Hot and Cold IPO Market: Evidence from Sweden

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Abstract

The Nordic Initial Public Offering (IPO) market is expected to set a new record in IPO activity in 2017. This IPO boom is mainly driven by high number of listings in the Swedish IPO market, which constituted 80% of all listings in the Nordic on average in the last two years. Due to increased importance of the Swedish IPO market it becomes essential to understand the trends in the market. This paper investigates the cyclicality of the Swedish IPO market from 1993 to 2016 with respect to the demand for capital and the adverse selection hypotheses. According to these theories, increased demand for capital leads to more firms going public, more bad firms pool creating adverse selection, hence there should be dispersion in firm quality between hot and cold periods in the IPO market. The results of the empirical analysis suggest that the Swedish IPO market similarly to US IPO market is driven by firms' demand for capital. By classifying the IPO market into cold and hot periods, the analysis show that there is dispersion in firm quality across hot and cold IPO markets in Sweden. Surprisingly, only when more extreme separation criteria is applied in the cold and hot period classification, the statistical significance of the relationship between heat degree and firm quality increases. This suggests that more extreme separation criteria are needed in the relatively colder IPO market in Sweden, compared to US. The findings also stress the importance of choice of heat measure, firm quality measure and especially the hot and cold period separation methodology.

Keywords: IPO cyclicality, demand for capital, adverse selection, hot and cold market, firm quality

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List of Abbreviations

IPO Initial Public Offering

NumIPO Number of Initial Public Offerings

EWU Equally weighted underpricing

InvestGr Real Private Non-residential Fixed Investment Index

PE Private Equity

CAR Cumulative abnormal return

BHAR buy-and-hold abnormal return

SDC Thomson Reuters Securities Data Company database

ADR American depositary receipt

REIT Real Estate Investment Trust

OPM Operating Profit Margin

EBITDA Earnings before interest, taxes, depreciation and amortization

ISIN International Securities Identification Number

SEDOL Stock Exchange Daily Official List

MA(4) Moving average of the last four quarters

MTF Multilateral Trading Facility

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1. Introduction

The Nordic Initial Public Offering (IPO) Market has served as one of the most active listing markets in the recent years and is on the way to set a record high number of IPOs in 2017. This high activity in the IPO market is driven by a boom in the Swedish IPO market, which constituted 83.3% of the Nordic IPO volume in 2016 (Bloomberg Markets (2017)). The current boom in the Swedish IPO market makes it important to gain a good understanding of the IPO market trends, the cyclical pattern of the market and the implications it brings. This issue is highly relevant from both the perspective of companies becoming public and investors choosing to invest in IPOs, especially since the current literature on this topic is limited for the Swedish market. This paper focuses on explaining the cyclicality trends in Swedish IPO market over 1993-2016 time period and aims to contribute to the existing literature in this field by providing evidence from Sweden. The focus of the study will be on the demand for capital and the adverse selection hypotheses since both of these hypotheses have been widely investigated in the US market and are applicable to the Swedish IPO market.

Demand for capital hypothesis is based on the notion that when economic conditions are good, more companies choose to issue in order to get access to capital that will be used for investment needs. This theory has been proven by researchers to be one of the main reasons for IPO decision and has been used in multiple studies to model IPO market cyclicality. The most important studies on this topic include Lowry (2003) and Pastor and Veronesi (2005). Authors were some of the first researchers who introduced changes in business cycles and companies' demand for capital as possible sources of the IPO market cyclicality. Ivanov and Lewis (2008), Khanna et al. (2008) conclude, similarly to Lowry (2003) and Pastor and Veronesi (2005), that demand for capital is one of the most important drivers for IPO market cyclicality.

Similarly, multiple IPO pricing and cyclicality models are based on information asymmetry and adverse selection phenomenon. Alti (2005) introduced information spillover effect, explaining that more information becomes public as more pioneer companies get valued by investors, which reduces the information asymmetry for following companies, thus nudging more companies to issue. Banerjee et al. (2016) adds that pioneer companies, that start the wave, are high quality companies that use higher underpricing to signal their quality to uninformed investors. Yung et al. (2008) stresses the importance of the adverse selection, suggesting that due to improved investment conditions, more companies issue, including lower quality companies that are taking advantage of improved economic conditions. This occurrence causes high adverse selection, since there is high dispersion in unobservable firm quality, which in turn is the reason for high underpricing. Since bad quality firms pool in hot periods, there is higher probability for the hot period companies to end up worthless post-IPO. Khanna et al. (2008) applies similar assumptions in their hot IPO market model, recognizing the higher distribution of quality of companies in hot markets and lower chance of survival for companies issuing in these periods. Adverse selection hypothesis is applicable to the Swedish IPO market due to relatively high average underpricing of 19% recorded for the analyzed period (1993-2016), comparing to the 18% observed in US (Ritter IPO data website(2017)), which often is an indicator of high adverse selection.

The interesting fact is that, based on research done in other smaller IPO markets, such as Hong Kong, China (Gucbilmez (2015)) and Mauritius (Agathee et al. (2011)), IPO cyclicality trends and reasons behind them differ across the markets. The Chinese IPO activity was found to be less responsive to past market returns and volatility than US market, while the underpricing effect for the Mauritius market was only short-term, authors found no difference in issuing companies' quality in the long term. Since results are mixed across the markets, it is beneficial to perform an IPO market cyclicality study in Sweden to investigate whether basic trends observable is US IPO market could be also applicable to Sweden.

This study will be based on Yung et al. (2008) methodology since the model used by the authors is based on both demand for capital and adverse selection hypotheses, linking them together, and is one of the first studies that tried to explain why there is a difference in firm quality between the markets. Previous studies put a lot of focus on understanding what the differences are between the hot and cold markets, but not the underlying reason for why there are differences in firm quality between the periods. The Yung et al. (2008) develops a model in which positive NPV shocks (caused by changes in economic environment) increase the private firms' demand for capital, which leads to more firms issuing in the IPO market. Since lower quality companies can issue their stock more expensively in good economic environments, low quality companies tend to pool with high quality companies, creating adverse selection in the market. Due to high adverse selection, there is high distribution in firm quality in hot markets and higher likelihood for investors to choose low quality company.

In order to examine the demand for capital and adverse selection hypothesis in the Swedish market, 3 research questions are developed. The analysis is based on 271 Swedish IPOs between 1993 and 2016. The first research question addresses the demand for capital hypothesis and accesses whether there is a link between firms' demand for capital and IPO activity in the Swedish market. Examining correlation between demand for capital proxy

(Quarterly change in Real Private Non-residential Fixed Investment Index) and number of IPOs revealed that more companies become public when demand for capital is high. Next, the second research question examines the adverse selection hypothesis and analyses if hot and cold markets are different with respect to firm quality. In this part of the analysis, the sample is divided into hot and cold periods using 3 heat measures: NumIPO - number of IPOs per quarter, EWU - equally weighted underpricing per quarter, InvestGr - quarterly change in Real Private Non-residential Fixed Investment Index. The variance of cumulative abnormal return (CAR) and buy-and-hold abnormal return (BHAR) between hot and cold periods across 3 heat measures 3, 6, 9 and 12 months after IPO suggests that there is a difference in dispersion in firm quality between the periods. Lastly, the question whether firms going public during a wave are more likely to have lower quality is assessed. Using regression framework with 1, 3, 5 years CARs and BHARs as firm performance measures, the relationship between market heat degree and firm performance is estimated under all three heat measures. Due to statistically weak results in the regressions in the main analysis, more extensive robustness analysis was needed. The robustness analysis revealed that since the Swedish market is relatively colder compared to the US market in terms of IPO volume, more extreme separation criterion is needed in order to observe the existence of adverse selection trend in the Swedish IPO market. Only when neutral period IPOs are excluded from analysis (IPOs that were issued between hot and cold periods), more statistically significant negative relationship between market heat and firm performance was observed, suggesting that firms going public during hot periods are more likely to have worse post IPO performance and thus be of worse quality. However, the statistical significance still remained low in most cases, suggesting a weak relationship between firm performance and IPO market heat compared to the trend observed in the US IPO market. The overall analysis also stressed the importance of firm performance measure, market heat measure and most essentially the methodology applied in the separation of cold and hot market since results are sensitive to the approach and measure chosen.

The remainder of the paper is organized as follows: section 2 is a more detailed overview of the theoretical framework, presenting the most important findings of the previous literature and an overview of the Swedish IPO market landscape. Section 3 explains the motivation of the study and describes the research questions analyzed. Section 4 presents data and methodology, including data collecting and cleaning steps, sample description and the methodology of the research. Section 5 summarizes the results of the main research. Section 6 presents robustness checks, while the implications of the research, limitations and drawbacks are discussed in section 7. Section 8 concludes the paper.

2. Theoretical Framework

2.1 Previous Literature

This section reviews the research preformed trying to model and understand the IPO market and summarizes the most important findings. The section is divided into two parts: first, the background research on IPO cyclicality is reviewed, mentioning the most important studies. Next, the most relevant research strands on reasons for IPO cyclicality and firm distribution within the wave are presented, including changing risk composition and firm characteristics, changing business conditions and demand for capital hypotheses, and adverse selection and information asymmetry theories.

2.1.1. IPO Cyclicality – Theory and Evidence

The IPO market cyclicality was first documented in 1975 when Ibbotson and Jaffe (1975) pointed out the cyclical nature of the IPO market in US from January 1960 to October 1970. Authors run serial correlations tests on the first month after issue return premia and found that the series exhibit significant serial dependency. They conclude that due to the serial correlation, first month series could be modelled and predicted. Additionally, the authors found that the issuing companies may obtain a higher offer price when they issue in cold markets instead of hot. In the following years the authors expanded the research to include a longer time period and focused closely on average initial returns after the issue (Ibbotson et al. (1994, 1998)). Ibbotson et al. (1994) found observable cycles in both issue volume and underpricing over the 1960-1992 period and distinguished two anomalies happening in the hot IPO market: the first day returns (known as underpricing) averaged 10-15% during hot markets, but they were followed by long-run underperformance. This trend was not observable in the cold markets. The Ibbotson et al. (1998) research concludes that the recurring pattern of high initial returns is associated with the IPO volume increase. Mainly, periods of high initial returns and high IPO volume are considered to be the "hot issue" periods. Similarly, "cold issue" periods are characterized by unusually low initial returns.

Many researchers following Ibbotson and Jaffe (1975) and Ibbotson et al. (1994, 1998) tried to model the IPO market applying different models trying to understand what causes the cyclicality and the distribution of companies between the hot and cold IPO markets. The research is focused on theories of market timing, changing risk composition and market conditions of companies. Other researchers found proof that factors, such as investor sentiment, asymmetry of information and signaling incentives cause the distribution of companies between hot and cold markets. These theories are described in more detail in the following parts.

2.1.2. Changing Risk Composition and Firm Characteristics

Ritter (1984) introduced the difference in risk composition among companies as a possible explanation for increased initial returns and higher underpricing of companies during hot markets. According to the author, high-risk IPOs are underpriced more than low-risk IPOs. Following this assumption, periods in which many high-risk companies become public should be the periods of high initial returns. The hypothesis is based on Rock's (1982) model, in which higher initial returns are caused by investors' uncertainty about the aftermarket price. Riskier firms are more difficult to value, therefore, investors require higher returns as a compensation for risk. The hypothesis was tested investigating hot issue market of 1980 by examining the change in risk composition of firms in the hot market and the following colder period (1977-1982). Using annual sales as a proxy for risk, Ritter (1984) found that risk and average return are indeed correlated. Additionally, higher risk companies not only exhibit higher initial returns, but the variability of initial returns among companies is higher as well. However, the changing risk composition hypothesis could not explain the heat of the issue period. High initial returns in the chosen period were attributed mainly to one industry – natural resources, for which the risk-return relationship was not stationary.

