empirical foundation:** The basis for this study was data from firms on Nordic stock exchanges. The data was attained from Argentum, DataStream, Zephyr, annual-reports and firm-prospectuses
- Conclusions:** This paper find that there is significant difference in leverage ratio, market capitalization and offering size between private-equity backed IPOs, venture capital-backed IPOs and non-sponsored issues before and after the financial crisis. Further, private equity-backed IPOs in the sample outperform both venture capital-backed IPOs and non-sponsored issues in the long-run and have the lowest first-day returns before and after the financial crisis, however the differences are insignificant. Further, the independent variable offering size showed a significant negative impact on BHAR before and after the financial crisis and the independent dummy variable private equity showed a significant positive impact on BHAR after the financial crisis.

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# 1. INTRODUCTION

When a private firm decides to offer its shares to the public, it is said to undergo an initial public offering. While some firms choose to stay non-sponsored, some may choose to allow private equity firms to sponsor their offering. When it comes to funding firms through private equity, historically it is far more common in the United States than in Europe. It is only in more recent times that the European capital markets have adopted private equity (PE) funding; as of 2003 only 9 percent of initial public offerings (IPO) in Europe were private equity backed while as of 2016 that number has risen drastically to 48 percent. In the United States however that figure has stayed relatively stable over the years, sitting at 48 percent in 2003 and 50 percent in 2014. When looking at the Nordic region in particular, substantial growth in the PE industry can be observed; data shows that private equity investments grew from 0.19 billion USD in 1990 to a staggering 6.3 billion USD being invested in 2015 (PwC, 2014; Cotterill, 2016).

A private equity firm can be best described as a company that invests in the private equity of operating firms that they find suitable. The investment strategies of PE firms vary and range from venture capital to buyouts and leveraged buyouts (Mogilevsky & Murgulov, 2012). However, there are a few distinctions between PE and VC investment. PE investments tend to lean towards investing in more mature and cash-flow stable firms and also seek to have a majority ownership stake in the firm receiving the investment, on the other hand VC investments are categorized by investments in younger and riskier firms i.e. start-ups, and aim to invest only in a minority stake of the company (Schöber, 2008). Furthermore, PE investments are usually controlled by small teams of professionals with backgrounds in investment banking and management consulting, whereas VC investments are implemented by professionals with in-depth industry specific knowledge, and it is this specific expertise that allows VC firms to have an edge in distinguishing between start-ups with potential and start-ups that may not have such long term success. Despite these differences, what PE and VC firms have in common is the way they realize their return on investment, namely this is when the firm they have invested in is up for an initial public offering (IPO), for this reason one expects that there has been substantial research regarding IPO's that have been funded through VC and PE (Mogilevsky & Murgulov, 2012; Levis, 2011).

The financial crisis of 2008 has had major effects on the capital market, economy and the financial system around the world (Cotterill, 2016). With worse market condition and more

scarce investment by investors, IPO activity fell drastically. The numbers of IPOs fell by 60 percent globally during the first quarter of 2008 compared to the fourth quarter of 2007 (EY, 2008). 40.9 billion dollar was raised during the first quarter of 2008, which is 60 percent less than the 102.1 billion dollars that was raised during the fourth quarter of 2007. Leading up to the financial crisis of 2008, the market was booming, and with that so did the private equity industry (Axelsson et al, 2013). Between 2005 to mid-2007, the PE-industry reached a transaction value of 1.6 trillion dollars (Kaplan & Stromberg, 2009). Periods characterised with a booming financial market experience more private equity and venture capital fundraising (Kaplan & Stein, 1993). During a bull market, PE-firms are pressured to make more deals. In comparison, PE-firms are more resilient to make deals during a bear market Kaplan and Stein (1993) found that this may have effect on the type of firms being invested in by the PE-industry. The selection of low quality firms may be higher during a boom market i.e. during and in the aftermath of a financial crisis, and may be lower during a bear market i.e. before a financial crisis (Kaplan & Stein, 1993).

## 1.1 PROBLEM STATEMENT

The majority of previous studies that discuss the roles that private equity and venture capital play in IPO's focus mainly on the US market (Levis, 2011). There are a variety of studies that have been conducted on the European market, however, there is not nearly enough research concerning the Nordic market. Given that there are vast differences in the many aspects that influence the corporate environment in the US, Europe, and Scandinavia, the authors believe that further research is required about the role of PE and VC on IPO's in the Scandinavian market. Furthermore, due to the undeniable influence of the sovereign debt crisis on European market sentiment and as a result willingness to invest, it is also of interest to investigate the effects of PE and VC on IPO's before and after the crisis in order to get a more balanced view of the true effects of PE and VC funding (Spliid, 2013).

When looking at previous research of IPO's on the Scandinavian market, there have been no studies that consider the effects of different ownership structures on performance (Westerholm, 2007). Furthermore, there have only been limited studies regarding long-run performance of Scandinavian IPO's. Therefore, the authors' objective is to contribute relevant knowledge in the field in order to provide relevant insight for scholars interested in the ownership structure

of Scandinavian IPO's as well as providing insight to possible investors looking to invest in IPO's available on the Nordic markets.

## 1.2 PURPOSE AND RESEARCH QUESTIONS

The purpose of undertaking this study is to help in determining whether there are any significant differences in the performance of Scandinavian IPO's depending on their ownership structure; i.e. being Non-sponsored (NS) or funded through PE or VC. First day and first 3-year returns will be the basis of the measure of performance. In addition, the authors will attempt to control for the effects of the global financial crisis by seeing if there is a significant difference in performance between those Scandinavian companies that had their IPO before and after the crisis.

Throughout this study we will seek to answer the following questions:

*To what extent does the method of financial backing of IPO's effect their first-day and long-term performance?*

*How do the chosen variables explain long-run performance of IPO's on the Nordic market before and after the global financial crisis?*

## 1.3 SCOPE AND LIMITATIONS

IPOs from all the Nordic countries will be included in the study i.e. Sweden, Denmark, Finland and Norway. The reason for this is to see if European and US based findings also can be applied to the Nordic market. The time period used in this in study will be the years between 2000 and 2012. There are 2 reasons for this. Firstly, by using this time period we catch the financial crisis and have data on IPOs before and after the financial crisis. Secondly, this time period allows us to have enough data on IPOs to be able to conduct statistically significant tests (Brooks, 2014; Körner & Wahlgren, 2006). This time period resulted in a very large sample of NS IPOs. Because of limitation in time, the authors chose to use a random sample of the NS IPOs.

## 1.4 TARGET AUDIENCE

The target audience of the thesis is investors, researchers and students working or studying in the field of finance. This thesis will contribute to the current literature which and therefore

contribute to inspire other academics to carry out further research in this field. The authors also hope to assist in guiding investors to make better decisions when investing in Nordic IPOs.

## 2. THEORY

*In this section the authors present relevant theories discussing first-day returns and long-run performance. Previous academic literature regarding performance of PE, VC, and NS IPOs is also presented.*

### 2.1 FIRST-DAY RETURNS AND UNDER-PRICING

Several different scenarios may occur when a firm undertakes an IPO, one of these possible scenarios which is also one of the most common, is an IPO resulting in a large first-day return (Ritter, 1998). These large first day returns arise as a result of the offering being under-priced in comparison to the true market value. Under-pricing occurs in markets all over the world but the gap between the price set by the issuer and the market price varies from country to country. Furthermore, according to Levis, different levels of under-pricing can even be observed for IPO's with different ownership structures; PE and VC funded IPO's tend to be less under-priced than NS IPO's (Levis, 2011).

#### 2.1.1 THEORIES OF UNDER-PRICING IN IPOS

Information asymmetry is regarded as one of the foremost causes of IPO under-pricing, more informed investors will naturally have an advantage over less informed ones due to being able to recognize the true earning potential of an IPO. One common example of information asymmetry is what is commonly referred to as *the winners curse*, it is considered to be one of the more recognized theories when it comes to IPO under-pricing. The theory suggests that since IPO's are issued with a fixed number of shares and being sold at a fixed price, if a certain IPO arouses the interest of many investors then the shares will be evenly distributed among the interested investors. Naturally, some investors are more informed than others and can spot if an IPO is under or overpriced, if they observe that an IPO is overpriced then there will be less interest in that IPO. However, when the interest in an IPO is low then the less informed investors who are still interested will be able to buy even more shares than they would have if interest was high. The less informed investors in this example are said to suffer from the *winner's curse*, getting all the shares they want in an overpriced IPO but getting a limited amount of shares in an under-priced IPO (Ritter, 1998).

The *certification hypothesis theory* claims that an IPO that is funded through PE will be seen as a more promising IPO, because the financial backing in and of itself is considered as a sort

of certification. The theory argues that the party backing the IPO through private equity has its reputation invested in the offering, so if the offering is overpriced then that loss of reputation is so great that it would offset any potential returns that occur as a result of the overpricing. Another requirement for this theory to hold is that the certification of the backer should be costly and tough to acquire. Therefore, assuming this theory holds, it would be safe to assume that IPO's involving PE should have less of a tendency to be overpriced (Van Frederikslust & Van Der Geest, 2001).

The *market feedback hypothesis* is a theory introduced by Ritter (1998) that attempts to explain the occurrence of under-pricing that can be attributed to the underwriter issuing the IPO, the underwriter in this case would like more information about the price of the IPO so he attempts to receive this information from the market. In order for the underwriter to receive accurate information, he must under-price the IPO to compensate the market for offering credible information. The market feedback hypothesis has also been observed and documented on a US market study occurring between the years 1990 and 1996 (Ritter, 1998).

Another theory described by Ritter (1998) that attempts to explain IPO under-pricing is what is referred to as the *bandwagon hypothesis*. This is when investors neglect their own information and instead mimic what other investors on the market are doing. For example, some investors who have information that deems an IPO as a sound investment may choose not to invest in the IPO as a result of mimicking other more influential investors who are also not investing in the IPO. In order to avoid this predicament, the issuer of the IPO may choose to under-price so as to attract more investors in the hopes that those investors will cause a bandwagon effect and as a result attract even more investors.

When underwriters under-price an IPO, they are either wittingly or unwittingly signalling to investors that taking part in this IPO will be profitable for them, Ritter (1998) refers to this as *the signalling hypothesis*. Another advantage gained is that since the firm will be perceived as having a good reputation due to their ability to attract investors, then this sets them up for the possibility of setting higher prices on issuances in the future i.e. they are able to profit from the under-pricing.

Another theory also presented by Ritter (1998) is what is referred to as the *ownership dispersion hypothesis*. This hypothesis refers to such cases where the issuing firm would rather

not have large shareholders in the firm, so in order to avoid this situation they intentionally under-price the IPO to create an excess demand for their shares in the market and as a result attract many smaller shareholders.

### 2.1.2 PREVIOUS RESEARCH ON UNDER-PRICING AND FIRST-DAY RETURN

According to a study on first day returns of IPO's that Ritter (1984) conducted on upwards of 5000 IPO's between 1960 and 1982, there was on average an 18.8 percent increase in share price. In a later study, Ritter and Beatty find that there is a positive relationship between the level of uncertainty of the initial IPO value and the underwriters reputation stake, their study concluded that underwriters are incentivised to set prices as accurately as possible in order not to lose market shares (Ritter & Beatty, 1986).

Another study conducted on the under-pricing of IPO's carried out between 1980 and 2003 by Loughram and Ritter (2004) showed that there was a drastic difference between first day returns depending on the time period that the IPO took place; between 1980 and 1989 the average first day return was approximately 7 percent, between 1990 and 1998 the average first day return was approximately 15 percent, in the years 1999 and 2000 the average first day return had increased drastically to an average of 65 percent, and finally that number fell to 12 percent average first day returns in the years 2001 to 2003. The researchers explain these changes in first day returns in a number of ways, the fluctuations in the 1980's are attributed to the *winners curse*, whereas the changes occurring from 1990 to 2003 are attributed to venture capital and side payments made to CEO's.

Though these aforementioned studies do prove that IPO's are under-priced on average, unlike Levi's (2011), Megginson & Weiss (1991) and Mogilevsky and Murgolov (2012), they fail to take into account if the ownership structure of the IPO has any impact on the first day returns. Levi's (2011) study focuses on IPO's offered on the London Stock Exchange between 1992 and 2005 and makes a distinction between whether the IPO is backed through private equity or venture capital or whether it is a non-sponsored IPO. Levi's (2011) finds that those IPO's that are non-sponsored had the highest average first day returns at 21.1 percent, while those IPO's backed through venture capital had first day returns of 14.9 percent on average, with IPO's backed through private equity had the lowest first day returns of the three ownership structures (9.1 percent).

Mogilevsky and Murgolov (2012) like Levi's (2011) also take the three ownership structures into account with their study on the IPO's offered on the US Stock Exchange between the year 2000 and 2009. Contrary to those results concluded by Levi's (2011), Mogilevsky and Murgolov found that the highest average first day returns were found in those IPO's backed by venture capital at 23.4 percent while non-sponsored IPO's had an average first day return of 14.3 percent. Coinciding with Levi's (2011) findings, the lowest first day returns are found in IPO's funded through private equity (average of 7 percent).

Two further studies on the European market have results that coincide with Levi's (2011) and Mogilevsky and Murgolov's (2012) findings that IPO's funded through private equity tend to show lower levels of under-pricing than IPO's that are non-sponsored or funded through VC. The first of these studies was conducted by Frederikslust and Geest (2001) on the Amsterdam Stock Exchange where PE and non-PE backed IPO's were observed, they found that average first day returns of non-PE backed IPO's was 17 percent and for PE backed IPO's was 13 percent, the researchers argue that a possible explanation for these results is the *certification hypothesis* though it is noteworthy that the results of the study were not statistically significant. Another similar study comparing between PE and non-PE backed IPO's was carried out by Bergstrom et al. (2006) on IPO's on the London and Paris stock exchanges and found similar results but with an even lower average level of under-pricing for both PE and non-PE backed IPO's (9.33 percent and 12.87 percent respectively). In addition, Bergstrom et al. (2006) found that those firms IPO's that are backed through private equity tend to have more capital and argue that this higher capital could be a possible cause for the lower level of under-pricing.

Meggison and Weiss (1991) also attempted to explain IPO under-pricing through taking ownership structure into account to observe if it had any bearing on first day returns. Their study focused on making a distinction between VC and non-VC-backed firms and they found that less under-pricing occurs in VC-backed IPO's than it does in non-VC-backed IPO's.

## 2.2 LONG-RUN PERFORMANCE

Previous studies of long term performance of IPO have noticed and confirmed that IPO do underperform in the long term I.e. three years and five years. The presence of

underperformance of IPOs has been seen in many countries. When an IPO performs worse relative to a benchmark it is said to underperform.

### 2.2.1 THORIES OF LONG TERM PERFORMANCE IN IPOs

The *windows of opportunity hypothesis* states that during times when many firms go public in a specific period it could be a response to the sentiment of investors during periods of high economic growth. Many companies purposefully try to time their offering with the intention of taking advantage of the optimistic sentiment of investors during periods of growth. As a results of there being a lot of IPO's taking place during a specific period of time, the theory predicts that this IPO's issued during such times will be over-valued and in return will underperform in the long run when compared to IPO's issued in times of normal growth (Ritter, 1998).

Schultz (2003) takes this theory one step further by suggesting that many firms choose to carry out IPO's when they see that other firms are successful in issuing shares at higher prices, taking this into consideration, not all IPO's issued during times of high growth are over-valued but rather it is the IPO's of those firms that issue shares based on the success of other IPO's that are over-valued and as a result under-perform. Schultz refers to this as *pseudo market timing* (Schultz, 2003).

The *divergence of opinion* theory states that naturally, investors with the most optimistic sentiment about an IPO are the ones most willing to invest in it, even when there is uncertainty about an IPO's market value. However, as time goes by and more information is publicly available about the IPO, uncertainty decreases and as a result overly optimistic investors will become less optimistic and those investors who are pessimistic may become more optimistic. As a consequence, there is less divergence between the positive and negative sentiments of investors, when this happens market price declines (Ritter, 1998).

A possible explanation for the underperformance of IPO's brought forward by Ritter (1998) is that sometimes certain investment bankers purposefully under-price newly issued shares in order to create an image of superfluous demand in order to make the shares seem more desirable. This is referred to as the *impresario hypothesis* and it entails that IPO's that such

firms that exhibit high under-pricing tend to in-turn yield lower consecutive returns (Ritter, 1998).

It is worth noting that any firm that goes public always has the option to return to being private. Benninga, Helmantel and Sarig (2005) propose that this option can explain the underperformance of IPO's, this is referred to as the *delisting hypothesis*. Implementing the option to delist holds a greater value for those firms that are newly listed than for those who have been trading on the market for a while. The delisting option has an effect on the risk of the firm and also the value of the firm. Firms that are established on the market tend to produce more cash flows and as a result are riskier than newly issued firms. Therefore, the returns of established firms tend to be higher than the returns of the newer firms, this serves as an explanation as to why IPO's underperform.

### 2.2.2 Previous Research on Long run underperformance

The long-run performance of IPO's in the first three years after the initial offering was examined by Ritter (1991) in a study conducted on US companies having their initial public offerings between the years 1975 and 1984 on the New York Stock Exchange. The researcher attempts to further highlight long-run underperformance by comparing all 1526 IPO's in the study to 1526 non-IPO firms within similar industries and similar market capitalization. Ritter (1991) finds that an investment into the IPO's would on average yield a 13 percent lower 3-year return than an investment made into the matching non-IPO firms on the NYSE.

Loughran and Ritter (1995) performed an extensive study on the 5-year performance of IPO's on the US market, the study was conducted using companies being listed from 1970 to 1990. They compared the performance of IPO firms to non-IPO firms of the same size and found that for an investor to make the same return from investing in an IPO as for investing in a non-issuing firm, they would have to invest 44 percent more into the IPO. Westerholm (2007) being one of the few researching long-run IPO performance on the Scandinavian markets concludes findings that coincide with Ritter (1991) and Loughram & Ritter (1995); IPO's on the Scandinavian markets exhibit negative long-run performance. Westerholm (2007) study analyses 5 year returns and the study focuses on a sample of 254 IPO's issued on the Nordic markets between 1991 and 2002.

Though there is substantial evidence in the literature that points to the IPO's tending to underperform in the long-run, there is some research that is conflicting with such literature. Brav and Gompers (1997) as well as Gompers and Lerner (2003) take a similar approach to Ritter (1991) and Loughran & Ritter (1995) by matching IPO's with non-IPO's that are within the same industry and have similar market capitalization as well as book-to-market ratios. They find that there is no significant difference between the IPO's and non-IPO's in terms of long-run performance. Furthermore, they conclude that the IPO's perceived relative underperformance is highly dependent on the method used to make the comparison and the benchmark chosen.

Ownership structure is also believed to be a significant determinant in the long-run performance of IPO's. Brav and Gompers (1997) carried out a study on long-run performance of IPO's through observations lasting 5 years on a sample of VC backed IPO's and a sample of non-VC backed IPO's that had been floated on the US market between 1975 and 1992. The study concluded that, when returns are equally weighted, the venture capital backed firms do in fact outperform the non-VC backed firms.

Katz (2009) also observes the effects of ownership structure of IPO's on long-run performance. Her research is focused on comparing private equity backed firms with non-private equity backed firms in an attempt to observe the difference in long-run performance between them. It is concluded that those IPO's that are backed by PE tend to perform better than non-PE firms in the long-run. Furthermore Katz (2009) also finds that those PE-backed firms where the private equity firm holds a larger portion of the firm being offered tend to outperform those firms in which the PE firm only holds a minority stake. The researcher attributes this superior performance to more professional owners, stricter monitoring, and positive reputation of certain PE backers.

Levis (2011) also takes ownership structure into account in his research regarding IPO long-run performance on the London Stock Exchange, though unlike Katz (2009) and Brav & Gompers (1997), Levis separates the IPO's into 3 groups; those that are backed by private equity, those backed by venture capital, and those that are non-sponsored. It is noteworthy that in this study it is highlighted that other than ownership structure, these 3 groups differ in market capitalization, profitability and maturity. Levi's finds that those IPO's backed through private equity exhibited the highest profitability, have higher leverage, and a larger market cap than

the NS and VC-backed IPO's at the time of the offering. When examining the long-run performance, Levis found that the private equity backed firms showed significantly superior long-run performance when compared to the other 2 groups, however, all 3 groups showed negative average abnormal returns over the three-year period. Furthermore, Levis (2011) also shows that for PE-backed IPO's, there is a positive relationship between long-run performance, degree of leverage, and amount of equity the PE-firm maintains after the initial public offering.

In addition, Bergstrom et al. (2006) also provide literature on IPO performance of different ownership structure on various European markets, namely the London and Paris stock exchanges. This research makes a distinction between those IPO's that are backed by private equity and those that are not backed by PE (this group included several VC-backed firms), the performance of these IPO's is observed over periods of 6-months, 3 years, and 5 years. The results show that those firms which are PE-backed outperform the non-PE backed firms and yield positive abnormal returns in the 6-month period and negative abnormal returns in the 3 and 5 year periods. In addition, Bergstrom et al. (2006) show that there are substantial variations in performance over the different years, they find that in years where a large amount of firms initiate their offering there tends to be more underperformance than in years with average or below average amount of firms going public. The researchers attribute these variations to the *window of opportunity hypothesis* which has been previously described in this research.

## 2.3 HOT AND COLD ISSUE MARKETS

The hot and cold issue market phenomenon is closely linked to under-pricing (Ibbotson and Jaffe, 1975) defined the hot market phenomenon as a time-period where the average first month performance of IPOs is abnormally high. In their study, they found that companies that go public when the market is hot are able to obtain a higher offering price relative to the efficient price compared to when the market is cold. Furthermore, Ritter (1984) found that during a time period when the market is hot, there is a high volume of IPOs, since firms are able to obtain higher offering prices, thus incentivising to carry out an IPO under these market conditions. Ritter also explained how under-pricing is cyclical, during some periods average initial return is higher and in some period it is lower, i.e. hot and cold market.

In an attempt to explain hot markets, Ritter (1984) examined the risk exposure of companies going public. He explained that during some time-periods, companies going public have on average a higher risk exposure, this may explain the phenomena of hot and cold markets, since high-risk issues are under-priced more than low-risk issues. Ritter did however find that the average high initial return was more or less completely linked to the market in which they were operating in. Ljungqvist and Wilhelm (2003) confirmed this conclusion in their study, where they found that internet companies going public during the dot-com bubble experienced an average of 89 percent first day return. Given this, they stated that hot markets are not attributed only to the specific industry they are operating in, but on multiple factors. For instance, the sentiment of the investors during hot market is particularly important (Ljungqvist & Wilhelm, 2006).

### **3. METHOD**

*The study is to be quantitative and will not include qualitative data. In order to form our hypotheses and analyse results, previous research as well as theories concerning IPO performance will be used. Next, we will test these hypotheses using the collected data and analyse the results.*

#### **3.1 TIME FRAME**

In order to measure abnormal return, event time method will be used (Fama, 1998). More specifically, throughout this study a 36-month event time period is used when discussing long-term returns. Naturally, the first day closing price indicates the beginning of the event time period while the end of the event time period is indicated by the closing price after 36-months (Ritter, 1991). Since all firms have the same event time period, then we can freely compare between all IPO's in the study regardless of the time when they are first available on the market (Fama, 1998). For the authors to obtain a sample of Scandinavian PE and VC backed IPO's large enough and relevant enough in terms of timeliness, a 14 year time period was chosen, IPO's occurring on Nordic stock exchanges between 2000 and 2013 were considered suitable for the sample. Another consideration the authors made was how to account for the effects of the financial crisis in the study, while it is difficult to pinpoint an exact date for the occurrence of the financial crisis, we opted to split up the sample into those IPO's that occurred after and including 2008 and those that occurred before 2008.

#### **3.2 STOCK EXCHANGES**

Quantitative data used in the study is derived from 7 stock exchanges from the 4 Nordic countries being examined. These stock exchanges are as follows; Nordic Growth Market, Oslo Axess, Oslo Bors, Aktietorget, Nasdaq OMX Stockholm, Nasdaq OMX Copenhagen and Nasdaq OMX Helsinki.

#### **3.3 OWNERSHIP STRUCTURE CLASSIFICATION**

Firms in the sample were categorized according to ownership structure, namely PE-backed, VC-backed, or NS. Basis for determining ownership structure was obtained through annual reports, IPO prospectuses, data source Zephyr, and from Norwegian private equity fund Argentum.

### 3.4 SELECTION CRITERIA

- IPO's listed on Nordic stock exchanges between 2000 and 2013
- Seasoned equity offerings (SEO) were excluded
- IPO's cross listed on other markets before being listed on Nordic stock exchanges were excluded

### 3.5 DATA COLLECTION AND PROCESSING

The main source of data used of those previously mentioned was Zephyr, after filtering out unsuitable IPO's by implementing our selection criteria we had a sample of 634 IPO's. However, of these 634 an astounding 571 were NS and a mere 113 were PE and VC backed. A random sample of 58 NS firms was selected due to the time constraint of the study whereas all 113 PE/VC backed IPO's were selected. Upon further detailed inspection of the selected sample from Zephyr we began to realize that some IPO's were not correctly classified; some NS IPO's were wrongly classified as PE/VC and vice-versa. This led us to use additional sources in order to classify the IPO's correctly, namely; IPO prospectuses, stock exchange publications, and annual reports and data from Argentum (an established private equity firm based in Norway). Through these sources we were able to correctly classify IPO's into NS, VC, and PE. For many IPO's we were unable to classify which ownership structure was most accurate, these IPO's were excluded. This left us with a total of 52 PE-backed IPOs (27 before, 25 after the crisis), 54 VC-backed IPOs (30 before, 24 after the crisis) and 58 NS IPOs (32 before, 26 after the crisis).

Zephyr did not contain information regarding first day and 3 year closing prices nor did it include other financial performance measures such as market capitalization and leverage ratio. Therefore much of this additional data had to be extracted from the additional sources previously mentioned as well as from the database *DataStream*. While *Zephyr* did include the IPO offering price for most companies, some information was missing. In order to find this data as well as verify the offering prices, IPO prospectuses, annual reports and data from Swedish tax agency *Skatteverket* was used.

Once all data had been collected, we used the statistical program EViews to perform multiple regression analysis as well as other model tests. Excel was also in order to test for differences, as well as to create tables and diagrams.