Helwege and Liang (2004) also researched the IPO market trends looking at firm characteristics. Authors researched the global IPO market (all IPOs present in Thomson Reuters Securities Data Company database) between 1975 and 2000. However, similarly to Ritter (1984), Helwege and Liang (2004) were not able to explain the IPO market heat looking only at firm characteristics. All three measures used by authors to assess firm quality – growth potential, current operating performance and long-term post IPO performance, did not produce evidence that firm quality differs across hot and cold markets. Furthermore, authors did not find any difference in hot and cold IPO markets in respect to industries. It is believed, that IPO waves could be caused by booms in the same industry, as for example the internet bubble in 1997-2000, when only one industry companies issue their shares. However, authors did not find support for this hypothesis – companies in both hot and cold periods came largely from the same set of industries that accounted for most of issuances in the chosen period. The authors concluded that the difference between hot and cold periods is not in difference in firm characteristics, but in quantity of firms going public. Additionally, authors researched managerial opportunism, technological innovations and change in adverse selection costs as possible reasons for IPO market cyclicality, but were not able to find any strong trends that would influence market movement. They concluded that the IPO market heat is reflected more by higher investor optimism rather by firm characteristics or factors such as managerial opportunism or adverse selection costs.

Ljungqvist et al. (2005) also tried to explain IPO market trends using behavioral finance concepts, linking underpricing, hot issue markets, and long-run underperformance together. The common source of the three, according to the authors, is the presence of irrational investors, who are over enthusiastic during hot markets. Their presence, coupled with short-sale restrictions, leads to underperformance in the long term. As optimism of the irrational investors increases, more companies consider going public, which causes offer sizes to increase. Baker and Wurgler (2000) reach similar conclusion, stating that companies time their IPOs to issue in the periods with high overvaluation.

2.1.3. Changing Business Conditions and Demand for Capital Hypothesis

Lowry and Schwert (2002), Lowry (2003) and Pastor and Veronesi (2005) studies were the first comprehensive, market-wide empirical analyses of the issue activity trying to explain the factors and implications of the IPO market variation using rational explanations, such as changes in business environment or information asymmetry present in the market. Lowry and Schwert (2002) notice that IPO volume is higher following the periods of high initial returns, which is consistent with previous research. The authors suggest that this phenomenon is mainly driven by information learned during the registration period. When more positive information is available, initial returns become higher for offerings, which leads to more companies choosing to go public.

Lowry (2003), on the other hand, considers different explanations of the IPO volume fluctuations and focuses on the following factors: changing business cycles – during economic expansions there is higher demand for capital financing, therefore more companies decide to go public; changes in investor optimism – investors become more confident about investment opportunities; increased adverse selection costs – higher dispersion between companies and difficulty to correctly value the company might cause the lemon problem when investors abstain from investing in order to avoid lower quality companies. Lowry (2003) observed that all 3 factors contribute to IPO volume fluctuations, however, demand for capital is the most important factor.

Pastor and Veronesi (2005) add additional layer to the perception of the IPO volume fluctuations. Authors developed a model of optimal IPO timing, in which time variation of market conditions is used to explain IPO volume cyclicality. They show that IPO volume can fluctuate also when there is no asymmetric information or private benefits of control. Pastor and Veronesi (2005) focus on three basic dimensions: expected market return, expected aggregate profitability (caused by business cycles) and prior uncertainty concerning the post-IPO excess profitability. The authors find proof, both theoretically and empirically, that IPO volume responds to variations in all three dimensions. According to their research, IPO waves are preceded by high market returns and increases in aggregate profitability, followed by low market returns and lower aggregate profitability.

Lowry (2003) and Pastor and Veronesi (2005) were not the only ones that named demand for capital and change in business conditions as the strongest drivers for IPO volume cyclicality. Ivanov and Lewis (2008) studied factors influencing IPO activity using autoregressive conditional count model considering business conditions, adverse selection and investor sentiment proxies. Authors conclude that changing business conditions have the strongest effect on IPO volume - one standard deviation shock to the proxies for business conditions resulted in 28% increase in monthly IPO volume. Yung et al. (2008) use demand for capital as main driver for firms' decision to go public in their adverse selection model. According to authors, during high innovation and good investment opportunities periods, companies' demand for capital increases, nudging them to issue equity to finance their capital expenditure needs. Khanna et al. (2008) model is also based on similar assumption. The basic idea of the model is that IPO volume in hot periods depend on the level of IPO screening performed by banks, lower quality of the screening means that more companies get admitted to the market. However, the quality of IPO screening directly depends on economic conditions. Authors state that due to higher innovation level in market and better economic conditions companies have higher need for financing, therefore IPO volume increases.

2.1.4. Information Asymmetry, Adverse Selection and Signaling Hypotheses

Alti (2005) addresses the information spillover effect as a probable cause of the IPO market becoming hot. The basic idea of the spillover effect is that information that becomes public during valuations of the pioneer companies makes the valuation of the following companies easier, reducing uncertainty and adverse selection costs among investors, therefore more IPOs get triggered. The author develops a model of IPO clustering, highlighting the endogeneity of information spillovers (information is not revealed all at once). Offer prices are set based on investor's interest, which in turn depends on how much information is public. Higher offer prices facilitate stronger spillover effect, which in turn triggers more subsequent IPOs being issued. Consistent with the model, Alti (2005) found empirical evidence that firm's decision to go public is not driven by its financing needs, but rather is a result of IPO market valuations.

Banerjee et al. (2016) also assume that hot IPO market is created by pioneers and followers. Pioneers are represented by companies with better growth opportunities that need to distinguish themselves from other companies. The tool that these companies use to signal their higher quality, based on authors' model, is high underpricing. The authors find evidence that early movers (high quality companies with high underpricing) obtain higher valuations when going public than other companies. Additionally, long term performance of the early movers remains higher than the performance of the followers after an IPO.

Yung et al. (2008), on the other hand, focuses on adverse selection theory, driven by companies' demand for capital, trying to explain how hot IPO market is created. Based on their model, when there is an exogenous shock to investment opportunities, it causes adverse selection in the IPO market. When investment opportunities are good, more companies want to issue. Lower quality companies tend to pool and go public when there is a positive shock to the economy, since improved investment opportunities raise the price at which companies can sell their securities (some of the negative NPV projects become positive). This causes an increase in the IPO activity, which leads to market becoming hot. However, since there are more low quality companies in the market, the average firm quality goes down. This makes it difficult for investors to make informed decisions when choosing high quality company, thus, asymmetric information problem appears. Since investors are selecting the stocks more adversely during hot markets, companies need to underprice their stock in order to attract uninformed investors. Therefore, when investment opportunities are high, IPO volume increases, dispersion of companies gets higher, causing adverse selection problem, which in turn causes higher underpricing during hot markets. Khanna et al. (2008) also use the pooling factor and its implications on company quality in their model of hot IPO market, stating that bad quality companies tend to follow good quality companies in the hot IPO markets taking advantage of good market conditions and the fact that IPOs are not screened as extensively in the hot market due to lower banking capacity. Since there are more bad quality companies in the hot market, there is higher probability that company that issues in the hot market will have lower chance of survival.

Similarly, Amihud et al. (2003) find support for existence of adverse selection in the IPO market – informed investors avoid overpriced IPOs, investing in the underpriced IPOs; uninformed investors, on the other hand, receive smaller allocation in underpriced IPOs and larger in overpriced IPOs, earning negative returns. Florin and Simsek (2007) link adverse selection and IPO market heat in their IPO pricing study, using IPO market heat as a proxy for adverse selection in the IPO market. Authors concluded that higher adverse selection (proxied by IPO market heat) increases first day IPO returns.

2.2 Defining Hot and Cold IPO Markets

As has been mentioned earlier, the IPO market has a cyclical pattern where different periods can be classified as either hot issue market or cold issue market. Numerous measures exist for measuring the heat of the IPO market in order to separate the periods into hot or cold. Traditionally, the most natural way is to use the IPO volume as a heat measure: periods with high number of IPOs should be classified as hot (Ibbotson et al. (1988), Loughran and Ritter (1995), Helwege and Liang (2004), Banerjee et al. (2016)). Various studies – Ritter (1984), Ibbotson et al. (1994) and Loughran and Ritter (1995), have suggested that a relation exists between underpricing (first day return) and IPO volume. Since multiple studies documented that IPO volume and underpricing are positively correlated – high underpricing periods are also high issue periods (Lowry and Schwert (2002), Yung et al. (2008)), underpricing is also a common measure of market heat.

Although volume and underpricing are the most common heat measures, there are additional measures proposed in the literature. The IPO cycles have been studied using time-varying market conditions, such as business cycles and adverse selection costs (Pastor and Veronesi (2005)); some authors concluded that time-varying real investment opportunities lead to adverse selection in the IPO markets (Yung et al. (2008)). Other authors argue that both firms' demands for capital and investor sentiment are important determinants of IPO volume (Lowry (2003)). In those cases, the IPO market is classified into hot or cold based on the firms' investment opportunities as a proxy for firms' demand for capital.

The methodology frequently used among researchers to assess the hotness of the period quantitatively is to compare the moving average of the recent observations to the historic average of the chosen heat measure (Yung et al. (2008)) or to an estimated threshold moving average value for hot or cold period (Helwege and Liang (2004), Banerjee et al. (2016)). As has been suggested by Helwege and Liang (2004), using the moving average instead of historic average helps to account for seasonal difference, as the error of appointing seasonally low periods as cold when they are normal becomes lower. Although most of the researchers agree on the moving average approach, the exact period classification approaches differ slightly. Helwege and Liang (2004) use lowest and highest quartile moving average values to appoint hot and cold periods, the values in between are appointed to neutral periods. Yung et al. (2008) compares historic average value to the recent moving average value, if the moving average is 1.5 times higher than historic, the period is appointed to hot, the remaining periods are cold. Banerjee et al. (2016) on other hand, appoint period as hot when they observe "a rising IPO cycle" – moving average has risen in at least three quarters in a row.

2.3 Background and the Swedish IPO Market Landscape

The political uncertainties in both UK and US has affected the investors risk appetite and led to fewer global number of IPOs in 2016 (EY (2016)). However, focusing on the Nordic Market, it could be found that it has served as one of the most active listing markets in the recent years and has stood quite strong against the global geopolitical climate. The stable operating environment, high equity prices have been attractive for investors and the Nordic market is even on the way to set a record high number of IPOs in 2017 (Bloomberg Markets (2017)). Low volatility in the stock market in 2017 with combination of relatively low interest rates makes IPOs very beneficial from a listing point of view, especially for entrepreneurial and fast growing firms. The IPO activity in the Nordic IPO market is driven mostly by a boom in the Swedish IPO market. The Swedish IPO market volume constitutes 83.3% of the Nordic IPO volume in 2016 and 78% in 2017, as of September, 2017 (YTD terms) (EY (2017)).

In Sweden, companies can list on Nasdaq Stockholm, the largest and main Stockholm exchange, previously known as OMX. The exchange was established in 1863, currently hosting 314 companies. Nasdaq Stockholm is the biggest exchange among the 4 exchanges Nasdaq OMX Nordic operates, with Nasdaq Copenhagen being the second largest, followed by Helsinki and Iceland. Companies listed on Nasdaq Stockholm are divided into 10 industries, Large, Mid and Small cap companies. OMX Stockholm 30 is the most actively traded index on Stockholm stock exchange. It is a capitalization-weighted index and consists of the 30 most-traded stocks on the exchange. Since 2003 one additional regulated exchange operates in Stockholm – Nordic Growth Market (NGM). However, it is a relatively new and less known exchange, it currently hosts only 88 companies (only 12 of which are listed on main exchange, the rest trade through Nordic MTF – a multilateral trading facility operated by NGM).

Since 2007 companies can also choose to list on First North - Nasdaq's European growth market, designed for small and growing companies, officially classified as a multilateral trading facility (MTF). It is a less regulated market that allows companies to focus on development and growth. Each company is appointed a Certified Adviser who makes sure that the company complies with all requirements. Most of the companies listed on First North go on to listing on the Nasdaq main exchange once they gain more experience and growth. The First North market in Stockholm is very active – as of 27th of October 2017, there are 265 companies listed on the market – much more than the total of 34 companies in the remaining 3 Nordic First North markets combined. First North has been very important determinant of the Swedish IPO landscape in the recent years - 54% of all companies issuing equity in the past 2 years on all exchanges were smaller, growing companies, listing on First North. As of September, 2017, the number of companies listed on First North in 2017 jumped to 37 (out of 50 in total), which constitutes 74% of all listings in Stockholm (measured on YTD terms), as provided by EY in Nordic Capital Market Insights (September 2017).

Additionally, companies can choose to issue on a smaller, less regulated exchange – Aktietorget. The exchange was established in 1998 and is managed by ATS Finans AB. The goal of this exchange was to enable companies that did not meet the requirements to be listed on the main (Nasdaq Stockholm) stock exchange to receive capital injection during a growth phase. In 2007 Aktietorget ceased to be an authorized marketplace and changed its status to a MTF with a lower degree of regulatory oversight and regulation. Since then, companies listed on Aktietorget are not formally considered as listed firms. As of 4th of November 2017, there are 164 companies listed on Aktietorget.

3. Research Questions and Motivation

3.1 Motivation of Study

The extremely hot IPO market in terms of IPO activity in the recent years in Sweden makes it important to understand the IPO cyclicality trends in the market. Specifically, what causes cycles in the first place, how companies are distributed between the waves in terms of quality and what is the outlook of investing in hot IPO market. The understanding of IPO market cyclicality is highly relevant from both the perspective of companies becoming public and investors choosing to invest in IPOs, especially since the current literature on this topic is limited for the Swedish market. This paper aims at contributing to the exiting literature in the field of IPO cyclicality, by providing evidence from the Swedish IPO market.

The analysis of the hot and cold IPO markets has been found to be specific to different geographical markets. Gucbilmez (2015) found that the Hong Kong IPO market is similar to the US market - IPO volume is sensitive to changes in the market conditions. The Chinese IPO activity, on the other hand, is less responsive to past market returns and volatility. Agathee et al. (2011) used the Stock Exchange of Mauritius to study the features of the hot and cold IPO markets and found results that are consistent with the changing risk composition hypothesis in predicting that firms going public in hot markets are relatively more risky. The article suggests that many theories developed using US data may still hold in smaller stock markets. As the results often differ across different geographic markets, it is interesting to conduct an analysis of the Swedish IPO market to investigate if the results predicted using the IPO cyclicality theories developed using the US market still hold.

Multiple theories exist that try to explain why the cycles in IPO activity occur. Adverse selection theory, driven by information asymmetry, is one the most commonly used theories in the literature, combined together with demand for capital hypothesis. Demand for capital has been proven by multiple researchers to be one of the main reasons for IPO decision. Mikkelson et al. (1997) conclude that 64% of the firms entering IPOs do it to finance capital expenditures, Lowry (2003), Pastor and Veronesi (2005) and Yung et al (2008) all use demand for capital proxies to model IPO cyclicality. Multiple IPO pricing and cyclicality models are also based on adverse selection phenomenon (Rock (1982), Banerjee et al. (2016), Yung et al. (2008), Balvers et al (1993), Michaely and Shaw (1994)). However, some studies found it to be not as a strong explanatory factor of IPO market cyclicality as investor optimism (Lowry (2003)).

Since results are mixed, it could be concluded that adverse selection in the IPO market is an important factor, however, its power depends highly on the market and time period studied.

Considering the Swedish IPO market, it is important to point out the fact that the average underpricing in Sweden over the 1993-2016 period is relatively high (19%), exceeding US IPO market average underpricing over the same period (18%), based on US IPO data provided on J. Ritter's IPO data website (2017) and the average underpricing of 15.4% recorded in the study performed by Lowry (2003). Since multiple studies are linking high adverse selection and high underpricing, adverse selection can be expected to be high in the Swedish IPO market over the analyzed period. Due to the fact that adverse selection is expected to be high, it feels natural to consider adverse selection hypothesis as one of the most important determinants of the Swedish IPO market movements and test its relevance on the Swedish IPO data.

Yung et al. (2008) develops a model that combines adverse selection and demand for capital hypotheses. It is one of the first studies that tries to explain why there is a difference in firm quality between the markets. Previous studies focused mainly on understanding the differences between the hot and cold markets, but not as much the underlying reason for the existence of the differences. Yung et al. (2008) develops a model in which they argue that time-varying real investment opportunities lead to adverse selection in the IPO market. They explain that observable firm characteristics do not need to change over time; it is more that over time the distribution of private information changes, which leads to adverse selection in the market. Therefore, clustering of firms by observable firm characteristics, examined by previous researchers, does not necessarily need to reflect the trends of information asymmetry. It is more that the adverse selection, created by information asymmetry, is the cause for change in firm characteristics between hot and cold periods. The authors argue that positive NPV shocks increase the private firms' demand for capital, and that leads to more firms in the IPO market. They also found that within these waves, the dispersion in firm quality is high and that firms having an IPO in a hot market are more likely to become worthless. Since the model developed by Yung et al. (2008) dig deeper into understanding of the IPO waves cyclicality, focusing on the reasons behind the waves, this model is decided to be the main inspiration for the paper in terms of methodology.

3.2 Research Questions

In order to test the significance of the demand for capital and adverse selection hypotheses in Swedish IPO market, the model developed by Yung et al. (2008) is adapted to Swedish IPO data and 3 research questions have been put forward:

Research Question 1: Is there a link between firms' demand for capital and IPO activity?

This first research question aims to analyze the demand for capital hypothesis, which is an underlying assumption in the Yung et al. (2008) model. The model predicts that adverse selection is created when many companies with different quality go public at the same time, creating the information asymmetry problem. Based on the model, the dispersion in IPO firm quality appears when demand for capital is high. High demand for capital and favorable market conditions cause firms of lower quality to issue their equity, since it is less costly for them to issue, comparing to regular market conditions. In order to test the overall model, it is therefore important to first investigate the relationship between demand for capital and IPO volume in the Swedish IPO market. Multiple proxies for demand for capital could be used, but the paper follows Yung et al. (2008) and applies InvestGr as a proxy for firm's demand for capital. The motivation for the choice of the demand for capital proxy is described in section 3.3.

The strength of the link between the InvestGr and IPO volume will be assessed by calculating the correlation estimate between the two time series over the 1993-2016 period. If there is a statistically significant positive correlation between the variables, it could be concluded that there is a link between firm's demand for capital and IPO volume, suggesting that higher IPO volume can be expected when demand for capital is high.

Research Question 2: Are hot and cold markets different with respect to firm quality?

Once the relationship between demand for capital and IPO market activity has been tested in Research Question 1, Yung et al. (2008) model of adverse selection hypothesis will be applied to the Swedish IPO market. The first stage of testing would be to investigate whether there are observable, statistically significant differences in distribution in firm quality between hot and cold markets. Following the model, the dispersion in firm quality in hot IPO market would be expected to be higher than in cold. The higher dispersion would predict that in hot IPO market there is higher number of lower quality companies that are taking advantage of better market conditions for investment and mimic good quality companies, therefore forcing the average firm quality in market down. If the differences are observed, it would suggest that adverse selection is present in the Swedish IPO market over 1993-2016 period, which in turn would indicate that the gap between high and low quality firm is higher and that companies would tend to underprice their offerings more in the hot IPO market in order to attract investors.

The Research Question 2 will be answered dividing issue quarters into hold and cold using NumIPO, EWU and InvestGr as separation criteria and comparing the dispersion in variance of post IPO abnormal returns between hot and cold markets over 3, 6, 9 and 12 month periods. Both CARs and BHARs will be calculated to make sure that the results are not influenced by the type of abnormal returns.

Research Question 3: Are firms going public during a wave more likely to have lower quality?

Research Question 3 will address the final part of the Yung et al. (2008) model. The two previous research questions evidenced that more companies become public when investment opportunities are favorable (demand for capital is high) and that there are observable, statistically significant differences in firm quality between hot and cold periods. This suggests the presence of adverse selection in the Swedish IPO market, but more analysis regarding the difference in firm quality between cold and hot periods is needed. Research Question 3 is trying to answer whether increased demand for capital and the adverse selection present in the hot market not only widens the gap between high and low quality companies, but also increases the likelihood for company to become worthless post IPO. Due to sample size limitations, it is difficult to follow the Yung et al. (2008) methodology exactly answering the 3rd research question. Yung et al. (2008) uses liquidation rates for companies post IPO as the proxy of worthlessness. However, using the sample of 271 IPOs (See section 3.1 for more details regarding data sample construction), only 14 companies were delisted within 3 years after IPO (the time period suggested by Yung et al. (2008)). The variation in the delisting variable (dummy variable equal 1 if company got delisted) is not enough to provide any statistically significant trends in likelihood of becoming worthless, therefore the assessment of company's worth needed to be slightly shifted. The paper will consider post IPO performance of the company, measured by CARs and BHARs, as a proxy of firm performance. If company's abnormal returns are low or negative, company is perceived to be of lower quality.

Research Question 3 will be answered using regression framework investigating the relationship between firm performance proxied by abnormal returns (both CAR and BHAR) and heat degree measure, which is measuring IPO market heat and is higher for hot markets and lower for cold. All 3 heat measures will be considered (NumIPO, InvestGr and EWU). Following the Yung et al. (2008) model, the coefficient on the heat degree would be expected to be significantly negative, suggesting that as the heat degree of the IPO market increases, it becomes more likely that company's post IPO performance will be low.

4. Data and Methodology

4.1 Collection of Data and Sample Construction

4.1.1 Collecting IPO Data

The data on the IPOs used in the analyses has been collected using multiple sources. Thomson Reuters Securities Data Company (SDC) database has been used as the initial source of data. A total of 289 Swedish IPOs from 1993 to 2017 were collected. This sample was afterwards cleaned to exclude Real Estate Investment Trusts (REIT), American Depository Receipts (ADR) and unit offers. The data items obtained from SDC include the date of issue, offer price, underpricing (the percentage change between the offer price and first day closing price), International Securities Identification Number (ISIN), Stock Exchange Daily Official List (SEDOL) codes, industry and listing exchange. Second source for the IPO data was Bloomberg database – a total of 459 IPOs were collected from the database. This sample has been cleaned to exclude withdrawn and pending IPOs, REITs, unit offers, ADRs and funds. The joined SDC and Bloomberg sample consisted of 656 IPOs. This joined sample was again cleaned to exclude all duplicate entries and IPOs with missing ISIN codes. Companies listed on Aktietorget and NGM operated exchanges were also removed from the sample in order to have exposure only to Nasdaq Stockholm operated exchanges (both main exchange and First North). The main reason for these exclusions is that NGM and especially Aktietorget exchanges might have different regulatory requirements and lower trading volume, since they are smaller and less recognized exchanges, therefore the companies listed on those exchanges might not be directly comparable to companies listed on Nasdaq Stockholm operated exchanges. The final joined and cleaned sample consists of 364 IPOs. The Table 1, presented below, provides values for exact number of IPOs removed at each cleaning step.