### 3.6 LONG-RUN PERFORMANCE

According to Barber & Lyon, abnormal returns can be calculated through buy and hold abnormal returns (BHAR) and cumulative abnormal returns (CAR). The authors chose to use BHAR when measuring long term performance as we believe BHAR is better suited for measuring abnormal returns in a way that reflects the authors method of analysis, i.e. comparing the initial offering price to the price at the end of the 36 month period, as if we are an investor that has decided to buy and hold for 3 years (Barber & Lyon, 1997)

In order to measure BHAR, first one must calculate buy and hold return (BHR) which is a measure of the return of a stock from one time period to the next. The formula for BHR is as follows:

$$BHR = \frac{P_1 - P_0}{P_0}$$

From BHR we can they calculate BHR which give us the abnormal buy and hold return as well as the calculating the correlation between the expected return and required return. The formula for BHAR is as follows:

$$BHAR_{iT} = \prod_{t=1}^T [1 + R_{it}] - \prod_{t=1}^T [1 + E(R_{it})]$$

where

$$\prod_{t=1}^T [1 + R_{it}] = BHR_{IPO} = \frac{P_T - P_0}{P_0}$$

### 3.7 BENCHMARK

The authors had to find a suitable benchmark for the sample of Nordic IPO's used in the study. The benchmark chosen for this study is the MSCI Nordic countries index which, is an index representing the various firms listed on the Nordic market. This index comes in two variations; a price index and a total return index. The total return index assumes that all dividends are reinvested while the price index is based solely on the price i.e. the price falls when dividends are distributed. For this study we believed the that total return index is most suitable as different firms distribute dividends very differently, so for example a firm that chooses to distribute dividends more frequently will as a result have frequent drops in share price, and since these

drops are not indicative of the true performance of the firm the authors believed that the total return index would give a more accurate depiction of the performance of stocks.

### 3.8 INDEPENDENT VARIABLES

Our selected independent variables have chosen after a comprehensive review of previous literature therefore the theories and findings of previous works will also be discussed. The hypotheses that the authors developed are also drawn from previous research with the intent of finding whether the results and conclusions of previous research is applicable to the Scandinavian market.

#### 3.8.1 FIRST-DAY RETURNS

According to Levis (2011) there is a negative relationship between first day returns and long run IPO performance. Levis also adds that IPO's that are backed by private equity face less under-pricing and better long run performance than those IPO's that are non-sponsored or backed by venture capital. This is reinforced by another research carried out Bergstrom et al. (2006) in which results showed that those IPO's that are not funded through PE tend to be more under-priced and underperform on the financial market.

In order for us to test whether the previously mentioned conclusions can also be applied to companies being traded in the Scandinavian market we form the following hypothesis:

*Hypothesis 1: There is a negative relationship between first-day returns and long-run performance*

According to Ritter (1991) first-day return is by definition the difference between the initial offering price and the first day closing price divided by the initial offering price

$$\text{First-day return} = \frac{P_1 - P_0}{P_0}$$

#### 3.8.2 LEVERAGE RATIO

When it comes to the performance of IPO's, leverage plays a significant role. Levi's finds that there exists a positive relationship between long-run return and leverage, the higher leverage

commonly found in PE backed firms is one of the main reasons that such firms tend to outperform other IPO's that tend to use less leverage. Hou & Robinson (2006) as well as Hamada (1972) also find a positive relationship between leverage and long-run stock return. However there is a divergence of opinions, Dimitroy & Jain (2008) as well as Korteweg (2010) find that there is a negative correlation between leverage and long-run returns.

To test whether the results regarding the role leverage plays in regards to IPO performance, we compose the following hypothesis.

*Hypothesis 2: There is a relationship between leverage and long-run performance*

### 3.8.3 OFFERING SIZE

Ritter (1991) finds that a positive relationship exists between the size of the initial public offering and the long-run performance of the offering. Bergstrom et al. (2006) also finds that the same positive relationship exists as those IPO's that are funded through private equity tend to have larger offerings than other non PE-backed IPO's.

To test whether the results from these previous researches can be applied to our study, we compose the following hypothesis.

*Hypothesis 3: There is a positive relationship between offering size and long-run performance.*

The offering size is calculated through multiplying the amount of shares issued with the offering price. And in accordance with Loughran and Ritter (1995), for us to operationalize offering size we use the natural logarithm of it.

### 3.8.4 MARKET CAPITALIZATION

There are contradicting results when it comes to the relationship between long-run performance and market capitalization. Brav, Geczy and Gompers (2000) as well as Bergstrom et al. (2006) conclude that there is in fact a positive relationship between offering size and long-run performance; however, Hart & Oulton (1996) fail to show that any such relationship exists.

To test whether these results can be applied to our study, we compose the following hypothesis.

*Hypothesis 4: A positive relationship exists between long-run performance and market capitalization.*

Market capitalization figures used in the study have been converted to their corresponding natural logarithms for us to operationalize the variable, again this is in line with Loughran and Ritter (1995) as well as Westerholm (2007)

### 3.8.5 OWNERSHIP STRUCTURE

A variety of literature indicates that the IPO's ownership structure has an effect on the long-run performance. A study conducted by Levis (2011) based on IPO performance on the London Stock Exchange over a 3 year period found that those IPO's that are backed by private equity tend to outperform both non-sponsored as well as venture capital backed IPO's. Similarly, a study by Katz (2009) shows that those IPO's that are PE-backed tend to outperform non-PE-backed IPO's over the long-run. On the contrary however, Brav and Gompers (1997) show that, according to their study based on the US market, VC-backed IPO's tend to perform better than IPO's that are non-VC backed over the long-run.

In order to test whether these results can also be applied to the Scandinavian market, we compose the following hypothesis:

*Hypothesis 5: The ownership structure (PE, VC, NS) has an effect on the long-run performance.*

Ownership structure is a qualitative variable therefore it is included in the regression analysis as a dummy variable taking the value of either 0 or 1.

### 3.8.6 THE IPO ACTIVITY PERIOD

We base this variable on the number of IPO's occurring in the same year. Findings from Ritter (1991), Bergstrom et al. (2006) as well as Levis (2011) all suggest that a negative relationship exists between the amounts of IPO's issued in a year and the long-run performance of IPO's. These findings coincide with the *window of opportunity* hypothesis discussed previously.

For the authors to find if these findings can be applied to the Nordic market, we will test the following hypothesis:

*Hypothesis 6: A negative relationship exists between IPO activity and long-run performance.*

We determine the level of IPO activity by comparing the years to each other in order to find which years have relatively high, medium, or low IPO activity. In years where the number of IPO's is below the 25<sup>th</sup> percentile are considered as low activity year, in years where this number is between the 25<sup>th</sup> and 75<sup>th</sup> percentile are considered medium, and in years where the number of IPO's is above the 75<sup>th</sup> percentile are considered high activity years.

## **3.9 TEST STATISTICS**

In this section the authors will explain the statistical test used to answer the research questions.

### **3.9.1 TESTING BETWEEN GROUPS**

When testing between two different groups of data, Student t-test is most commonly used. Student t-test examines if a difference exists between the average values of two groups. Since the authors are going to test the average values three groups (PE, VC, NS), student t-test is insufficient to use. In this case, an alternative approach is using the ANOVA test. The ANOVA test, likewise the t-test, tests for the differences between the averages values of the groups i.e. the alternative hypothesis. It also tests the null hypothesis, i.e. no differences in the average values of the groups. To obtain a statistically significant result, a significant level needs to be established where 5 percent, 1 percent and 0.1 percent is most commonly used. Given this, the authors will use all three significant levels when conducting the tests. A post hoc test is conducted when the ANOVA test is significant, so that the authors can determine in which group there exists a difference (Körner & Wahlgren, 2006).

### **3.9.2 REGRESSION ANALYSIS**

To test for the existence of a relationship between the dependent variables i.e. BHAR and the independent variables i.e. ownership structure, first-day return, offering size, leverage ratio, market capitalization, and IPO activity a regression analysis was used. Since the two independent variables offering size and market capitalization are not standardized and not compared to anything, the logarithms of these values are used. This is in line with previous studies conducted by Loughran and Ritter (1995), Megginson and Weiss (1991) and Westerholm (2007). Since the independent variables IPO activity period and ownership

structure are qualitative data, they were translated to dummy variables i.e. the variables are dichotomous and can only take the values of either one or zero (Brooks, 2014). Hence, two dummy variables was created for the ownership structure for PE-backed IPOs and VC-backed IPOs. The NS IPOs were used as a reference for the two dummy variables, PE-backed IPOs and VC-backed IPOs. Likewise, IPO activity high was set as a dummy variable, with IPO activity medium and low working as references for the dummy variable. For explanation, see section 3.8.6.

To conduct the regression analysis, the Ordinary Least Squares (OLS) method was used as it is the most commonly used model (Brooks, 2014). OLS minimizes the total sum of the squared areas by adjusting the line so that the vertical distances between each point is minimized. To conduct the regression analysis, the models itself must be linear, hence the Ramsey RESET test was used to test the linearity of the model. For OLS to hold, certain assumption must hold. These are the following;

1.  $E(u_t) = 0$
2.  $var(u_t) = \sigma^2 < \infty$
3.  $cov(u_i, u_j) = 0$
4.  $cov(u_t, x_t) = 0$
5.  $u_t \sim N(0, \sigma^2)$

Assumption 1 states that the errors should have an average value of zero. Brooks (2014) explains that for this assumption to hold, the line needs to have a y-intercept otherwise slope coefficient estimates could be biased. Assumption 2 is referred to as the assumption of homoscedasticity and states that the errors must have a variance that is constant. This assumption can be verified through tests that detect if there is any heteroscedasticity present (i.e. non-constant variance). Such tests include the Goldfeld-Quandt (GQ) and White's tests, though the GQ test is the simpler of the two, the authors conducted White's test since it has fewer assumptions regarding the likely form of heteroscedasticity. The third assumption states that errors should be uncorrelated with one another, if such a correlation exists then the errors are said to be autocorrelated. We conduct a Durbin-Watson test to verify that the third assumption holds. The fourth assumption states that the covariance between an independent variable and its corresponding error term should be zero. The fifth and final assumption claims that error terms should be normally distributed, and we use the Bera-Jarque test to interpret if

any deviation exists through checking the kurtosis and skewness of the distribution (Brooks, 2014).

Once we confirm that all 5 assumptions hold, we must test for multicollinearity for the OLS estimation to produce results that are effective. This acts as a sixth assumption that states that all independent variables are uncorrelated to each other, otherwise multicollinearity exists. Multicollinearity is categorized into 2 classes; near and perfect. Near multicollinearity indicates that there is a non-negligible correlation whereas perfect multicollinearity occurs if at least 2 independent variables are perfectly correlated with each other. In practice, near multicollinearity is more likely to occur, and if it does occur then statistical significance is reduced. For this reason, a correlation test must also be conducted. In order to distinguish if any multicollinearity exists between the variables, the variance inflation factor test and a correlation matrix were used (Brooks, 2014).

When all previously mentioned assumptions hold, the estimators determined by OLS are said to be BLUE, i.e. best linear unbiased estimators. This can be confirmed through the Gauss-Markov theorem which states that OLS estimators have the lowest variance of all similar methods (Brooks, 2014).

The tests that have been conducted to determine that all OLS assumptions holds are highlighted in the following table:

<b>Assumption</b>	<b>Test</b>	<b>Value to hold</b>
Non-linearity	Ramsey's RESET	Above 5 percent significance
Heteroscedasticity	White test	Above 5 percent significance
No autocorrelation	Durbin-Watson test	Above 1.65
Normally distributed errors	<u>Bera-Jarque test</u>	Above 5 percent significance
No Multicollinearity	Correlation matrix & VIF tests	Below 0.8 and $\leq 1$ respectively

Next, to determine the extent to which the BHAR's linear variation can be explained through the linear relationship with an independent variable, we make use of the coefficient of determination ( $R^2$ ). In the case that  $R^2$  turns out to be greater than zero, then the linear relationship between BHAR and an independent variable can be explained. However, in the study we make use of the adjusted  $R^2$  since we make use of more than one independent variable. The adjusted  $R^2$  takes into account the number of variables as opposed to  $R^2$  which would simply accumulate the degrees of explanation for each of the independent variables (Korner & Wahlgren, 2006)

## 3.10 LIMITATIONS OF RESEARCH

### 3.10.1 TIME

Abnormal return can be measured either through event time or calendar time (Fama, 1998). Gompers and Lerner (2003) claim that since cross sectional dependence among IPO's exists and leads to returns overlapping with one another, it is better to use calendar time when variations of abnormal returns across years are being analysed and that it is better to use event time when IPO's on different dates are being analysed. However, the authors chose to use event time due to the prevalent use of event time in previous studies and also due to the time constraint of the research.

### 3.10.2 BHAR

Our dependent variable of long-run performance could be measured in a number of ways, according to previous literature there are two main methods used to calculate long-run abnormal returns; buy and hold abnormal returns (BHAR) and cumulative abnormal returns (CAR). The underlying assumption of trading strategy is a factor in deciding which of these two methods is more suitable (Bergstrom, 2006). Gompers and Lerner (2003) state that choosing CAR becomes less and less suitable as volatility increases, and since IPO's firms tend to consist of smaller firms that are in the growth stage they are more volatile (Berk & Demarzo, 2013). Since this study focuses on a trading strategy over a three-year period, BHAR is considered the most appropriate measure for long-run abnormal returns (Brown & Warner, 1985).

### **3.10.3 BENCHMARK**

Previous academic literature highlights two main types of benchmarks, the first method is more straightforward and utilizes the use of large equity market index' such as the MSCI countries index'. The second method relies on constructing a portfolio which consists of public firms that match each IPO based on characteristics such as market capitalization, profitability, and industry type. Although a simple market index cannot truly reflect the specific and individualistic qualities of the various IPO firms, due to the complexity and time required in using the second method the authors decided to use a market index. The MSCI Nordic index is used.

### **3.10.4 RELIABILITY**

A known requirement for a research study is that results should be replicable. For that reason, no random errors that effect the results should be present. Throughout the course of the research the authors made assumptions and choices that may have certain effects on the outcome of the research, had the same research questions been used in a study with a slightly different methodology then different results and conclusions may arise. A perfect example would be the use of a different benchmark, or the use of CAR instead of BHAR. However, the variables chosen in this study have been done so on the basis of published academic literature and therefore no reason can be found for changing these choices. In terms of data collection and processing, the same results would be attained in the case of a repeated study, the sources of data Zephyr, Argentum, and DataStream are all established and acknowledged databases commonly used by researchers in the financial industry.

### **3.10.5 NON-RESPONSE ANALYSIS**

Approximately 25 percent of all IPOs on the Nordic market were part of the sample in this research. Through the Zephyr database, a random selection of the NS IPOs and all of the PE and VC IPOs available on the database were selected. Though as previously mentioned, after a closer inspection we realize that Zephyr was not accurate in distinguishing the ownership structure of the various IPO's; some NS firms were listed as PE/VC and vice-versa. After distinguishing the true ownership structure and using our selection criteria to filter out firms that we unsuitable for the study we were left with 52 PE-backed IPOs, 54 VC-backed IPOs and 58 Ns IPOs. IPO's that were listed on more than one exchange pre-IPO had to be excluded as such cross-listed stocks are highly correlated with one another and would tamper with the

results; shares in the firm already being listed on another exchange would affect the IPO since the firm already has an established market value (See section 3.4 & 3.5).

## 4. Results

*In the following presentation of results, the authors will present results from the data that has been collected and results from the tests conducted. For all subgroups (PE, VC, NS) the average BHAR values as well as first day returns before and after the crisis will be presented.*

*ANOVA tests will also be presented in an attempt to illustrate whether we can prove if any statistical differences exist between the three subgroups. The authors also conducted regression analyses in order to determine whether the selected independent variables had an impact on BHAR. Furthermore, the result of the OLS assumptions will be presented.*

## 4.1 PRESENTATION OF THE DATA

the authors present the data in this section. The data is presented according to the origin of country and ownership structure.

### 4.1.1 ORIGIN OF COUNTRY

The data was collected and divided into two subcategories; IPOs before and after the financial crisis. As seen in table 1, Sweden represent the biggest sample in both subcategories, whereas Norway follows as second biggest in both samples. In comparison, the study sample has only a few IPOs from Denmark and Finland.

TABLE 1

<b>Study Sample before the financial crisis</b>			<b>Study Sample after the financial crisis</b>		
<i>Country</i>	<i>All</i>	<i>Percent</i>	<i>Country</i>	<i>All</i>	<i>Percent</i>
Denmark	13	15	Denmark	6	8
Finland	10	11	Finland	1	1
Norway	32	36	Norway	23	31
Sweden	34	38	Sweden	45	60
<i>Total</i>	<i>89</i>	<i>100</i>	<i>Total</i>	<i>75</i>	<i>100</i>

### 4.1.2 OWNERSHIP STRUCTURE

The study sample consists mostly of NS issues, followed by VC-backed IPOs and lastly PE-backed IPOs. This is consistent both before and after the financial crisis as seen from table 2.

TABLE 2

Study Sample before the financial crisis			Study Sample after the financial crisis		
<i>Ownership</i>	<i>All</i>	<i>Percent</i>	<i>Ownership</i>	<i>All</i>	<i>Percent</i>
PE	27	30	PE	25	33
VC	30	34	VC	24	32
NS	32	36	NS	26	35
<i>Total</i>	<i>89</i>	<i>100</i>	<i>Total</i>	<i>75</i>	<i>100</i>

## 4.2 BHR

In this section the statistical tests that have been made on the data will be presented. First the authors will present a t-test for BHR to show if differences exist between the average BHR of IPOs and the average BHR of the market index MSCI before and after the financial crisis of 2008. Moreover, the authors will present ANOVA-tests to prove statically if there exists any difference between the variables before and then after the financial crisis of 2008.

### 4.2.1 BHR BEFORE THE FINANCIAL CRISIS

The t-test shows the average BHR for IPO and the market index MSCI. As seen from the statistical test, the average BHR for IPO is negative while the average BHR of the index is found to be positive. The differences in the average BHR is statistical proven; average BHR of MSCI index outperform the average BHR IPO with approximately 40 percent (see appendix 1).

#### 4.2.1.1 BHR AFTER THE FINANCIAL CRISIS

As seen from the statistical test, the average BHR for IPO is positive and almost equal to the average BHR of the MSCI index. The differences in the average BHR is not statistically proven, since the significance level is above the significance level of 5 percent (See appendix 2).

### 4.2.2 FIRST DAY-RETURNS BEFORE THE FINANCIAL CRISIS

Table 3 shows the averages in first day returns between the three subgroups; PE, VC and NS. As seen in table 3, the averages are quite similar between the NS-group and the PE-group.

However, they do both differ substantially from the VC-group. PE-backed IPOs had the lowest first day return, followed by NS IPOs and lastly followed by VC-backed IPOs.

TABLE 3

<b>Average First-Day Return (%)</b>			
<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
5,18	42,26	6,99	18,14
(17,02)	(151,24)	(35,07)	(91,39)

*Standard Deviation is displayed within the parentheses (%).*

Since the variance in the samples is large, an ANOVA test is performed to test the following hypothesis:

$H_0 =$  *The mean of the first-day return is the same for all three subgroups*

$H_1 =$  *In a non-random manner, at least one of the groups has a difference in the average first-day return*

TABLE 4

<b>ANOVA test for First-Day Return</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	25959,86	2.00	12979,93	1,57	0,21
<i>Within Groups</i>	708987,1	86	8244,036		
<i>Total</i>	734946,9	88			

The ANOVA test shows a significance level of 21.3 percent, which is above the significance threshold level. Hence, the null-hypothesis is accepted and no difference between the averages in first day-return can be proven.

#### 4.2.2.1 FIRST DAY-RETURNS AFTER THE FINANCIAL CRISIS

Table 5 shows the averages in first day returns between the three subgroups; PE, VC and NS. As seen in table 5, the averages are quite similar between the NS-group and the PE-group. However, they do both differ substantially with the VC-group. PE-backed IPOs had the lowest

first day return, followed by NS IPOs and lastly followed by VC-backed IPOs. The rankings of the three subgroups are the same as before the financial crisis, however the averages differ.

TABLE 5

<b>Average First-Day Return (%)</b>			
<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
4,00	50,53	26,19	26,58
(18,64)	(169,09)	(63,14)	(103,46)

*Standard Deviation is displayed within the parentheses (%).*

Since the variance in the samples is large, an ANOVA test is performed to test the previous hypothesis.

TABLE 6

<b>ANOVA test for First-Day Return</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	26518,82	2.00	12979,93	1,25	0,29
<i>Within Groups</i>	765600,1	72	10633,33		
<i>Total</i>	792118,9	74			

The ANOVA test shows a significance level of 29.4 percent, which is above the significance threshold level. Hence, the null-hypothesis is accepted and no difference between the averages in first day-return can be proven.

### 4.2.3 BHAR

The table below shows the averages in BHAR between the three subgroups; PE, VC and NS. As seen in the table below, the average BHAR is very different between the subgroups, whereas the NS-group is showing the highest underperformance (61.67 percent). This is then followed by the VC group with an underperformance of 49.49 percent and lastly by PE-backed IPOs who is showing the least underperformance (8.69 percent).

TABLE 7

<b>Average BHAR (%)</b>			
<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
-8,69	-49,49	-61,67	-41,49
(104,69)	(124,89)	(115,22)	(115,86)

*Standard Deviation is displayed within the parentheses (%).*

An ANOVA test is performed to test the following hypothesis;

$H_0 =$  *The mean of BHAR is the same for all three subgroups*

$H_1 =$  *In a non-random manner, at least one of the group has a difference in the mean of BHAR*

TABLE 8

<b>ANOVA test for BHAR</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	44001,78	2.00	22000,89	1,66	0,20
<i>Within Groups</i>	1137237	86	13223,68		
<i>Total</i>	1181238	88			

The ANOVA test shows a significance level of 19.54 percent, which is above the significance threshold level. Hence, the null-hypothesis is accepted and no difference between the means of BHAR can be proven.

#### 4.2.3.1 BHAR AFTER THE FINANCIAL CRISIS

Table 9 shows the averages in BHAR between the three subgroups; PE, VC and NS. As seen in the table below, the average BHAR's vary greatly between each other and also are very different from the average values before the financial crisis. The rankings of underperformance change somewhat after the financial crisis, where the VC-backed IPOs are showing the highest underperformance (34.22 percent). NS-backed IPOs and PE-backed IPOs are not showing any underperformance as the values are positive. As seen from the

table below, PE-backed IPOs are performing best with a positive average BHAR of 23.76 percent, which is then followed by NS-backed IPOs with an average BHAR of 9.51 percent.

TABLE 9

<b>Average BHAR (%)</b>			
<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
23,758	-34,2242	9,506985	0,26
(112,39)	(147,42)	(145,63)	(136,45)

*Standard Deviation is displayed within the parentheses (%).*

An ANOVA test is performed to test the hypothesis in the previous section.

TABLE 10

<b>ANOVA test for BHAR</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	44566,97	2.00	22283,49	1,20	0,31
<i>Within Groups</i>	1333258	72	18517,47		
<i>Total</i>	1377825	74			

The ANOVA test shows a significance level of 30.6 percent, which is above the significance threshold level. Hence, the null-hypothesis is accepted and no difference between the averages BHAR can be proven.

#### 4.2.4 MARKET CAPITALIZATION

Table 11 shows the average logarithm of the market capitalization between the subgroups and varies between the values of 11.32 and 12.31.

**TABLE 11**

<b>Average Market Capitalization (ln)</b>			
<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
12.18	11.31	12.31	11.94

An ANOVA test is performed to test the following hypothesis;

$H_0 =$  *The mean of the logarithm of market capitalization is the same for all three subgroups*

$H_1 =$  *In a non-random manner, at least one of the groups has a difference in the mean of the logarithm of the market capitalization*

**TABLE 12**

<b>ANOVA test for Market Capitalization (ln)</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	17,80463	2	8,902315	4,28	0.02
<i>Within Groups</i>	178,9941	86	2,081327		
<i>Total</i>	196,7987	88			

The ANOVA test shows a significance level of 1.7 percent, which is below the significance threshold level. Hence, the null-hypothesis is rejected and a difference between the mean of the logarithm of market capitalization can be proven.

Since the ANOVA test do not provide information regarding which mean differ from each other, a post-hoc test is performed to determine between which subgroups a difference exist. The post-hoc test in table 13 shows that PE-backed IPOs have a significantly higher mean in the logarithm of market capitalization than VC-backed IPOs and that NS issues have a significantly higher mean in the logarithm of market capitalization than VC-backed IPOs. However, a difference between the means of logarithm market capitalization cannot be statistically proven between the PE-backed IPOs and NS IPOs.

TABLE 13

<b>Multiple Comparisons – LSD</b>				
<b>Dependent Variable: Market Capitalization (ln)</b>				
<i>(I)</i>	<i>Sponsored</i>	<i>Mean</i>	<i>Variance</i>	<i>Sig.</i>
<i>Type</i>		<i>Difference</i>		
		<i>(I-J)</i>		
<b>PE</b>	<i>NS</i>	-0,13226	2,48	0,75
	<i>VC</i>	0,86761	1,17	0,00
<b>NS</b>	<i>PE</i>	0,13226	2,48	0,75
	<i>VC</i>	0,99988	2,54	0,02
<b>VC</b>	<i>PE</i>	-0,86761	1,17	0,00
	<i>NS</i>	-0,99988	2,54	0,02

#### 4.2.4.1 MARKET CAPITALIZATION AFTER THE FINANCIAL CRISIS

Table 14 shows the average logarithm of the market capitalization between the subgroups and varies between the values of 10.74 and 12.28.

TABLE 14

<b>Average Market Capitalization (ln)</b>			
<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
12.28	11.19	10.74	11.40

An ANOVA test is performed to test the previous hypothesis.

TABLE 15

<b>ANOVA test for Market Capitalization (ln)</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	31,55855	2	15,77928	5,02	0.01
<i>Within Groups</i>	226,151	72	3,140986		
<i>Total</i>	257,7096	74			

The ANOVA test shows a significance level of 0.9 percent, which is below the significance threshold level. Hence, the null-hypothesis is rejected and a difference between the mean of the logarithm of market capitalization can be proven.

As seen in the post-hoc test below, table 16, PE-backed IPOs have a significantly higher mean in the logarithm of market capitalization than VC-backed IPOs and NS issues. However, a difference between the means of logarithm of market capitalization cannot be statistically proven between the VC-backed IPOs and NS IPOs.

**TABLE 16**

---

**Multiple Comparisons – LSD**  
**Dependent Variable: Market Capitalization (ln)**

---

<i>(I)</i>	<i>Sponsored Type</i>	<i>Mean Difference (I-J)</i>	<i>Variance</i>	<i>Sig.</i>
<b>PE</b>	<i>NS</i>	1,53572	3,81	0
	<i>VC</i>	1,08610	1,80	0,00
<b>NS</b>	<i>PE</i>	-1,53572	3,81	0,00
	<i>VC</i>	-0,44961	3,77	0,42
<b>VC</b>	<i>PE</i>	-1,08610	1,8	0,00
	<i>NS</i>	0,44961	3,77	0,42

---

#### 4.2.5 THE OFFERING SIZE

As seen in table 17, the mean of the logarithm of offering size between the PE-backed IPOs, VC-backed IPOs and NS issues varies between the values of 10.04 and 11.36.