Table 1: Cleaning steps IPO sample data

The table presents the cleaning process of the IPO data for the period of 1993-2017. For each of the datasets (SDC, Bloomberg and joined) the total raw number of IPOs is presented, then it is outlined how many IPOs were removed at each cleaning stage (presented by negative numbers). ISINs - International Securities Identification Numbers and Ticker symbol in Bloomberg are used to join the two datasets. The total number of IPOs left after cleaning for each dataset is presented.

Cleaning steps IPO sample data (1993-2017)	
Number of IPOs collected from SDC:	*289*
REITs, ADRs, Unit offers removed:	-7
Primary trading place is not Sweden:	-5
Total SDC:	**277**
Number of IPOs collected from Bloomberg:	*459*
Pending status IPOs:	-19
Withdrawn status IPOs:	-43
REITs, ADRs, Unit offers removed:	-2
Primary trading place is not Sweden:	-16
Total Bloomberg:	**379**
SDC and Bloomberg sample joined:	*656*
Duplicate companies removed:	-198
Missing ISINs:	-33
Joined cleaned IPO sample including Aktietorget and NGM:	**425**
Companies listed on Aktietorget:	-50
Companies listed on NGM:	-11
Joined cleaned IPO sample:	**364**

4.1.2 Collecting Return Data

Monthly prices on IPO companies (which were later used to calculate returns) were collected using Thomson Reuters Eikon database. Missing price data was filled using Bloomberg database. Companies, for which price data was missing in both Eikon and Bloomberg, were removed from the sample (16 companies removed). Afterwards, consistent with the methodology presented by Yung et al. (2008), the return dataset is reduced to the event window which includes only returns for 12 months after each IPO, with issue date being the start of the event window and 12th month return being the end. Only companies that have at least 6 out of

12 monthly returns available are left in the sample (34 companies removed). Also, the companies whose issue date was October 2016 or later were removed from the sample, since a complete set of 12 month returns for these companies is not available at the time of the analysis (46 companies). This reduced the sample to 271 companies, which is the final IPO sample used in the study. Cleaning steps are summarized in the Table 2, presented below. Missing returns among the final 271 companies were replaced by the equally weighted average return of IPO companies for the same periods, as suggested by Yung et al. (2008). The authors use a portfolio of IPOs with issue date at least 12 months before reference date, rebalancing it each period. However, Swedish IPO market is not as active as US, the number of reference returns in rebalanced IPO portfolio might be too low in some periods to arrive at a reasonable average estimate, therefore, in order to get enough variance in reference companies' returns, a simple equally weighted average is taken across the months of the observed returns. Finally, in order to limit the effect of extreme outliers in returns, the 1% (two-sided) winsorizing of returns was applied by replacing the abnormal returns below 0.5^{th} and above 99.5^{th} percentile with the respective percentile's return value.

Table 2: Cleaning steps return data – final IPO sample used in the study

The table presents the additional cleaning process of the IPO sample collected for the period of 1993-2017, adjusting to the return data available and required by the methodology. The total joined IPO sample is presented, then it is outlined how many IPOs were removed at each of the additional cleaning steps (presented by negative numbers). Finally, the total number of IPOs left after cleaning for each dataset is presented, which constitutes the final sample used for the study.

Cleaning steps IPO return data (1993-2017)	
Joined cleaned IPO sample:	*364*
Price data not available in both Bloomberg and Eikon:	-16
Fewer than 6 out of 12 months returns are available:	-31
Issue date is after October 2016:	-46
Final IPO sample used in the study:	**271**

3.1.3 Collecting Firm Fundamentals

Variables used in regression analysis to answer Research Question 3 (whether firms going public during a wave are more likely to have lower quality), are collected using Eikon Datastream. The variables collected include company's sales, total assets, total debt 1 year, 3 years and 5 years after the IPO issue date. Company’s incorporation date (used to estimate company’s age at the listing date) was also collected using Eikon Datastream. In order to be able to compare the results from 1 year, 3 years and 5 years, the data sample was adjusted to the minimum amount of firms available in the 5 year sample, which means that all firms with issue date after October 2011 were disregarded in the regression part of the analysis. Due to missing data, the IPO sample was further reduced to 145 observations. Missing incorporation date in Eikon Datastream for the 145 IPOs sample has been collected manually using Swedish company registry pages: Allabolag and Ratsit. The trustworthiness of these two web-based sources could be questionable, however, it is important to keep in mind that too aggressive reductions in sample size might negatively influence the significance of the results. 1 year, 3 year and 5 year monthly returns are collected from Thomson Reuters Eikon database. Bloomberg database was used to collect information concerning private equity backing. The more detailed cleaning steps are presented in Table 3 below.

Table 3: Cleaning steps of regression data

The table presents the additional cleaning process of the IPO sample collected for the period of 1993-2016 (271 observations), adjusting to the regression data available and making sample comparable across years. The total joined IPOs sample is presented, then it is outlined how many IPOs were removed at each of the additional cleaning steps (presented by negative numbers). Finally, the total number of IPOs left after cleaning is presented, which constitutes the final sample used for the regression study. Firstly, all IPOs with issue date after October 2012 were removed from sample in order to make the results from regressions for 1 year, 3 years and 5 years post-IPO performance comparable. Next, 49 observations are removed due to missing data on Total Debt, Total Assets or Total Revenues. Finally, 6 observations were removed due to incorporation date not available.

Cleaning steps regression data	
IPO sample before regression cleaning:	**271**
Transactions removed for IPOs with issue date later than Oct. 2012:	-71
Missing Total Debt	*48*
Missing Total Revenues	*42*
Missing Total Assets	*40*
Transactions removed due to missing Total Debt, Total Revenues or Total Assets data:	-49
Missing incorporation data:	-6
Final regression sample:	**145**

4.2 Sample Description

Although regression sample has been reduced to 145 IPOs due to missing data, as described earlier, the main sample used in this paper is still 271 Swedish IPOs between the years 1993-2016 (see Table 2). Taking a closer look at the sample, some interesting trends can be noticed. The Figure 1, presented below, shows the cyclical pattern of NumIPO and EWU for the same periods. It can be clearly seen that Swedish IPO market is highly cyclical, which is to be expected. The IPO volume cycles from 0 to 21 per quarter, three bigger waves could be noticed – 1997-1999, 2005-2008 and 2015 until 2016 (the wave continues in 2017) and a couple of smaller waves. This pattern is consistent with previous research performed in the US market – Yung et al. (2008) also found 1997-1999 to be the period of high IPO volume, while based on Banerjee et al. (2016) research, 2005-2008 is also one of the hotter periods. This is not surprising, since both these periods are characterized by better economic environment, which leads to more active equity market.

One more important trend that could be noticed is that Swedish IPO market is not as pronounced as US in a sense that high and low IPO volume periods are closer to each other – in many cases the difference in volume between high and low periods is below 10 IPOs, while for US market the number is much higher (Yung et al. (2008)). This trend is to be expected, since Swedish IPO market is much smaller, not as active, so it is expected that cold and hot periods could be not as different from each other with respect to volume as in larger markets like US. The positive relationship between IPO and underpricing, recorded by multiple researchers, could also be noticed looking at the Figure 1 – during periods of high IPO volume, average underpricing is also higher, while it becomes close to zero or even negative for extremely low volume periods.

Figure 1: Quarterly IPO volume and equally weighted underpricing over time (1993-2016)

The figure presents the NumIPO-quarterly IPO volume in units (stacked graph, left axis) and EWU-equally weighted underpricing in % (columns, right axis) over the 1993-2016 period for the sample of 271 companies.

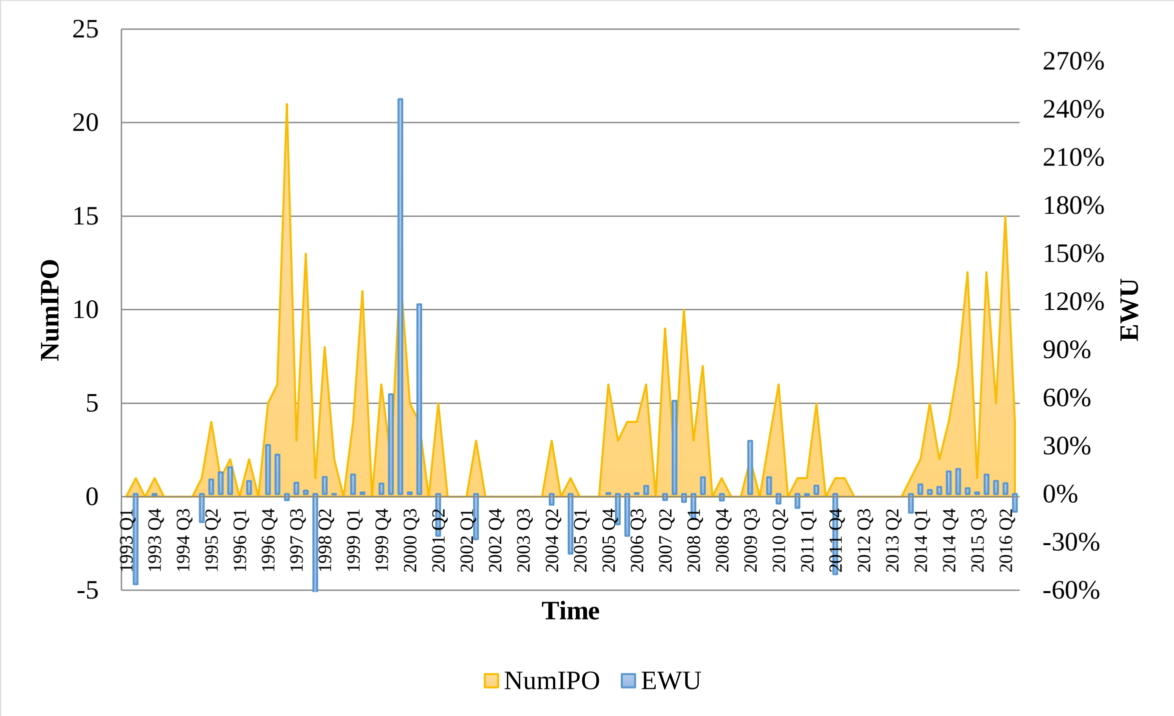


Table 4: Distribution of IPOs by industry

The table shows the distribution of industry sectors for IPOs in period 1993-2016. In total 271 Swedish IPOs are displayed according to industry sector separation used by Nasdaq. The table shows that the IPO sample obtained can be divided into several industries, where Industrials and Technology account for the majority in terms of the number of IPOs - 19% of the total sample each.