**TABLE 17**

---

**Average Offering Size (ln)**

---

<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
11.36	10.04	10.83	10.73

---

An ANOVA test is performed to test the following hypothesis;

$H_0$  = The mean of the logarithm of offering size is the same for all three subgroups.

$H_1$  = In a non-random manner, at least one of the group has a difference in the mean of the logarithm of offering size.

The ANOVA test shows a significance level of 0.8 percent, which is below the significance threshold level. Hence, the null-hypothesis is rejected and a difference between the mean of the logarithm of offering size can be proven.

TABLE 18

<b>ANOVA test for Offering Size (ln)</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	25,16391	2	12,58196	2.06	0.00
<i>Within Groups</i>	213,7823	86	2,48584		
<i>Total</i>	238,9462	88			

As seen in the post-hoc test below, table 19, PE-backed IPOs have a significantly higher mean in the logarithm of offering size than VC-backed IPOs. Furthermore, NS issues have a significantly higher mean in the logarithm of offering size than VC-backed IPOs. However, a difference between the means of logarithm of offering size cannot be statistically proven between the PE-backed IPOs and NS issues.

TABLE 19

**Multiple Comparisons – LSD****Dependent Variable: Offering Size (ln)**

<i>(I)</i> <i>Type</i>	<i>Sponsored</i>	<i>Mean Difference (I-J)</i>	<i>Variance</i>	<i>Sig.</i>
<b>PE</b>	<i>NS</i>	0,527275	3,1	0,26
	<i>VC</i>	1,315828	1,25	0,00
<b>NS</b>	<i>PE</i>	-0,52728	3,1	0,26
	<i>VC</i>	0,78855	3,03	0,08
<b>VC</b>	<i>PE</i>	-1,31583	1,25	0,00
	<i>NS</i>	-0,78855	3,03	0,08

## 4.2.5.1 THE OFFERING SIZE AFTER THE FINANCIAL CRISIS

As seen in table 20, the mean of the logarithm of offering size between the PE-backed IPOs, VC-backed IPOs and NS issues varies between the values of 9.45 and 11.47.

TABLE 20

**Average Offering Size (ln)**

<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
11.47	9.92	9.45	10.27

An ANOVA test is performed to test the hypothesis in the previous section.

TABLE 21

**ANOVA test for Offering Size (ln)**

	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	56,41661	2	28,20831	7.78	0.00
<i>Within Groups</i>	260,9647	72	3,624509		
<i>Total</i>	317,3813	74			

The ANOVA test shows a significance level which is below the significance threshold level. Hence, the null-hypothesis is rejected and a difference between the mean of the logarithm of offering size can be proven.

As seen in the post-hoc test below, table 22, PE-backed IPOs have a significantly higher mean in the logarithm of offering size than VC-backed IPOs and NS issues. However, a difference between the means of logarithm of offering size cannot be statistically proven between the VC-backed IPOs and NS issues.

**TABLE 22**

**Multiple Comparisons – LSD**

**Dependent Variable: Offering Size (ln)**

<i>(I)</i> <i>Type</i>	<i>Sponsored</i>	<i>Mean Difference (I-J)</i>	<i>Variance</i>	<i>Sig.</i>
<b>PE</b>	<i>NS</i>	2,0197	4,46	0,00
	<i>VC</i>	1,550466	1,84	0,00
<b>NS</b>	<i>PE</i>	-2,0197	4,46	0,00
	<i>VC</i>	-0,46924	4,52	0,44
<b>VC</b>	<i>PE</i>	-1,55047	1,84	0,00
	<i>NS</i>	0,46924	4,52	0,44

#### 4.2.6 LEVERAGE RATIO

As seen in table 23, the mean in the leverage ratio between the PE-backed IPOs, VC-backed IPOs and NS issues varies between the values of 25.67 and 152.36.

**TABLE 23**

**Average Leverage Ratio (%)**

<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
152.36	25.67	63.94	77.87

An ANOVA test is performed to test the following hypothesis;

$H_0$  = The mean in leverage ratio is the same for all three subgroups

$H_1$  = In a non-random manner, at least one of the group has a difference in leverage ratio

TABLE 24

<b>ANOVA test for Leverage Ratio</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	237763,3	2.00	118881,6	10.89	0.00
<i>Within Groups</i>	938665,6	86	10914,72		
<i>Total</i>	1176429	88			

The ANOVA test shows a significance level which is below the significance threshold level. Hence, the null-hypothesis is rejected and a difference between the mean in leverage ratio can be proven.

As seen in the post-hoc test below, table 25, PE-backed IPOs have a significantly higher leverage ratio than VC-backed IPOs and NS issues. Furthermore, NS issues have a significantly higher leverage ratio than VC-backed IPOs.

TABLE 25

<b>Multiple Comparisons – LSD</b>				
<b>Dependent Variable: Leverage Ratio</b>				
<i>(I)</i>	<i>Sponsored</i>	<i>Mean</i>	<i>Variance</i>	<i>Sig.</i>
<i>Type</i>		<i>Difference</i>		
		<i>(I-J)</i>		
<b>PE</b>	<i>NS</i>	88,4148	15465,4	0,00
	<i>VC</i>	126,689	13086,7	0,00
<b>NS</b>	<i>PE</i>	-88,4148	15465,4	0,00
	<i>VC</i>	38,2741	4600,55	0,03
<b>VC</b>	<i>PE</i>	-126,689	13086,7	0,00
	<i>NS</i>	-38,2741	4600,55	0,03

#### 4.2.6.1 LEVERAGE RATIO AFTER THE FINANCIAL CRISIS

As seen in table 26, the mean in the leverage ratio between the PE-backed IPOs, VC-backed IPOs and NS issues varies between the values of 21.83 and 202.41.

TABLE 26

<b>Average Leverage Ratio (%)</b>			
<i>PE</i>	<i>VC</i>	<i>NS</i>	<i>All</i>
202.41	21.83	54.21	93.25

An ANOVA test is performed to test the hypothesis in the previous section.

TABLE 27

<b>ANOVA test for Leverage Ratio</b>					
	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	459915,3	2.00	229957,7	10.99	0.00
<i>Within Groups</i>	1505197	72	20905,51		
<i>Total</i>	1965112	74			

The ANOVA test shows a significance level which is below the significance threshold level. Hence, the null-hypothesis is rejected and a difference between the mean in leverage ratio can be proven.

As seen in the post-hoc test below, table 28, PE-backed IPOs have a significantly higher leverage ratio than VC-backed IPOs and NS issues. Furthermore, NS issues have a significantly higher leverage ratio than VC-backed IPOs.

TABLE 28

<b>Multiple Comparisons – LSD</b>				
<b>Dependent Variable: Leverage Ratio</b>				
<i>(I)</i>	<i>Sponsored</i>	<i>Mean</i>		
<i>Type</i>		<i>Difference</i>	<i>Variance</i>	<i>Sig.</i>
		<i>(I-J)</i>		
<b>PE</b>	<i>NS</i>	148,196	30146,8	0,00
	<i>VC</i>	180,574	28821,3	0,00
<b>NS</b>	<i>PE</i>	-148,196	30146,8	0,00
	<i>VC</i>	32,3772	3720,78	0,07
<b>VC</b>	<i>PE</i>	-180,574	28821,3	0,00
	<i>NS</i>	-32,3772	3720,78	0,07

### 4.3 REGRESSION ANALYSIS

To answer the second research question, five regression analyses were conducted before and after the financial crisis (see table 29 and 30). BHAR, which was the dependent variable in the regression model, was tested against each independent variable, one at a time, until all independent variables were added into the regression i.e. regression model 5 (See appendix 3 and 4 for the fifth regression model). Since we want to answer the second research question, model 5 will be the focus in this section as all independent variables are included in this regression model. Due to problems with the OLS assumptions, the independent variable market capitalization is removed from the regression both before and after the financial crisis, hence only five independent variables are included in the regression model (For further explanation, see section 4.2.4).

#### 4.3.1 REGRESSION ANALYSIS BEFORE THE FINANCIAL CRISIS

Almost none of the independent variables show any significant impact on BHAR. The only independent variable that had a significant impact on BHAR was offering size. The independent variable offering size is significant below the 5 percent threshold and has a negative impact on BHAR. See table 29 and appendix 3.

TABLE 29

<b>Independent Variable</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>	<b>Model 5</b>
<i>First-day return</i>	0.0747 (0.136)	0.0839 (0.137)	0.044 (0.135)	0.0579 (0.135)	0.0477 (0.134)
<i>Leverage Ratio</i>		0.07878 (0.10799)	0.169 (0.1134)	0.0809 (0.1213)	0.1011 (0.1212)
<i>Offering size (ln)</i>			-17.66 (8.02)	-19.43 (8.08)	-21.13 (8.11)
<i>PE (Dummy)</i>				56.18 (31.27)	47.55 (31.6)
<i>VC (Dummy)</i>				-2.07 (29.75)	-11.13 (30.17)
<i>High IPO Activity Period (Dummy)</i>					-37.9 (25.74)
<i>C</i>	-42.86	-49.165	133.90	143.18	179.35
<i>N</i>	89	89	89	89	89
<i>Adjusted R<sup>2</sup> (Squared)</i>	-0.00798	-0.01343	0.02991	0.0507	0.06387

## Summary

<b>Independent Variable</b>	<b>Expected outcome</b>	<b>True outcome</b>
First-day return	Negative relationship	No relationship
Leverage ratio	A relationship	No relationship
Offering size	Positive relationship	Negative relationship
PE-backed	Different from the reference groups	No relationship
VC-backed	Different from the reference group	No relationship
High IPO activity period	Different from the reference group	No relationship

### 4.3.2 REGRESSION ANALYSIS AFTER THE FINANCIAL CRISIS

In line with the previous result, almost none of the independent variables show any significant impact on BHAR. The only independent variables that have a significant impact on BHAR are offering size and PE. The independent variable offering size is significant below the 1 percent significance level and has a negative impact on BHAR. The independent variable PE is significant below the 10 percent significant level and has a positive impact on BHAR. See table 30 and appendix 4.

TABLE 30

<b>Independent Variable</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>	<b>Model 5</b>
<i>First-day return</i>	-0.0039 (0.154)	0.00522 (0.156)	-0.043267 (0.142)	-0.0037 (0.141)	-0.02245 (0.1402)
<i>Leverage Ratio</i>		0.0556 (0.099)	0.228 (0.0996)	0.141 (0.1055)	0.1207 (0.1054)
<i>Offering size (ln)</i>			-31.67 (7.852)	-35.08 (8.036)	-34.38 (7.976)
<i>PE (Dummy)</i>				64.14 (39.229)	79.04 (40.11)
<i>VC (Dummy)</i>				-22.61 (35.489)	-11.70 (35.91)
<i>High IPO Activity Period (Dummy)</i>					-68.67 (45.56)
<i>C</i>	-0.3668	-5.0577	305.51	333.50	328.467
<i>N</i>	118	75	75	75	75
<i>Adjusted R<sup>2</sup> (Squared)</i>	-0.00389	-0.02329	0.155776	0.187595	0.202294

## Summary

<b>Independent Variable</b>	<b>Expected outcome</b>	<b>True outcome</b>
First-day return	Negative relationship	No relationship
Leverage ratio	A relationship	No relationship
Offering size	Positive relationship	Negative relationship
PE-backed (Dummy)	Different from the reference groups (NS)	Positive compared to reference
VC-backed (Dummy)	Different from the reference group (NS)	No relationship
High IPO activity period (Dummy)	Different from the reference group (Medium/low)	Negative compared to reference

## 4.4 OLS ASSUMPTIONS

For a valid and interpretable result, assumptions regarding OLS must be satisfied as explained in chapter 3. In this section the results of the tests performed on the regressions to prove that the OLS assumptions hold are presented

### 4.4.1 LINEAR IN PARAMETERS

To perform a regression analysis, OLS requires that a y-intercept exists. Since each regression, both before (see appendix 3) and after (see appendix 4) have a C-value that is smaller or greater than zero, this assumption holds.

#### 4.4.2 HOMOSCEDASTICITY

For OLS to hold, the residuals i.e. the error terms must have constant variance. To test this assumption the authors performed a variance white-test for the regression before and after the financial crisis, where the null hypothesis is that the errors terms are homoscedastic. The white test shows that the variance of the errors terms is constant (i.e. homoscedastic) since the significance level is above the 5 percent threshold in both regressions (see appendix 9 and 10). Thus, the null hypothesis of homoscedasticity is accepted and the assumption is confirmed in both regressions.

#### 4.4.3 AUTOCORRELATION

OLS assumes that there is no autocorrelation between the residuals. To test this assumption, a Durbin-Watson test is included in each regression analysis i.e. before and after the financial crisis. For the null hypothesis of no autocorrelation between the residuals to hold, the Durbin-Watson test must have a value above 1.65. As seen in appendix 5 and 6, the value of the Durbin-Watson test is above the threshold of 1.65. Hence, the assumption of no autocorrelation holds in both regressions.

#### 4.4.4 MULTICOLLINEARITY

Another assumption of OLS is that there should not exist any correlation between the independent variables i.e. multicollinearity should not exist. To test that no multicollinearity exists, two tests are performed, a correlation matrix and a Variance Inflation Factor (VIF) test. As seen in the appendix 5 and 6, the correlation matrix shows that there exist a correlation between the logarithms of offering size and market capitalization both before and after the financial crisis, since the correlations have a value above the threshold of 0.8 in both cases. This is confirmed by the VIF test, as the values of the logarithms of offering size and market capitalization are at the higher spectrum compared to the other variables (see appendix 7 and 8). To solve the issue of multicollinearity, one of the variables has to be excluded from the regression analysis. In both regressions, the authors chose to exclude market capitalization, since it has the lowest impact on BHAR in both cases i.e. before and after the financial crisis. Once the variable market capitalization was removed, the issue of multicollinearity was solved and the assumption of no multicollinearity was thereafter confirmed.