Distribution of Industry

Industry	Number of IPOs	% of Total
Industrials	51	18,8%
Technology	51	18,8%
Health Care	42	15,5%
Financials	40	14,8%
Consumer Services	34	12,5%
Consumer Goods	26	9,6%
Telecommunications	10	3,7%
Basic Materials	9	3,3%
Utilities	5	1,8%
Oil & Gas	3	1,1%
Total	**271**	**100%**

The Table 4 presents the distribution of IPOs in 1993-2016 period by industries. Since the sample used in the analysis consists of companies listed on Nasdaq operated exchanges, industries are separated into 10 industries following the separation used by Nasdaq. It is interesting to see that Swedish IPO market is slightly skewed towards Technology, Industrial and Health Care sectors, 53% of IPOs in the sample came from these 3 largest industries. However, the number of IPOs for remaining industries (Health Care, Financial, Consumer Services, Consumer Goods) is not far from numbers for above mentioned two leading industries. Therefore, although most of IPOs are Technology and Industrial companies, it could be stated that Swedish IPO market is well diversified among the six industries, that cover together 90% of all IPOs over 1993-2016 period. Only Oil & Gas, Basic Materials, Utilities and Telecommunications companies have considerably lower percentage share of IPOs in the market. Comparing to the US data over 1975-2000 period (Helwege and Liang (2004)), similar trends could be noticed – most of the IPOs came from Technology, Health Care and Consumer Goods sectors. Industrial sector, on the other hand, was not as active in US.

4.3 Measuring Firms' Demand for Capital

The 3research questions developed in this paper (section 3.2) are all build up upon a model in which increased demand for capital leads to more active IPO market. Previous finance literature suggests different proxies for measuring firms' investment opportunities. One of the proxies to use could be sales growth (Lowry (2003)). In order to generate sales, firms require equipment and investments into working capital, therefore periods of high sales growth should coincide with periods when firms' demand for capital is high (Lowry (2003)). However, income based measures can be associated with firms' current assets in place and not investment opportunities itself (Yung et al. (2008)). Another option is GDP growth (Lowry (2003), Derrien and Kecskes (2009)). However, GDP is a broad measure, covering more than just trends on private companies' investment opportunities. Additionally, GDP is a measure that is relatively steady over time, therefore it might not provide enough variance to correctly appoint hot and cold IPO firms (Landefeld et al. (2008)).

Following the approach in Lowry (2003), Pastor and Veronesi (2005) and Yung (2008), the quarterly percentage change in Real Private Non-residential Fixed Investment Index is used as a proxy for the firm's demand for capital. The index measures private companies' spending on fixed assets, such as structures, equipment and software, that are used in the goods' production process. It encompasses the improvement of existing assets, purchase of new assets and replacement of worn out assets. The index also helps to measure the willingness of private companies to expand their production capacity (BEA (2017)). This InvestGr index data was collected using Eikon Datastream. The clear advantage of using this index in the analysis over the income based and other discussed measures to capture the changes in investment opportunities, is that the index reflects actual investment changes.

4.4 Classification into Hot and Cold Periods

Following the methodology presented by Yung et al. (2008), 3 heat measures are used to separate Swedish IPO market into hot and cold periods: IPO volume, underpricing and changes in investment opportunities. At this point of the research, the whole Swedish IPO market is considered (companies listed on Nasdaq, Aktietorget and NGM, a total of 425 companies). In this part of the analysis it is assumed that IPO cyclicality is a market wide phenomenon, which does not depend on the listing exchange, therefore all companies listed in Sweden are included in period separation process to capture the whole market trend. The robustness of this assumption is tested later in the paper in section 6.1.

The first and the most common approach among researchers, is to use IPO volume as a heat measure. The methodology is as follows: number of IPOs are summed quarterly, in order to observe more profound differences between hot and cold periods; afterwards, the historic IPO volume average is compared to the MA(4)-moving average of the last 4 quarters. As has been mentioned earlier in the paper, the moving average helps to control for seasonality in the IPO market, in respect to the historic average. Each quarter is classified into either hot or cold using the following decision rule: If the moving average is 30% higher than historic average, then the period is hot, otherwise it is cold. It is worth noting that the decision rule needed to be adjusted to the Swedish market, keeping in mind that its overall volume is much lower comparing to US. In order not to overestimate cold periods and, in turn, underestimate hot, the threshold for the hot period appointment was lowered from 50% to 30% of the historic average comparing to the methodology applied in Yung et al. (2008).

The second heat measure used is underpricing, which is estimated as the percentage difference between the offer price and the first trading day closing price. Using the same decision rule as for the first approach, each quarter is classified into either hot or cold using EWU. In order to be consistent among heat measures, a threshold of 30% is applied as well.

The final heat measure used is change in firms' capital demand, proxied by InvestGr. The index presents Swedish market's capital expenditure trends. Companies invest more when market conditions for investment become favorable and therefore, more companies become public when investment opportunities are good. The methodology used in qualifying the heat periods is analogous to the previous two heat measures: historic average in index value change is compared to the moving average of the four last quarters, if the moving average is 30% or higher, the quarter is considered to be hot. The threshold of 50% proposed by Yung et al. (2008) is also changed to 30% for this heat measure in order to preserve consistency among the heat measures.

4.5 Calculations of Abnormal Returns

Following the methodology in Yung et al. (2008), the simple market model is used to calculate the abnormal return. The abnormal return is calculated as:

$$AR_{it} = R_{it} - R_{mt} \tag{1}$$

R_{it} is the stock return for firm *i* in month *t* and R_{mt} is the return of OMX Stockholm 30 market index.

The cumulative abnormal return (CAR) and buy-and-hold abnormal return (BHAR) for T periods are calculated using the definitions:

$$CAR_{it} = \sum_{t=1}^{T} AR_{it} \tag{2}$$

$$BHAR_{it} = \prod_{t=1}^{T}(1 + R_{it}) - \prod_{t=1}^{T}(1 + R_{mt}) \tag{3}$$

In total, the 3-month, 6-month, 9-month and 12-month CAR and BHAR are calculated using the three different heat measure approaches, described earlier in the paper.

4.6 Regression Framework

In order to examine if firms issuing equity in hot IPO periods are more likely to be of lower quality, a regression framework is developed. CARs and BHARs for 1 year, 3 years and 5 years following the IPO date are used as a proxy for firm performance at that point in time. The regression model is as follows:

$$Y_i = \beta_0 + \beta_1 HD_i + \beta_2 Size_i + \beta_3 OP_i + \beta_4 LV_i + \beta_5 UP_i + \beta_6 PE_i + \beta_7 Age_i + \varepsilon \qquad (4)$$

where the dependent variable Y_i is the CAR or BHAR for firm i 1, 3 or 5 years after the IPO date, β_0 is the constant and ε is the residual.

(i) HD_i is the heat degree, defined as the moving average of respective heat degree divided by the corresponding historical average for firm i. In total 3 IPO market heat degrees are studied: InvestGr, NumIPO and EWU.

(ii) $Size_i$ is the firm size, defined as logarithm of one plus sales for firm i.

(iii) OP_i is the offer price for firm i, the price at which the issue was offered to public.

(iv) LV_i is the level of leverage for firm i, defined as total debt divided by total assets.

(v) UP_i is the underpricing for firm i , also known as the first day return of IPO.

(vi) PE_i is the variable indicating if the IPO for firm i was private equity backed or not. The variable equals one if the IPO was private equity backed, otherwise it is zero.

(vii) Age_i is the firm age, defined as the logarithm of one plus the age of firm i at the time of the IPO date.

Running this regression and controlling for firm characteristics such as size, leverage, offer price, underpricing, age and PE-backing, the result should show if issuing in a hot period is associated with lower post IPO abnormal returns and thus increased likelihood of being a low performance firm. This would be true if the coefficient for the variable HD is significantly negative.

5. Results

5.1 Research Question 1: IPO Activity and Firms' Demand for Capital

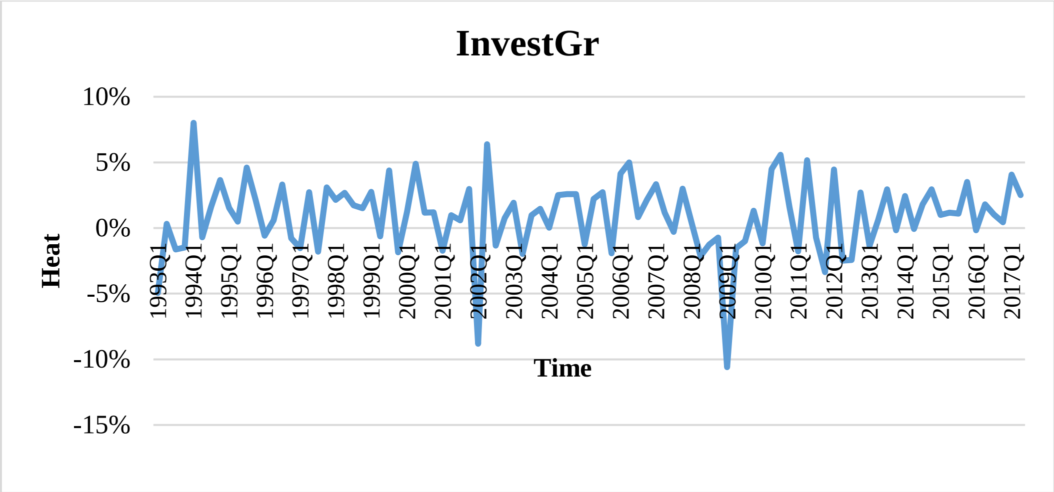
Figure 2 shows the plots of the three heat measures used to classify the IPOs into hot and cold periods. The correlation between InvestGr and NumIPO is positive (ρ = 0.1998 significant at 5% level), which is consistent with the expectation and Yung et al. (2008) model – the IPO activity becomes higher when demand for capital increases (increase in InvestGr). NumIPO and EWU are also positively correlated (ρ = 0.1842 significant at 10% level). The result is also consistent with expectations – when number of IPOs increases, companies are forced to underprice more in order to attract investors, since the adverse selection problem for investors becomes higher. Surprisingly, the correlation between InvestGr and EWU is only 0.04 but not significant, contrary to Yung et al. (2008) result, who found the correlation between InvestGr and EWU to be equal to 0.2787, significant at 1%. The result is very puzzling, however, there are possible reasons for this discrepancy.

First of all, InvestGr for Swedish market is much less volatile than for US during similar period, based on data provided by Yung et al. (2008) research. The biggest difference comes from the dotcom bubble period (1998-2001). Comparing how the index behaved for both countries during the same period, the index jumped by almost 80% between 1998 and 2000 with minor fluctuations, followed by approximately the same drop in the following year (2001). However, for Swedish market, the index did not experience any significant changes during 1998-2001 period, as can be evidenced by the index's movements, presented in Figure 2 below. The finding suggests that the dotcom bubble was not as pronounced in Sweden as in US. Additionally, authors include the period between 1960 and 1984, which was quite volatile as well, comparing to the years after 1984, when index did not vary by more than 10% between the periods. Keeping in mind that the jumps in the index are coupled with the same jumps in IPO volume and, consequently, underpricing, it is not surprising that Yung et al. (2008) found a highly significant correlation between InvestGr and EWU. Although the link between InvestGr and EWU seems to be non-existent in Swedish IPO market, InvestGr is still significantly correlated with IPO volume. The latter correlation is the one that needs to be economically and statistically significant in order to be able to proceed with the analysis of the Yung et al. (2008) model.