#### 4.4.5 NON-LINEARITY

OLS assumes linearity between the independent variables, hence for OLS to hold the independent variables need to be linear. To test non-linearity between the independent variables, Ramsey Reset test is performed. In both cases i.e. before and after the financial crisis, the null hypothesis of linearity between the variables is accepted, since in both cases the p-value is above the significance value of 5 percent (see appendix 11 and 12).

#### 4.4.6 NORMALLY DISTRIBUTED RESIDUALS

To properly interpret the results, OLS assumes that the residuals are normally distributed. To test whether the residuals are normally distributed, a Bera-Jarque test was conducted. As seen in appendix 13 and 14, the p-value is above the 5 percent significance level in both cases i.e. before and after the financial crisis. Hence, the null hypothesis is accepted and the assumption of normally distributed residuals holds for both regressions.

## 5. ANALYSIS

*In this section the authors analyse the results through theories and previous research that has been discussed in section two. Through this analysis the authors attempt to answer both research questions posed in section one.*

### 5.1 DIFFERENCES IN THE FIRST-DAY RETURNS BETWEEN OWNERSHIP STRUCTURES

According to the results, there was no statistical significance between the first-day returns of the three ownership structures. Nonetheless, it is still feasible to compare and analyze the change in average value of the first-day returns between PE, VC, and NS IPOs (Frederikslust & Geest, 2001). All three groups experience under-pricing both before and after the crisis and the rank of the under-pricing between the groups also remains the same; VC-backed firms have the highest level of under-pricing, followed by NS-backed, and with PE-backed as having the lowest under-pricing.

While the degree of underpricing remains relatively stable for PE and VC-backed firms before and after the crisis, non-sponsored firms become 19.2 percent more underpriced. A possible explanation for this could be the *market feedback hypothesis*, where firms are encouraged to underprice in order to obtain more information from the market. Whereas PE and VC sponsors perhaps have more information readily available than firms without a sponsor, NS firms are more incentivized to underprice to obtain information from the market in the turbulent times during and after the crisis.

Through analysis of the three ownership structure average values, it is apparent that PE-backed IPO's are on average less underpriced than VC-backed and NS IPO's and we can verify that the results of previous researches can also be applied to the Nordic market; PE-backed IPOs exhibit the least underpricing). This relatively low PE-backed IPO underpricing could possibly be explained through the *certification hypothesis*; certain PE firms have a high regard for their reputation and feel as though too much underpricing relative to competing IPO's would give them a bad reputation. Furthermore, it would be possible to explain the results through this theory with more certainty if we could verify that the PE firms involved in the IPO's in the study do in fact have relatively good reputations and that the VC firms involved have relatively bad reputations. However, even if this information was available to us, the ANOVA test between the three subgroups did not provide a statistically significant result therefore we cannot

conclude with certainty that PE-backed IPOs do exhibit less underpricing than VC-backed IPOs. This could be due to the high standard deviation within the groups; some firms showed large first-day returns while other firms exhibited large first-day losses.

## 5.2 BHAR

The result shows that there is no significant difference in the average values of BHAR between the three subgroups; PE, VC and NS. However, an analysis can still be made between the subgroup on the basis of the different values of BHAR.

When analyzing the average values of BHAR, it is clear that PE-backed IPOs outperformed VC-backed IPOs and NS issues both before and after the financial crisis. This is consistent with the results of several previous studies on the European and US market which found that PE-backed IPOs outperform none PE-backed IPOs. However, Levis (2011) found that PE-backed IPOs do not underperform relative to a benchmark, which is to some extent in line with this study. This is not the case before the financial crisis as all groups underperform the benchmark, however after the financial crisis PE-backed IPOs outperform the benchmark and surprisingly so do NS issues, however this was not statistically proven. This is inconsistent with Levis (2011) as NS-issues should underperform relative to a benchmark. Furthermore, this study shows that NS-issues outperform VC-backed IPOs after the financial crisis, which is also inconsistent with Levis (2011).

The superior performance of PE-backed IPOs relative to VC-backed IPOs and NS issues can be attributed to the positive reputation of PE ownership and to PE sponsors being able to monitor the company more closely (Katz, 2009). Thus, these factors decrease the information asymmetry on the market, which is line with the *divergence of opinion hypothesis*. Ritter (1998) explained that due to information asymmetry, investors hold different expectations regarding a company. Since PE-backed IPOs demonstrated the least amount of underperformance in comparison to the other groups and even showed no underperformance after the financial crisis, one could assume that this may be linked to PE-sponsors reducing the information asymmetry to the market. This would result in better performance according to the hypothesis, which is consistent with our result. Conversely, this would also assume that VC-sponsor increase the information asymmetry as VC-backed IPOs show higher underperformance than NS-issues after the financial crisis. However, before the financial crisis the *divergence of opinion*

*hypothesis* holds for both PE and VC-sponsors, as both have less underperformance than the NS-issues.

Ritter (1998) showed that high first-day returns will lead to a higher degree of underperformance and explained this with the *impresario hypothesis*. The theory is consistent with the result of this study both after and before the financial crisis, as PE-backed IPOs showed lowest average first-day returns and also lowest underperformance while VC-backed IPOs showed the highest average first-day returns and also the highest underperformance. Moreover, this is consistent with the findings of Levis (2011) who states that PE-backed IPOs have lowest first-day returns and perform better than VC-backed IPOs and NS-issues.

The *delisting hypothesis* (Benninga et al, 2005) explains how the option to reprivatize i.e. to go from being public to being private can explain underperformance of IPOs and can be applied to this study's result. Since the cash flow of newly issued companies is less than that of more mature companies, the risk of the newly issued companies should be lower and thus their returns should be lower. This is confirmed before the financial crisis as the MSCI Nordic Index performs better than the Nordic IPOs (See appendix 1). However, this is not the case after the financial crisis, as the IPOs do perform better than the MSCI Nordic Index. This can be attributed to the PE-backed IPOs, who have had a large positive BHAR value after the financial crisis. However, the outperformance of the IPOs in comparison to the MSCI Nordic Index after the financial crisis is not statistically proven. Nevertheless, since the PE-backed IPOs perform better than the subgroups, one can assume that PE-sponsors increase the cash-flow of the issuing firms, thus the risk and hence the returns. The value of the delisting option would in this case be decreased, as the presence of a PE-sponsor complicates the option to delist.

Since the ANOVA test did not show significance between the subgroups, the average values of BHAR cannot be compared with certainty. The authors may only suggest, based on the studies result, that PE-backed IPOs outperform VC-backed IPOs and NS issues, both before and after the financial crisis.

### 5.3 INDEPENDENT VARIABLES

As seen in appendix 1, before the financial crisis there is a significant difference between the average BHR in IPOs and MSCI Nordic Country Index, where MSCI outperforms the IPOs. This result is consistent with previous studies both from the European and the US market which

found that IPOs underperform in the long-run. However as seen in appendix 2, after the financial crisis there is no significant difference between the average BHR in IPOs and the MSCI Nordic Country Index, where the IPOs outperform the MSCI. The result is not significant, however we analyze the averages values of the result which are consistent with previous studies which have found that IPOs do not underperform in the long-run (Brav and Gompers, 1997; Gompers and Lerner, 2003).

Appendix 3 and 4 displays the final regressions and the impact the independent variables have on BHAR. The only variable that has a positive significant impact on BHAR before and after the financial crisis is *offering size*. This is inconsistent with previous research that found a positive relationship between the size of the offering size and long-run performance (Ritter, 1991) and the performance of PE-backed IPOs (Bergström et al, 2006). The regression analysis in appendix 4 shows that the dummy variable PE had a positive significant impact on BHAR after the financial crisis. This is in line with previous research which has found that PE-backed IPOs outperform VC-backed IPOs and NS issues (Bergström et al, 2006, Katz, 2009; Levis, 2011).

The other independent variables; first day return, leverage ratio, VC-ownership and high IPO activity – had no significant impact on BHAR neither before nor after the financial crisis. However, the authors analyze the coefficient of the independent variables and compare that to previous studies and researches. This finding can be explained by the hot and cold issue market phenomenon which states that under a certain time-period, the average first month performance is abnormally high (Ibbotson & Jaffe, 1975). Furthermore, Ritter (1984) found that companies during certain time periods exhibit average initial returns which are higher and in some time period they are lower. This entails that in this study, the market was cold after the financial crisis, hence underpricing was more severe and we therefore see a higher average first-day return for VC-backed IPOs and NS issues after the financial crisis. However, PE-backed IPOs experienced less underpricing after the financial crisis, which is contradictive of the theory. Nevertheless, the result was not significant.

### 5.3.1 FIRST-DAY RETURN

As noted in appendix 3 and 4, first-day returns had no statistically significant impact on BHAR either before or after the financial crisis. In the regression of the data before the crisis, the coefficient which shows the change in BHAR for every percentage change in first-day return

varies from 0.0747 to 0.0477 as seen in table 29, i.e. according to the coefficient from the first regression, for every percentage increase in first-day returns BHAR increases 0.0747. However, for the post-crisis data as seen in table 30, this coefficient ranges from -0.0039 to -0.0225 which indicates that there is a negative relationship between first-day returns and BHAR, this is in line with findings of Ritter (1991), Bergstrom et al. (2006), and Levis (2011). The coefficient of determination in the regression for both pre and post-crisis data is negative; this implies that first-day returns cannot explain BHAR which contradicts the previous research (Ritter, 1991; Bergstrom et al., 2006; Levis, 2011).

An ANOVA test was performed to see if there exists any difference in the average value of first-day returns between the three subgroups. As seen in table 4 and 6, the significance level is above the threshold level, hence we cannot prove that a difference exist. Even though we cannot prove a significant difference between the subgroups, the average values of first-day return are to some degree in line with previous literature which states that PE-backed IPOs are less underpriced than non-PE-backed IPOs (Bergström et al, 2006; Levis, 2011). This is the case both before and after the financial crisis. Furthermore, the average value of first-day return increased for VC-backed IPOs and NS issues, which is consistent with the hot and cold issue market theory that states first-day returns increase after the financial crisis (Ritter, 1998).

### 5.3.2 LEVERAGE RATIO

As seen in the appendix 3 and 4, the independent variable Leverage Ratio has a positive coefficient but no significant impact on BHAR, neither before or after the financial crisis of 2008. Furthermore, the adjusted coefficient of determination  $R^2$  is in both regressions negative as the independent variable leverage ratio is first added to the regression. Hence, leverage ratio cannot explain BHAR. This is not consistent with previous findings that state that a positive relationship exists between leverage ratio and BHAR (Hamada, 1972; Hou and Robinson, 2006; Levis, 2011) and that a negative relationship between leverage ratio and BHAR exists (Dimitroy and Jain, 2008; Korteweg, 2010).

An ANOVA test was performed to see if any difference exists in the average value of leverage ratio between the three subgroups PE, VC and NS. As seen from table 24 and 27 the significance level of the ANOVA test is below 0.01 percent both before and after the financial crisis, so a difference must exist. A post-hoc test was then performed to see in which subgroups the difference lies. By analyzing the post-hoc test (see table, 25 and 28), we see that PE-backed

IPOs have a significantly higher leverage ratio than VC-backed IPOs and NS issues at the 1 percent significance level. This is in line with previous research that finds that PE-backed IPOs have a higher leverage ratio than VC-backed IPOs and NS issues (Bergström et al., 2006; Levis, 2011; Mogilevsky & Murgulov, 2012). Furthermore, the post-hoc test tell us that NS firms have a significantly higher leverage ratio than VC-backed IPOs before the financial crisis at a 5 percent significant level and at a 10 percent significant level after the financial crisis. This could imply that VC-backed companies may have restricted access to the debt capital market, thus only seek funding from the equity capital market.

### 5.3.3 OFFERING SIZE

The regression analysis (see appendix 3 and 4) shows that the independent variable offering size has a negative coefficient and has a significant impact on BHAR both before the financial crisis of 2008. As seen in tables 29 and 30, the adjusted coefficient of determination  $R^2$  becomes positive in both regressions as the independent variable offering size is added to the regressions. Hence, offering size can explain BHAR. However, this is not in line with previous research which finds that offering size has a positive impact on BHAR ((Ritter, 1991; Bergström et al., 2006) since this study found that it has a negative impact on BHAR.

To see if a difference in the average value of offering size exists between the three subgroups, an ANOVA test was conducted. As seen from the ANOVA test in table 18 and 21, the significance level is below 0.1 percent both before and after the financial crisis, hence a difference exists. Therefore, a post-hoc test was performed to see in which subgroups the difference lies. As seen from table 19, the average logarithm of offering size before the financial crisis is significantly larger for PE-backed IPOs than that of VC-backed IPOs and significantly larger for NS issues than for VC-backed IPOs. This is partly in line with previous research which found that PE-backed IPOs have the biggest offering size, followed by VC-backed IPOs and lastly NS issues (Bergström et al., 2006; Ritter, 1998). However, these findings are completely in line with the result after the financial crisis, nevertheless it cannot be statically proven between VC-backed IPOs and NS issues.

### 5.3.4 OWNERSHIP STRUCTURE

As stated in the previous section, NS issues were set as a reference group when examining whether ownership structure has an impact on BHAR. As seen in appendix 3 and 4, the independent dummy variable PE has a positive coefficient both before and after the financial

crisis. This is in line with previous research on both the European and US market which finds that PE-backed IPOs have a positive impact on BHAR (Holthausen & Larcker, 1996; Bergström et al, 2006; Katz, 2009; Cao & Lerner 2009; Levis, 2011; Mogilevsky & Murgulov, 2012). The impact that PE-ownership has on BHAR is not significant before the financial crisis; however it is significant after the financial crisis.

In comparison, the independent variable VC has a negative coefficient both before and after the financial crisis i.e. it has a negative impact on BHAR. This is not consistent with previous findings on the European and US market (Brav & Gompers, 1997; Levis, 2011). However, the impact that VC-ownership has on BHAR is not significant neither before nor after the financial crisis.

### 5.3.5 IPO ACTIVITY PERIOD

Medium and low IPO Activity were set as a reference group when examining whether IPO activity has an impact on BHAR. As seen in appendix 3 and 4, the independent dummy variable high IPO activity has a negative coefficient i.e. a negative impact on BHAR both before and after the financial crisis. This is consistent with previous finding on the European market (Bergström et al., 2006; Levis, 2011) and the US market (Ritter, 1991). However, the impact that High IPO Activity has on BHAR is not significant both before and after the financial crisis.

## 6. CONCLUSION

*In this section the authors conclude based on the analysis and results of the study. Suggestions for further research are also discussed.*

The purpose of this research was to find if there were any differences in first day returns and long-run performance of IPOs with different ownership structures and to examine the effects that certain variable had on IPO performance before and after the global financial crisis. The

authors intent was to contribute to the field of IPO research by discussing IPO performance on the Scandinavian market due to the lack of substantial research on the region. We consider that the purpose of the study has been fulfilled even though not all results proved to be significant. No differences between long-run and first-day performance of the various subgroups could be determined, though this still answers the first research question. Furthermore, for those results that proved to be insignificant, analysis of average values was conducted in order to determine whether those results could be related to the previous research to see if the same relationships that have been established on foreign markets could also apply to the Nordic market. As for the second research question, the only variables that had a statistically significant impact on BHAR were PE-backed firms after the crisis and the offering size both before and after the crisis. With this we can conclude that there exists a positive relationship between PE-ownership and BHAR after the financial crisis and there is a negative relationship between offering size and BHAR both before and after the financial crisis. Though we could not determine significant impact of the rest of the variables we consider the second research question also answered, variables that were not significant nonetheless show a coefficient of determination and therefore demonstrate which variables may not impact BHAR. From the viewpoint of attempting to determine the factors influence long-run returns, determining certain variables that do not affect these returns could be seen almost as important as finding variables that do affect such returns.

Not every single IPO floated on the Scandinavian market from 2000 to 2013 has been included in the study, this begs the question of how our results may have differed had we included all IPOs. Though through the selected sample we believe that our results do show a balanced representation of all IPOs issued on the Nordic market.

Previous studies on first-day returns have found that VC-backed IPOs perform better than NS issues. However, in this study the results have deviated severely from that of previous studies since we have found that VC-backed IPOs on average experience much higher underpricing than NS issues. Furthermore, it is not as certain that PE-ownership and VC-ownership has an effect on IPOs in the Nordic market as it is in the US and the European markets, hence according to the *certification hypothesis*, this may explain why VC-backed IPOs experienced low performance in first-day returns and long term performance in our study. However PE-backed IPOs did perform in accordance with the findings in the European and the US markets and the regression analysis after the financial crisis had a significant impact on the long term

performance. Considering this, the authors question whether venture capitalists have a lower reputation on the Nordic market than the venture capitalists in the European market and the US market. Since the PE and VC industry has just recently started to establish itself in the Nordic market, one can assume that the establishment of private equity firms in the Nordic market have progressed more adequately than venture capitalists. Hence, the Nordic market may perceive that venture capitalist have less credibility, hence the poor performance of VC-backed IPOs. Since reputation is something that has to be built, it may be the case that the venture capital industry just needs more time to establish itself in the Nordic market and build a stronger reputation. Therefore, it may take some time before this establishment occurs and we can see similar results to those of PE-backed IPOs in the Nordic market.

In this study all stock exchanges in the Nordic market were considered which may have affected the results of BHAR and the first-day return. This is because there are different rules and regulation on different stock exchanges, thus this may have affected the result. If one would have only used stock exchanges with similar regulation, one may have gotten different results. The authors believe however that this would have been biased since a proper representation of the Nordic market would not have been possible in this case, since all Nordic countries have different stock exchanges some countries may have had to be excluded from the study.

To avoid the survivorship bias, some IPOs that were delisted within 3 years were included in the study. Perhaps a sample consisting of only IPOs which was successful enough to survive 3 years would have yielded a different result since the data in the sample would have been more comparable with one another. However, not including these IPOs would have been biased and a misrepresentation of the Nordic market since it is common for newly issue firms to delist. The study aimed to guide investors intrested to invest in IPOs on the Nordic market. Based on the results of the study, the authors would not recommend investors to invest in IPOs on the Nordic market since IPOs did underperform compared to the MSCI Nordic Countries Index before the financial crisis. However, this study also saw that IPOs did overperform compared to the MSCI Nordic Country Index after the financial crisis. However, since this result was not significant, no recommendation can be made based on it. The study also found that PE-backed IPOs do in fact have a significant effect on the BHAR, which is in line with previous studies drawn from the European and the US market. Based on this, the authors do recommend investing in PE-backed IPOs rather than VC-backed IPOs and NS issues. However, considering that the MSCI Nordic Country Index significantly outperforms the IPO market on average, the

authors recommend investing in the MSCI index over any IPOs, irrespectively of the ownerships structure.

## 6.1 FURTHER RESEARCH

The authors suggest further research in a few aspects. The first being to focus more on PE ownership and attempt to establish a relationship between IPOs with different degrees of PE ownership and IPO performance. Katz (2009) states that firms with higher level of PE ownership exhibit superior performance. While we classified PE ownership into PE and VC, it would be of interest to classify PE ownership in terms of degree of ownership which would allow us to observe if a relationship between degree of IPO ownership and IPO performance exists.

Secondly, conducting a study in which a distinction is made between the performance of IPOs in the four Nordic countries (Sweden, Norway, Denmark, Finland) would also be of interest. Though our justification for grouping the Nordic market together was that they shared several economic and social factors and that they have more in common together than they do with any other countries, more practically each country has several different factors that differentiate them from one another. A study on how average BHAR and average first-day returns vary between the Nordic countries could be of interest.

Further, one could repeat the entire study but by measuring the variables by different methods; instead of event time one could utilize calendar time and instead of BHAR one could utilize CAR. Previous literature suggests that these methods have different advantages and disadvantages therefore it would be of interest to see in what way the results would differ had calendar time and CAR as a measure of abnormal returns been used. (Gompers & Lerner, 2003) (Brown & Warner, 1985)



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# 8. APPENDIX

## APPENDIX 1 – TEST FOR EQUALITY OF MEANS BEFORE THE FINANCIAL CRISIS

Test for Equality of Means Between Series

Date: 05/21/18 Time: 00:12

Sample: 1 89

Included observations: 89

Method	df	Value	Probability
t-test	176	-4.113346	0.0001
Satterthwaite-Welch t-test*	170.2081	-4.113346	0.0001
Anova F-test	(1, 176)	16.91962	0.0001
Welch F-test*	(1, 170.208)	16.91962	0.0001

\*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	7.661604	7.661604
Within	176	79.69698	0.452824
Total	177	87.35859	0.493551

Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
BHR_IPO	89	-0.100081	0.732363	0.077630
BHR_MSCI	89	0.314853	0.607694	0.064415
All	178	0.107386	0.702532	0.052657

## APPENDIX 2 – TEST FOR EQUALITY OF MEANS AFTER THE FINANCIAL CRISIS

### Test for Equality of Means Between Series

Date: 05/21/18 Time: 00:17

Sample: 1 75

Included observations: 75

Method	df	Value	Probability
t-test	148	0.019482	0.9845
Satterthwaite-Welch t-test*	133.9042	0.019482	0.9845
Anova F-test	(1, 148)	0.000380	0.9845
Welch F-test*	(1, 133.904)	0.000380	0.9845

\*Test allows for unequal cell variances

### Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	0.000260	0.000260
Within	148	101.3987	0.685126
Total	149	101.3989	0.680530

### Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
BHR_IPO	75	0.104487	0.952583	0.109995
BHR_MSCI	75	0.101854	0.680321	0.078557
All	150	0.103170	0.824942	0.067356

### APPENDIX 3 – MULTIPLE REGRESSION ANALYSIS BEFORE THE FINANCIAL CRISIS

Dependent Variable: BHAR  
 Method: Least Squares  
 Date: 05/20/18 Time: 17:06  
 Sample: 1 89  
 Included observations: 89

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	179.3489	90.88207	1.973425	0.0518
FIRST_DAY_RETURN	0.047667	0.134111	0.355429	0.7232
LEVERAGE_RATIO	0.101110	0.121215	0.834135	0.4066
LN_OFFERING_SIZE	-21.12880	8.107216	-2.606173	0.0109
PE	47.55077	31.60169	1.504691	0.1362
VC	-11.12885	30.17489	-0.368811	0.7132
HIGH_IPO_ACTIVITY_PERIOD	-37.89835	25.74345	-1.472155	0.1448
R-squared	0.127697	Mean dependent var	-41.49348	
Adjusted R-squared	0.063870	S.D. dependent var	115.8584	
S.E. of regression	112.0974	Akaike info criterion	12.35200	
Sum squared resid	1030397.	Schwarz criterion	12.54773	
Log likelihood	-542.6640	Hannan-Quinn criter.	12.43089	
F-statistic	2.000678	Durbin-Watson stat	1.839865	
Prob(F-statistic)	0.074874			

### APPENDIX 4 – MULTIPLE REGRESSION ANALYSIS AFTER THE FINANCIAL CRISIS

Dependent Variable: BHAR  
 Method: Least Squares  
 Date: 05/20/18 Time: 18:15  
 Sample: 1 75  
 Included observations: 75

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	328.4671	77.85883	4.218752	0.0001
FIRST_DAY_RETURN	-0.022452	0.140222	-0.160117	0.8733
LEVERAGE_RATIO	0.120724	0.105447	1.144885	0.2563
LN_OFFERING_SIZE	-34.38311	7.976023	-4.310809	0.0001
PE	79.03956	40.11079	1.970531	0.0529
VC	-11.69718	35.90520	-0.325780	0.7456
HIGH_IPO_ACTIVITY_PERIOD	-68.66967	45.56317	-1.507131	0.1364
R-squared	0.266973	Mean dependent var	0.263334	
Adjusted R-squared	0.202294	S.D. dependent var	136.4524	
S.E. of regression	121.8716	Akaike info criterion	12.53250	
Sum squared resid	1009983.	Schwarz criterion	12.74880	
Log likelihood	-462.9687	Hannan-Quinn criter.	12.61887	
F-statistic	4.127660	Durbin-Watson stat	1.778199	
Prob(F-statistic)	0.001362			

## APPENDIX 5 – CORRELATION MATRIX BEFORE THE FINACIAL CRISIS

	<i>BHAR</i>	<i>First-day return</i>	<i>Leverage Ratio</i>	<i>LN Firm Size</i>	<i>LN Off.Size</i>	<i>C Dummy</i>	<i>PE Dummy</i>	<i>High IPO Activity Period Dummy</i>
<i>BHAR</i>	1							
<i>First-day return</i>	0,058943	1						
<i>Leverage Ratio</i>	0,07253	-0,092	1					
<i>LN Firm Size</i>	-0,18116	-0,02428	0,251705	1				
<i>LN Offering Size</i>	-0,19383	-0,15833	0,371512	0,858603	1			
<i>VC Dummy</i>	-0,04949	0,187767	-0,32373	-0,29861	-0,29711	1		
<i>PE Dummy</i>	0,187893	-0,09551	0,427581	0,108681	0,254986	-0,4706	1	
<i>High IPO Activity Period Dummy</i>	-0,13939	-0,06171	0,058194	-0,09115	-0,08359	-0,138	-0,08699	1

## APPENDIX 6 – CORRELATION MATRIX AFTER THE FINACIAL CRISIS

	<i>BHAR</i>	<i>First-day return</i>	<i>Leverage Ratio</i>	<i>LN Market Capitalization</i>	<i>LN Offering Size</i>	<i>VC</i>	<i>PE</i>	<i>High IPO Activity Period</i>
<i>BHAR</i>	1							
<i>First-day return</i>	-0,00295	1						
<i>Leverage Ratio</i>	0,065958	-0,10412	1					
<i>LN Market Capitalization Size</i>	-0,33392	-0,03161	0,417717	1				
<i>LN Offering Size</i>	-0,35767	-0,12114	0,436829	0,895338	1			
<i>VC</i>	-0,17455	0,159863	-0,30266	-0,0763	-0,1181	1		
<i>PE</i>	0,122571	-0,15538	0,476847	0,335661	0,411216	-0,48507	1	
<i>High IPO Activity Period</i>	-0,18248	-0,09122	-0,02853	0,034099	0,113389	0,098513	0,17408	1

## APPENDIX 7 – VARIANCE INFLATION FACTORS BEFORE THE FINANCIAL CRISIS

Variance Inflation Factors  
 Date: 05/20/18 Time: 17:51  
 Sample: 1 89  
 Included observations: 89

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	12349.46	86.40711	NA
FIRST_DAY_RETURN	0.019393	1.166107	1.120517
LEVERAGE_RATIO	0.014969	2.019495	1.384467
LN_OFFERING_SIZE	256.2718	211.1211	4.814072
LN_MARKET_CAPITA...	293.1695	296.8362	4.535788
PE	1092.993	2.320025	1.616197
VC	991.8401	2.339239	1.550732
HIGH_IPO_ACTIVITY...	675.9614	1.700527	1.089102