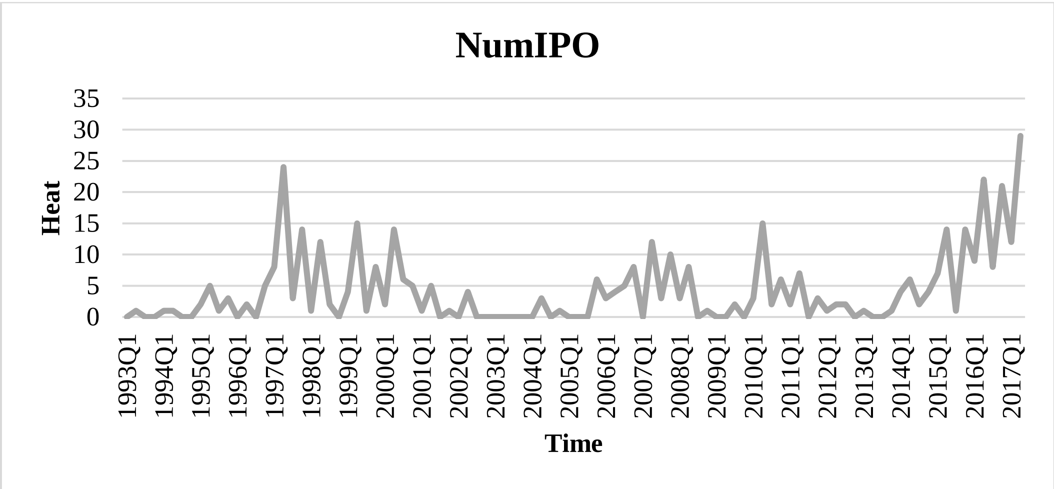
Figure 2. The graphical plot of the 3 different heat measures over time (1993-2017).

The plots are on a quarterly basis for the time period 1993 to 2017. InvestGr is the percentage change in Real Private Non-residential Fixed Investment Index. NumIPO is the number of IPOs each quarter. EWU is the equally weighted underpricing in each quarter in %.

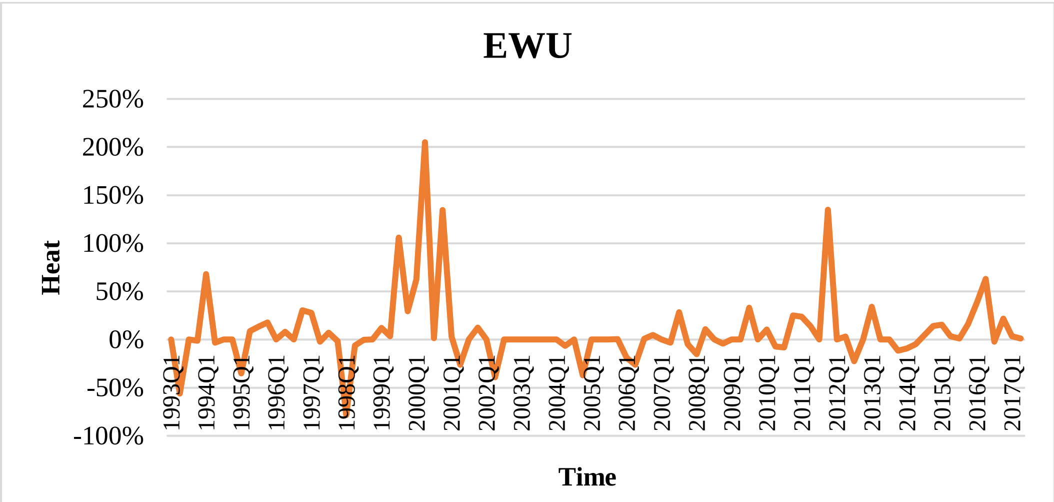
A



B



C



5.2 Research Question 2: Difference between Hot and Cold Markets

In order to examine the question whether there are differences in dispersion in firm quality across hot and cold markets, an analysis of cross-sectional dispersion in firms' long-run returns is performed. Firstly, the whole sample period is classified into hot or cold periods on a quarterly basis using the three heat measures, InvestGr, NumIPO and EWU. Secondly, the variance of abnormal returns for cold and hot periods over 3, 6, 9, and 12 months for each heat measure is calculated and F-test is used to check significance of the results. Table 5, presented below, summarizes the results of firm quality dispersion analysis.

Table 5: CAR and BHAR variances across hot and cold markets, quarters classified using full sample of 425 IPOs

The table shows the number of IPO firms and the CAR and BHAR variances across hot and cold markets using the 3 heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The variances for 3-month, 6-month, 9-month and 12-month returns are presented for hot and cold periods separately. The classifications of quarters into cold and hot are performed by comparing the four quarters moving average MA(4) with the historical average of each heat measure going back to 1993. If it is 30% above the historic average, then the quarter is classified as hot, otherwise the quarter is classified as cold. The whole Swedish IPO market consisting of 425 companies (companies listed on Nasdaq, Aktietorget and NGM) is considered in the methodology of hot and cold classification. Due to cleaning process and missing return data, 271 companies are used to calculate the CAR and BHAR variances displayed in the table. All 271 IPOs are appointed to either hot or cold period issue based on the quarter in which the IPO takes place. N represents the numbers of cold and hot IPOs within each hot and cold heat-group. The p-values are shown using F-test.

CAR and BHAR variances across hot and cold markets

	Heat measure is InvestGr			**Heat measure is NumIPO**			**Heat measure is EWU**		
Return	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value
	N=63	N=208		N= 128	N= 144		N=121	N=150	
3-Month CAR	**0,0512**	**0,0952**	**0,0049**	0,0777	0,0933	0,2925	**0,0474**	**0,1154**	**0,0000**
3-Month BHAR	**0,0518**	**0,1179**	**0,0002**	**0,0872**	**0,1192**	**0,0719**	**0,0520**	**0,1436**	**0,0000**
6-Month CAR	**0,1391**	**0,2088**	**0,0618**	**0,2264**	**0,1693**	**0,0917**	**0,1436**	**0,2379**	**0,0042**
6-Month BHAR	**0,1310**	**0,3551**	**0,0000**	**0,4540**	**0,1833**	**0,0000**	**0,1472**	**0,4381**	**0,0000**
9-Month CAR	**0,2035**	**0,3044**	**0,0638**	**0,3629**	**0,2148**	**0,0024**	**0,1883**	**0,3587**	**0,0003**
9-Month BHAR	**0,1753**	**0,8506**	**0,0000**	**1,1840**	**0,2700**	**0,0000**	**0,1824**	**1,1066**	**0,0000**
12-Month CAR	0,3237	0,4422	0,1496	**0,5354**	**0,3198**	**0,0028**	**0,2713**	**0,5412**	**0,0001**
12-Month BHAR	**0,2031**	**1,0405**	**0,0000**	**1,4062**	**0,3768**	**0,0000**	**0,2025**	**1,3787**	**0,0000**

It can be seen that the dispersion in variance of CAR and BHAR returns of IPO companies is different across all three heat measures between cold and hot periods, in most of the chosen periods. Only 3-month CAR variances under NumIPO heat measure and 12-month CAR variances under InvestGr heat measure are not significantly different between hot and cold markets. The overall results therefore suggest that there is a statistically significant difference in firm quality between cold and hot IPO markets. This result is supported using all 3 heat measures, but only InvestGr and EWU market heat measures provide results that are consistent with the findings in Yung et al. (2008) – the dispersion in firm quality is higher for hot periods. Using the NumIPO as heat measure the dispersion in company quality is lower in hot markets than cold.

One possible explanation for this divergence of results is that NumIPO heat measure is different from EWU and InvestGr in a sense that it captures a lower dispersion in market activity between hot and cold periods, comparing to other two measures. Swedish IPO market, as presented by the analysis, is less active than other big markets, such as US. There are more cold periods and hot periods are not as profound. The highest number of IPOs per quarter over the 1993-2016 period was 24 (June, 1997), while 29 out of 96 quarters analyzed were the “empty” periods when no IPOs happened. In comparison, the IPO volume in US market over 1960-2004 period reached over 280 IPOs in some quarters, with only 7 quarters being close to zero (Yung et al. (2008)). Keeping in mind that Swedish IPO market is much colder in general, it seems reasonable that there will be more cold periods considering the number of IPOs per quarter as a heat measure. Since more IPOs get appointed into cold periods, comparing to other heat measures, it is also reasonable that the dispersion between company qualities will be higher for cold market.

5.3 Research Question 3: Market Heat and Firm Quality

As there is dispersion in firm quality across cold and hot periods, the question now is whether issuing in a hot period could increase the likelihood of having low post IPO returns and worse performance. Using regression framework controlling for firm characteristics such as age, size, leverage, offer price, underpricing and indicator of PE-backing the result for CARs and BHARs using the three heat measures NumIPO, InvestGr and EWU for 1 year, 3 years and 5 years respectively is shown in the Table 6 and Table 7 below.

Table 6: Determinants of firm performance using CARs as proxy -original sample of 145 IPOs

The results for CARs as proxy for firm performance are presented using regression framework for original full sample of 145 IPOs. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is CAR-Cumulative abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective CAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**0.0104**	**0.0426**	**0.0432**	**-0.00871**	**-0.0961**	**-0.117**	**-0.00841**	**-0.0102**	**-0.00590**
	(0.0246)	**(0.0340)**	**(0.0429)**	**(0.0768)**	**(0.151)**	**(0.162)**	**(0.00904)**	**(0.0159)**	**(0.0181)**
Size	0.0424	0.0817	0.208***	0.0429	0.0842*	0.210***	0.0417	0.0820	0.208***
	(0.0278)	(0.0504)	(0.0611)	(0.0273)	(0.0508)	(0.0614)	(0.0267)	(0.0495)	(0.0604)
Leverage	-0.460*	-0.527	-0.271	-0.460*	-0.512	-0.252	-0.484*	-0.559	-0.292
	(0.272)	(0.515)	(0.610)	(0.272)	(0.522)	(0.617)	(0.265)	(0.512)	(0.600)
Offer price	-0.000849	-0.00129	-0.00382	-0.000837	-0.00121	-0.00373	-0.000799	-0.00121	-0.00376
	(0.00230)	(0.00366)	(0.00323)	(0.00230)	(0.00368)	(0.00325)	(0.00219)	(0.00347)	(0.00310)
Underpricing	0.00180	-0.0709***	-0.0576***	0.00224	-0.0699***	-0.0569***	0.00528	-0.0651***	-0.0533***
	(0.0130)	(0.0189)	(0.0179)	(0.0129)	(0.0189)	(0.0177)	(0.0138)	(0.0202)	(0.0190)
Age	0.0553	0.102	0.0411	0.0548	0.0981	0.0364	0.0592	0.106	0.0432
	(0.0504)	(0.0794)	(0.0887)	(0.0507)	(0.0791)	(0.0883)	(0.0507)	(0.0812)	(0.0896)
PE backed	0.00394	-0.0326	-0.103	0.00318	-0.0535	-0.130	0.00413	-0.0271	-0.0965
	(0.131)	(0.217)	(0.223)	(0.129)	(0.218)	(0.231)	(0.134)	(0.226)	(0.223)
							(0.00904)	(0.0159)	(0.0181)
Constant	-0.539*	-1.243**	-2.522***	-0.515	-1.063*	-2.313***	-0.532*	-1.198**	-2.473***
	(0.287)	(0.514)	(0.695)	(0.332)	(0.570)	(0.701)	(0.288)	(0.520)	(0.698)
Observations	145	145	145	145	145	145	145	145	145
R-squared	0.034	0.080	0.139	0.033	0.078	0.139	0.040	0.079	0.137

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Determinants of firm performance using BHARs as proxy -original sample of 145 IPOs

The results for BHARs as proxy for firm performance are presented using regression framework for original full sample of 145 IPOs. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is BHAR, buy-and-hold abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective BHAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGR			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**0.0704***	**0.0467**	**0.0237**	**-0.0163**	**-0.101**	**-0.301**	**-0.000357**	**-0.00887**	**0.0101**
	(0.0371)	**(0.0343)**	**(0.0504)**	**(0.0853)**	**(0.232)**	**(0.213)**	**(0.0101)**	**(0.0259)**	**(0.0150)**
Size	0.0318	0.0209	0.135***	0.0346	0.0237	0.139***	0.0343	0.0215	0.137***
	(0.0259)	(0.0527)	(0.0370)	(0.0253)	(0.0528)	(0.0392)	(0.0255)	(0.0515)	(0.0376)
Leverage	-0.647	-0.217	0.597	-0.653	-0.202	0.656	-0.657	-0.247	0.622
	(0.418)	(0.483)	(0.668)	(0.422)	(0.492)	(0.705)	(0.418)	(0.513)	(0.686)
Offer price	0.00102	0.00520	0.000526	0.00108	0.00528	0.000706	0.00107	0.00527	0.000491
	(0.00209)	(0.00389)	(0.00199)	(0.00203)	(0.00387)	(0.00210)	(0.00201)	(0.00376)	(0.00210)
Underpricing	-0.0128	-0.0178	-0.0222**	-0.00922	-0.0167	-0.0250**	-0.00887	-0.0122	-0.0244**
	(0.0126)	(0.0201)	(0.00963)	(0.0126)	(0.0194)	(0.0110)	(0.0131)	(0.0210)	(0.0113)
Age	0.0479	0.0176	0.00522	0.0460	0.0133	-0.00521	0.0467	0.0210	-0.000160
	(0.0829)	(0.0841)	(0.0889)	(0.0828)	(0.0811)	(0.0855)	(0.0823)	(0.0821)	(0.0881)
PE backed	-0.212	-0.108	0.0124	-0.204	-0.129	-0.0723	-0.199	-0.101	0.0185
	(0.165)	(0.254)	(0.364)	(0.165)	(0.242)	(0.371)	(0.165)	(0.268)	(0.360)
Constant	-0.376	-0.671	-1.817***	-0.271	-0.481	-1.387***	-0.293	-0.621	-1.783***
	(0.271)	(0.470)	(0.446)	(0.325)	(0.592)	(0.404)	(0.272)	(0.488)	(0.464)
Observations	145	145	145	145	145	145	145	145	145
R-squared	0.035	0.048	0.092	0.022	0.046	0.113	0.022	0.046	0.094

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As seen, the regression results differ across heat measures. For InvestGr, a positive relationship is identified (0.0704) for the 1-year BHAR at a significance level of 10%, suggesting that in the short time horizon, having an IPO in a hot wave increases the probability of having high post-IPO cumulative abnormal returns and being of higher quality. Even though for the other time horizons the results are not significant, a consistent positive pattern could be identified, as the sign of the coefficient is always positive for both CARs and BHARs.

The positive patterns identified for firms' abnormal returns using InvestGr as heat measure are quite unexpected since the results are the opposite of the results obtained in the Yung et al. (2008). In their study, they found that firms issuing in hot periods are more likely to become delisted and worthless. Following their reasoning, firms having an IPO in a hot period should be of worse quality and hence more likely to have lower abnormal returns. The expected sign of the coefficient between abnormal returns and heat degree should therefore be negative. On the other hand, using InvestGr as heat measure, it means that the heat degree is high when there is high demand for capital and good investment opportunities in the general market. Good economic conditions could be beneficial for decisions about IPOs if the issuance for most companies in the hot wave is in the beginning of the wave. Banerje et al. (2016) showed that early movers in a hot IPO market invest significantly more and obtain higher growth and profitability. If the sample consists of early movers in the hot IPO waves, then this could be an explanation of the positive pattern identified. More analysis inside each hot issue wave is needed in order to verify this explanation, but this is beyond the scope of this paper. In more general terms, expected stock returns have been found to vary inversely with economic conditions (DeStefano (2004)), which means that the good economic conditions should be connected with lower returns. Therefore, following this economical reasoning, it is still unexpected that the coefficient is positive, suggesting that IPO issuance in hot periods is characterized by high post-IPO abnormal returns. Even though a positive pattern is identified for InvestGr, the economic significance is still small; the magnitude of the coefficient size varies from 0.0104 to 0.0704 (both CARs and BHARs), which is a vague relationship. Considering the absence of statistical significance in most cases, it is important to be cautious when interpreting these patterns.

Using NumIPO and EWU as heat measures, the relationship between heat degree and the CAR or BHAR is always negative, irrespective of time horizon. Even though the results for NumIPO and EWU are not significant, the negative coefficient is in line with the expected results of the analysis. This implies that having an IPO in a hot wave increases the probability of being of low quality. These results, opposed to the heat measure InvestGr, are consistent with the results obtained by Yung et al. (2008). Their model, using adverse selection and demand for capital hypothesis, explains that when more firms go public when there are good economic conditions, more bad firms pool and hence the negative relationship between heat degree and abnormal returns should be found. Ritter (1991) found that IPO volume is negatively correlated with post-IPO stock returns, which means that the sign of the coefficients are in accordance with the results obtained in this analysis. The insignificant results for NumIPO could also be verified by the study performed by Lowry (2003). The author found that the post-IPO stock returns are not significantly related to IPO volume at the time the firm went public.

Using EWU as heat measure, the pattern is mostly negative with coefficients ranging between -0.000357 to -0,0102, which is of small economic significance even if the results would be statistically significant. This negative pattern is consistent with the results obtained in the previous analysis performed in this paper. In Research Question 2, it has been shown that using EWU as heat measure, the dispersion in the variance of abnormal returns is higher in hot periods compared to cold periods, which suggests that if firms issue in the hot period, then the likelihood of receiving higher returns is small. This result is therefore consistent with the result obtained in the regression analysis as it is shown that the increase in heat degree is negatively correlated with the increase of abnormal returns.

On the other hand, using NumIPO as heat measure, it could be seen that the magnitude of the coefficients is significantly larger, ranging between -0,00871 and -0.301, which is a stronger relationship identified and would be more material if the results were statistically significant. A surprising finding is that the result of the regression analysis is opposite to the result obtained comparing the dispersion in variances of returns between hot and cold periods using NumIPO as heat measure (Research Question 2). In Research Question 2, it has been found that using NumIPO as heat measure, the dispersion in variance of returns is higher in the cold periods compared to the hot periods, which suggests that if the firm issues in a hot period, it should be more likely to have higher post-IPO returns, since the pooling factor is not observable anymore for the hot periods, but for cold instead. However, in the regression analysis, the results are opposite – the negative pattern for coefficients of heat degrees means that if the firm issues in a hot period, then the firm is more likely to have lower post-IPO returns.

These conflicting results described above for NumIPO suggest that more analysis is needed for this particular heat measure. One possible reason for the conflicting results obtained could be that as the Swedish IPO market is relatively cold, more firms are appointed to the cold period when in reality the IPOs belong to neutral periods that do not qualify as neither cold nor hot. To test this explanation, more extreme separation criteria are applied in the cold and hot separation analysis in the robustness section for all 3 heat measures.

In summary, since the results are not statistically significant, it is hard to draw some general conclusions regarding the relationship between heat in IPO market and the performance of firms. Insignificant results could suggest that there is no relationship between IPO market heat and company's performance post IPO in the Swedish market. However, it could be the case that results depend on the performance measure used, therefore more comprehensive analysis is performed in the robustness section to further study this third research question assessing the relationship between firm post-IPO performance and IPO market heat.

6. Robustness Tests

6.1 Separation of IPOs into Heat Periods using Adjusted Samples

The first robustness check focuses on the data that has been used to separate issue quarters into hot and cold. Originally, the raw version of the IPO sample, including all Swedish IPOs in all exchanges, has been used to estimate the period. However, Aktietorget and Nasdaq exchanges are very different with respect to size, regulation level and overall market activity, therefore returns of companies listed on Aktietorget and Nasdaq might not be comparable. The effect would be most visible when EWU is used as a separation criteria. Since the Aktietorget market is not as active and the number of companies listed is lower, underpricing is also expected to be lower, even for hot periods. Therefore, it is important to investigate whether EWU separation criteria values are not driven down by addition of Aktietorget IPOs. The same period separation methodology is used as outlined in section 4.4, the only difference is that the sample excluding Aktietorget IPOs is used to calculate the separation criteria (375 IPOs), comparing to the full IPO sample of 425 used in the main research. The Table 8, presented below, summarizes the return distribution between hot and cold periods using new separation criteria values.

As can be seen in the table, the overall trend is similar to the one presented in the main research – there is a statistically observable difference in return distribution between hot and cold periods. As has been mentioned, the largest difference would be expected to be noticed in EWU measure. Taking a closer look at the number of companies appointed to hot and cold periods, it can be noticed that using reduced sample (375 companies) in classification of quarters into hot and cold does not provide different results comparing to the full sample (425 companies) – the trend is still the same as provided in the main research – hot period abnormal returns are more dispersed. However, more IPOs got appointed to hot periods when Aktietorget was removed from the separation sample, which is in line with expectations. Nevertheless, there is no difference in the overall trend, therefore it could be concluded that Aktietorget companies do not significantly change the overall abnormal return distribution trends between periods.

Table 8: CAR and BHAR variances across hot and cold markets, quarters classified using sample of 375 IPOs (Aktietorget excluded)

The table shows the number of IPO firms and the CAR and BHAR variances across hot and cold markets using the 3 heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO-number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The variances for 3-month, 6-month, 9-month and 12-month returns are presented for hot and cold periods separately. The classifications of quarters into cold and hot is performed by comparing the four quarters moving average MA(4) with the historic average of each heat measure going back to 1993. If it is 30% above the historic average, then the quarter is classified as hot, otherwise the quarter is classified as cold. Only the IPOs listed on Nasdaq (375 IPOs) are considered in the methodology of hot and cold period classification. Due to sample cleaning process and missing return data, 271 companies are used in cold and hot classification and to calculate the CAR and BHAR variances displayed in the table. All 271 IPOs are appointed to either hot or cold period issue based on the quarter in which the IPO takes place. N represents the numbers of cold and hot IPOs within each hot and cold heat-group. The p-values are shown using F-test.