## APPENDIX 8 – VARIANCE INFLATION FACTORS AFTER THE FINANCIAL CRISIS

Variance Inflation Factors  
 Date: 05/20/18 Time: 18:14  
 Sample: 1 75  
 Included observations: 75

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	8960.097	44.67616	NA
FIRST_DAY_RETURN	0.020400	1.146203	1.074314
LEVERAGE_RATIO	0.011360	1.976603	1.484092
LN_OFFERING_SIZE	271.6423	148.6798	5.731661
LN_MARKET_CAPITA...	313.5465	208.5728	5.371980
PE	1632.154	2.712707	1.808471
VC	1309.538	2.089447	1.420824
HIGH_IPO_ACTIVITY...	2138.042	1.279265	1.125753

## APPENDIX 9 – WHITE TEST BEFORE THE FINANCIAL CRISIS

Heteroskedasticity Test: White  
Null hypothesis: Homoskedasticity

F-statistic	1.084088	Prob. F(23,65)	0.3859
Obs*R-squared	24.67507	Prob. Chi-Square(23)	0.3673
Scaled explained SS	28.69360	Prob. Chi-Square(23)	0.1907

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 05/20/18 Time: 17:41

Sample: 1 89

Included observations: 89

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17831.97	54996.35	0.324239	0.7468
FIRST_DAY_RETURN^2	1.222567	0.613498	1.992779	0.0505
FIRST_DAY_RETURN*LEVERAGE_RATIO	-2.090117	1.148918	-1.819205	0.0735
FIRST_DAY_RETURN*LN_OFFERING_SIZE	231.7714	97.87768	2.367969	0.0209
FIRST_DAY_RETURN*PE	-201.9398	366.3453	-0.551228	0.5834
FIRST_DAY_RETURN*VC	-1011.110	397.9791	-2.540612	0.0135
FIRST_DAY_RETURN*HIGH_IPO_ACTIVI...	-185.4039	324.4510	-0.571439	0.5697
FIRST_DAY_RETURN	-1881.324	1066.029	-1.764796	0.0823
LEVERAGE_RATIO^2	-0.046161	0.203065	-0.227323	0.8209
LEVERAGE_RATIO*LN_OFFERING_SIZE	8.485927	36.68370	0.231327	0.8178
LEVERAGE_RATIO*PE	-32.90208	86.02088	-0.382489	0.7033
LEVERAGE_RATIO*VC	52.09377	100.5210	0.518238	0.6061
LEVERAGE_RATIO*HIGH_IPO_ACTIVITY_...	16.63950	53.05439	0.313631	0.7548
LEVERAGE_RATIO	-45.70384	383.7941	-0.119084	0.9056
LN_OFFERING_SIZE^2	-55.55284	491.9570	-0.112922	0.9104
LN_OFFERING_SIZE*PE	-1484.095	4758.335	-0.311894	0.7561
LN_OFFERING_SIZE*VC	-2721.605	4462.767	-0.609847	0.5441
LN_OFFERING_SIZE*HIGH_IPO_ACTIVIT...	-3156.552	3994.493	-0.790226	0.4323
LN_OFFERING_SIZE	619.1906	10383.49	0.059632	0.9526
PE^2	7220.107	52042.83	0.138734	0.8901
PE*HIGH_IPO_ACTIVITY_PERIOD	14109.50	12896.65	1.094044	0.2780
VC^2	23150.45	46150.01	0.501635	0.6176
VC*HIGH_IPO_ACTIVITY_PERIOD	7721.683	12779.16	0.604240	0.5478
HIGH_IPO_ACTIVITY_PERIOD^2	15549.52	44285.13	0.351123	0.7266
R-squared	0.277248	Mean dependent var	11577.50	
Adjusted R-squared	0.021505	S.D. dependent var	19271.83	
S.E. of regression	19063.48	Akaike info criterion	22.77401	
Sum squared resid	2.36E+10	Schwarz criterion	23.44511	
Log likelihood	-989.4436	Hannan-Quinn criter.	23.04451	
F-statistic	1.084088	Durbin-Watson stat	2.276257	
Prob(F-statistic)	0.385873			

## APPENDIX 10 – WHITE TEST AFTER THE FINANCIAL CRISIS

Heteroskedasticity Test: White  
Null hypothesis: Homoskedasticity

F-statistic	0.737865	Prob. F(22,52)	0.7800
Obs*R-squared	17.84293	Prob. Chi-Square(22)	0.7153
Scaled explained SS	12.03064	Prob. Chi-Square(22)	0.9567

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 05/20/18 Time: 18:19

Sample: 1 75

Included observations: 75

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	61319.55	53954.10	1.136513	0.2610
FIRST_DAY_RETURN^2	-0.168273	0.367247	-0.458201	0.6487
FIRST_DAY_RETURN*LEVERAGE_RATIO	-2.655809	1.816917	-1.461712	0.1498
FIRST_DAY_RETURN*LN_OFFERING_SIZE	39.96984	26.26046	1.522054	0.1341
FIRST_DAY_RETURN*PE	520.2605	294.5454	1.766317	0.0832
FIRST_DAY_RETURN*VC	218.6282	213.0371	1.026245	0.3095
FIRST_DAY_RETURN*HIGH_IPO_ACTIVI...	68.62306	460.2219	0.149109	0.8820
FIRST_DAY_RETURN	-429.6362	255.9067	-1.678878	0.0992
LEVERAGE_RATIO^2	0.036727	0.064654	0.568053	0.5724
LEVERAGE_RATIO*LN_OFFERING_SIZE	3.233366	25.58547	0.126375	0.8999
LEVERAGE_RATIO*PE	-22.06125	83.07687	-0.265552	0.7916
LEVERAGE_RATIO*VC	138.3677	198.5633	0.696844	0.4890
LEVERAGE_RATIO*HIGH_IPO_ACTIVITY_...	21.44099	170.9541	0.125420	0.9007
LEVERAGE_RATIO	-63.94326	275.1858	-0.232364	0.8172
LN_OFFERING_SIZE^2	317.1987	510.4505	0.621409	0.5370
LN_OFFERING_SIZE*PE	3587.756	4846.169	0.740328	0.4624
LN_OFFERING_SIZE*VC	26.68147	4117.705	0.006480	0.9949
LN_OFFERING_SIZE*HIGH_IPO_ACTIVIT...	-12225.60	11897.53	-1.027575	0.3089
LN_OFFERING_SIZE	-7431.156	10806.02	-0.687686	0.4947
PE^2	-44693.46	52419.11	-0.852618	0.3978
PE*HIGH_IPO_ACTIVITY_PERIOD	134445.0	123757.1	1.086362	0.2823
VC^2	-8103.349	39635.09	-0.204449	0.8388
VC*HIGH_IPO_ACTIVITY_PERIOD	131085.2	129792.9	1.009956	0.3172
R-squared	0.237906	Mean dependent var	13466.44	
Adjusted R-squared	-0.084519	S.D. dependent var	17363.86	
S.E. of regression	18082.77	Akaike info criterion	22.69040	
Sum squared resid	1.70E+10	Schwarz criterion	23.40109	
Log likelihood	-827.8898	Hannan-Quinn criter.	22.97417	
F-statistic	0.737865	Durbin-Watson stat	2.003799	
Prob(F-statistic)	0.779977			

## APPENDIX 11 – RAMSEY RESET TEST BEFORE THE FINANCIAL CRISIS

Ramsey RESET Test

Equation: UNTITLED

Specification: BHAR C FIRST\_DAY\_RETURN LEVERAGE\_RATIO

LN\_OFFERING\_SIZE PE VC HIGH\_IPO\_ACTIVITY\_PERIOD

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.713217	81	0.4778
F-statistic	0.508679	(1, 81)	0.4778
Likelihood ratio	0.557171	1	0.4554

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	6430.498	1	6430.498
Restricted SSR	1030397.	82	12565.82
Unrestricted SSR	1023967.	81	12641.57

LR test summary:

	Value
Restricted LogL	-542.6640
Unrestricted LogL	-542.3854

Unrestricted Test Equation:

Dependent Variable: BHAR

Method: Least Squares

Date: 05/20/18 Time: 17:07

Sample: 1 89

Included observations: 89

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	235.5871	120.5275	1.954634	0.0541
FIRST_DAY_RETURN	0.049032	0.134528	0.364476	0.7165
LEVERAGE_RATIO	0.144884	0.136194	1.063810	0.2906
LN_OFFERING_SIZE	-28.16919	12.78929	-2.202562	0.0305
PE	64.29737	39.44634	1.629996	0.1070
VC	-7.193475	30.76456	-0.233823	0.8157
HIGH_IPO_ACTIVITY_PERIOD	-47.36621	29.03346	-1.631435	0.1067
FITTED^2	0.003759	0.005271	0.713217	0.4778
R-squared	0.133141	Mean dependent var		-41.49348
Adjusted R-squared	0.058227	S.D. dependent var		115.8584
S.E. of regression	112.4347	Akaike info criterion		12.36821
Sum squared resid	1023967.	Schwarz criterion		12.59191
Log likelihood	-542.3854	Hannan-Quinn criter.		12.45838
F-statistic	1.777260	Durbin-Watson stat		1.850678
Prob(F-statistic)	0.103121			

## APPENDIX 12 – RAMSEY RESET TEST AFTER THE FINANCIAL CRISIS

Ramsey RESET Test

Equation: UNTITLED

Specification: BHAR C FIRST\_DAY\_RETURN LEVERAGE\_RATIO

LN\_OFFERING\_SIZE PE VC HIGH\_IPO\_ACTIVITY\_PERIOD

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.386255	67	0.7005
F-statistic	0.149193	(1, 67)	0.7005
Likelihood ratio	0.166821	1	0.6830

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	2243.994	1	2243.994
Restricted SSR	1009983.	68	14852.69
Unrestricted SSR	1007739.	67	15040.88

LR test summary:

	Value
Restricted LogL	-462.9687
Unrestricted LogL	-462.8853

Unrestricted Test Equation:

Dependent Variable: BHAR

Method: Least Squares

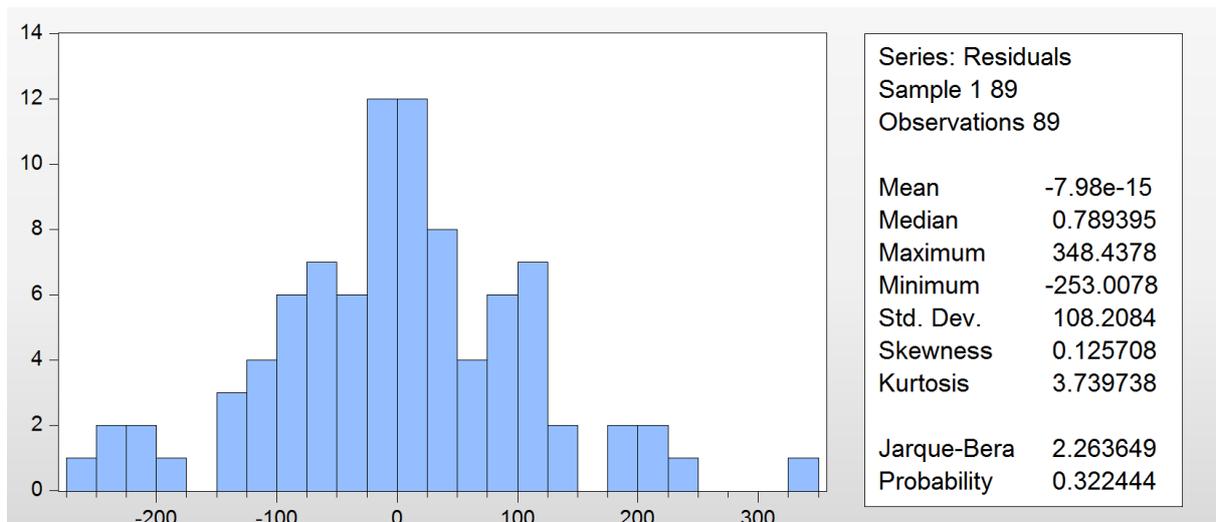
Date: 05/20/18 Time: 18:20

Sample: 1 75

Included observations: 75

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	331.3729	78.71086	4.210002	0.0001
FIRST_DAY_RETURN	-0.022234	0.141109	-0.157569	0.8753
LEVERAGE_RATIO	0.125488	0.106827	1.174686	0.2443
LN_OFFERING_SIZE	-35.41203	8.456893	-4.187357	0.0001
PE	86.24005	44.46095	1.939680	0.0566
VC	-7.792486	37.51949	-0.207692	0.8361
HIGH_IPO_ACTIVITY_PERIOD	-73.96704	47.85812	-1.545549	0.1269
FITTED^2	0.000856	0.002217	0.386255	0.7005
R-squared	0.268601	Mean dependent var		0.263334
Adjusted R-squared	0.192186	S.D. dependent var		136.4524
S.E. of regression	122.6413	Akaike info criterion		12.55694
Sum squared resid	1007739.	Schwarz criterion		12.80414
Log likelihood	-462.8853	Hannan-Quinn criter.		12.65565
F-statistic	3.515041	Durbin-Watson stat		1.753362
Prob(F-statistic)	0.002849			

### APPENDIX 13 – NORMALITY TEST BEFORE THE FINANCIAL CRISIS



### APPENDIX 14 – NORMALITY TEST AFTER THE FINANCIAL CRISIS