CAR and BHAR variances across hot and cold markets

	Heat measure is InvestGr			**Heat measure is NumIPO**			**Heat measure is EWU**		
Return	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value
	N=63	N=208		N=114	N=157		N=106	N=165	
3-Month CAR	**0,0512**	**0,0952**	**0,0049**	**0,0624**	**0,1449**	**0,0000**	**0,0581**	**0,1468**	**0,0000**
3-Month BHAR	**0,0518**	**0,1179**	**0,0002**	**0,0610**	**0,1741**	**0,0000**	**0,0537**	**0,1799**	**0,0000**
6-Month CAR	**0,1391**	**0,2088**	**0,0618**	**0,1743**	**0,3068**	**0,0016**	**0,1655**	**0,3168**	**0,0004**
6-Month BHAR	**0,1310**	**0,3551**	**0,0000**	**0,1698**	**0,5262**	**0,0000**	**0,1792**	**0,5084**	**0,0000**
9-Month CAR	**0,2035**	**0,3044**	**0,0638**	**0,2990**	**0,4522**	**0,0203**	**0,2352**	**0,5554**	**0,0000**
9-Month BHAR	**0,1753**	**0,8506**	**0,0000**	**0,3936**	**1,1934**	**0,0000**	**0,2337**	**1,3545**	**0,0000**
12-Month CAR	0,3237	0,4422	0,1496	0,4962	0,5782	0,3896	**0,3234**	**0,8524**	**0,0000**
12-Month BHAR	**0,2031**	**1,0405**	**0,0000**	**0,7465**	**1,2922**	**0,0022**	**0,2649**	**1,7249**	**0,0000**

An interesting finding is that NumIPO trend changed after excluding Aktietorget companies. This finding is surprising, however not unexpected. When Aktietorget companies were removed from the sample, the number of companies in hot and cold periods became lower, therefore the historic average, used in period classification methodology, became lower. Therefore, the marginal periods, that could be appointed to both hot and cold periods, depending on the strictness of the separation criteria, got appointed to hot periods, which is noticed in the increased number of hot period IPOs, comparing to the results presented in the main research. However, the trend change is not caused by specific characteristics of Aktietorget companies, rather simply by lower number of IPOs in the sample. If the separation sample is further reduced to 271 IPOs, to make the period separation sample and the sample used for dispersion in abnormal returns calculation consistent, the NumIPO heat measure is even more affected, which is to be expected (Appendix A, Table 9). The abnormal return dispersion trend is the same as in the main research – cold period abnormal returns are more dispersed, however, the statistical significance of the difference in abnormal return variances between hot and cold periods got reduced – only the difference in variances for 5 out of 8 cases analyzed remained statistically significant.

Concluding, it could be said that Aktietorget IPOs do not influence the separation criteria nor the distribution of abnormal returns between the periods in a significant way – the overall trend for EWU heat measure is the same as in the main research. However, the number of IPOs included is very important for NumIPO heat measure – the heat measure is very sensitive to the sample size, the trend changes based on how many IPOs and from which periods are removed. Therefore, the larger sample of IPOs is preferred to make sure that no bias is introduced concerning NumIPO heat measure due to removed IPOs.

6.2 Separation of IPOs into Heat Periods applying Stricter Rules

The second step checking robustness of the methodology used to appoint IPOs into hot or cold periods is to use stricter rules for period classification. Helwege and Liang (2004) suggest to make the classification more extreme by excluding the neutral period IPOs from the analysis. As has been mentioned earlier in the paper, Swedish IPO market is less active and relatively calmer than US IPO market, which means that hot and cold periods are not as pronounced and there are more periods that are in between the hot and cold periods. These periods could be appointed to either hot or cold depending on the criteria used. Therefore, it is important to check whether the dispersion in quality trends in the hot and cold samples are not influenced by the middle, neutral, companies. If the neutral companies get appointed largely to one of the subsamples, the results might lose their strength, since it would be more difficult to confidently state that the observed trend is specific to hot or cold period. Thus, the same methodology is used for appointment of quarters as outlined in section 3.3, however, the neutral period is excluded. Previously the separation criteria was 1.3 times the historic average, comparing to MA value, which meant that if MA of last 4 quarters was higher than 30% of historic average for the quarter, the quarter got appointed to hot, otherwise it was appointed to cold. The stricter separation criteria is introduced by setting the upper limit, used to appoint quarters into hot as 1.5, which means that the quarter, and all IPOs that issued in that quarter, get appointed to hot when the MA of the last 4 quarters is at least 1.5 times higher than the historic average. The lower bound, used to appoint cold quarters, is set at 1.1 times the historic average. This way the middle companies, which MA is between 1.1 and 1.5 are excluded when estimating the distribution of companies abnormal returns between hot and cold periods.

Table 10: CAR and BHAR variances across hot and cold markets, quarters classified using stricter decision rules

The table shows the number of IPO firms and the CAR and BHAR variances across hot and cold markets using the 3 heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The variances for 3-month, 6-month, 9-month and 12-month returns are presented for hot and cold periods separately. The classification of quarters into cold and hot are performed by comparing the four quarters moving average MA(4) with the historical average of each heat measure going back to 1993. In this analysis, stricter decision rules are applied in the hot and cold classification: if the MA(4) is 50% above the historic average, then the quarter is classified as hot. If the MA(4) is 10% lower than the historic average, then the quarter is classified as cold. The remaining quarters are classified as neutral quarters. All 271 IPOs are appointed to hot, cold or neutral period issue based on the quarter in which the IPO takes place. The IPOs classified into neutral periods are excluded in the analysis. N represents the numbers of cold and hot IPOs within each hot and cold heat-group. The p-values are shown using F-test.

CAR and BHAR variances across hot and cold markets

	Heat measure is InvestGr			**Heat measure is NumIPO**			**Heat measure is EWU**		
Return	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value
	N=40	N=201		N=67	N=109		N=118	N=146	
3-Month CAR	**0,0583**	**0,0979**	**0,0554**	**0,0467**	**0,0887**	**0,0054**	**0,0360**	**0,1147**	**0,0000**
3-Month BHAR	**0,0577**	**0,1215**	**0,0070**	**0,0517**	**0,1205**	**0,0003**	**0,0323**	**0,1442**	**0,0000**
6-Month CAR	**0,1191**	**0,2148**	**0,0304**	0,1088	0,1503	0,1559	**0,1409**	**0,2416**	**0,0026**
6-Month BHAR	**0,1020**	**0,3655**	**0,0000**	0,1301	0,1766	0,1798	**0,1476**	**0,4484**	**0,0000**
9-Month CAR	**0,1487**	**0,3101**	**0,0077**	0,1536	0,2038	0,2142	**0,1893**	**0,3672**	**0,0002**
9-Month BHAR	**0,1319**	**0,8743**	**0,0000**	**0,1966**	**0,2882**	**0,0937**	**0,1856**	**1,1394**	**0,0000**
12-Month CAR	**0,1883**	**0,4467**	**0,0020**	0,2372	0,2833	0,4365	**0,2692**	**0,5541**	**0,0001**
12-Month BHAR	**0,1504**	**1,0668**	**0,0000**	**0,2489**	**0,4048**	**0,0337**	**0,2038**	**1,4155**	**0,0000**

The Table 10 summarizes the results of the dispersion in variance of abnormal returns between hot and cold periods using the stricter separation rule. It is favorable to see that the overall results of the analysis presented in the main research are not significantly affected – there is still statistically significant difference in the distribution of abnormal returns between hot and cold periods, with the variance of abnormal returns more dispersed in hot periods. The noticeable difference appears for NumIPO heat measure. The neutral period has the highest effect on this heat measure – both hot and cold subsamples of IPOs are largely reduced, while only minor difference in subsample size is noticed for EWU and InvestGr. Using the stricter separation rule, the trend for this heat measure shifts – hot periods abnormal returns become more distributed too, which is consistent with result presented in Yung et al. (2008). This result is to be expected, since due to lower overall IPO volume in the market and multiple periods with no or very low IPO volume (1 IPO per quarter), the MA(4) measure is low in many periods. Therefore, relatively more periods are neutral that are wrongly appointed to cold, thus increasing the distribution of abnormal returns for those periods. However, an interesting finding is that although the trend shifts, the difference in distributions between hot and cold periods is not significant in half of the cases analyzed. Furthermore, the significance is lost for mostly CARs, the difference in distribution in BHARs between the periods is still significant with exception of 6 months period. It suggests that considering NumIPO as a heat measure, the choice of abnormal returns used in the analysis is very important, CARs for these companies are much more similar than BHARs. On the other hand, the significance of differences in distribution using EWU and InvestGr measures is increased when neutral period companies are removed from analysis, which is to be expected and strengthens the validity of the results presented in the main research. Overall, it seems that the result of the main research still shows the same trend when periods are separated more strictly, however, some statistical significance of the differences is lost for NumIPO heat measure. Nevertheless, excluding neutral period from the analysis brings more consistency across heat measures and provides results that are more in line with Yung et al. (2008).

6.3 Robustness of the Regression Framework – Additional Performance Measures

The regression results of CARs and BHARs as proxies for firm performance were not significant in the main analysis of studying the relationship between heat degree and firm performance. For NumIPO and EWU as heat measures, the identified coefficient was negative, while the result was opposite using InvestGr as heat measure. Since it is suspected that insignificant results might be specific to the performance measure used, more analysis is therefore needed in order to further access if firms issuing in hot periods are more likely to receive lower post IPO returns. The finance literature provides insight of other factors used as proxies for firm performance over time. Loughran and Ritter (1997) assessed the operating performance of firms using profit margin as an indicator of performance quality. Zheng and Strangeland (2007) used post IPO EBITDA growth as a measure of firm quality and concluded that IPO firms with higher underpricing are of better quality. Following their approach, regression analysis using operating profit margin (OPM) growth and Earnings before interest, taxes, depreciation and amortization (EBITDA) growth as proxies for firm performance is performed in this robustness test section accessing the relationship between firm quality and heat of the IPO market.

Table 11 reports the regression results using OPM growth as proxy for firm performance. Due to missing data on OPM, the original sample of 145 observations in regression analysis is now reduced to 109 observations. As seen in the table, the signs of the coefficients for the heat degrees with respect to the operating measures are mixed and still not significant for all three different heat measures. Using InvestGr as heat measure the coefficient for heat degree is positive for 5 years horizon, while negative for 1 year and 3 years. For NumIPO, the result is still negative for 5 years horizon, but positive for 1 year and 3 years. Only for EWU, the coefficients are negative and consistent with the results for CAR and BHAR in previous analysis using the 145 sample in Table 6 and 7. The result is slightly puzzling, since it would be expected to see consistency in the coefficient sign at least throughout the years for the same heat degree. It could be that short term effects on OPM post IPO are different in short term comparing to long – companies start performing poorly only when at least 3 years since IPO have passed or only short term performance is negative. However, the results are too mixed and statistically insignificant to be able to provide any sound interpretation using growth in OPM as a performance variable.

Table 12 shows the result of the regressions using EBITDA growth as a proxy for firm performance. In these regressions, the sample size is reduced to 107 observations due to missing data on EBITDA values. Overall, the results are non-significant and still mixed across different heat measures. Similarly to the results in Table 11 for OPM growth (sample size 109), the coefficient for heat measure InvestGr is positive for 5 years and negative for 1 year and 3 years horizon. On the other hand, using both NumIPO and EWU, the signs for the heat degree coefficients are completely opposite to the results in Table 11 for OPM growth – the coefficient sign in the case of NumIPO has a positive sign for 5 years horizon and negative for 1 and 3 years horizon, while the coefficient is positive for all time horizons using EWU heat measure.

The reasons behind different results compared to the case when CARs and BHARs were used could be due to changed sample size (too much variance is removed) or the results could just be specific to the firm performance measure. In order to understand whether the results obtained are caused by changed sample size, regressions for CAR and BHAR estimates need to be rerun using the identical samples to the ones used for growth in OPM and growth in EBITDA regressions. If the coefficient on heat degree for all heat measures for CAR and BHAR as dependent variables changes sign in the way to reflect the sign of the heat degree coefficients observed for the growth in OPM and growth in EBITDA, then it could be concluded that the mixed results are caused by sample bias and are not specific to the performance measures.

Table 11: Determinants of firm performance using OPM growth as proxy - reduced sample of 109 IPOs

The results for OPM growth as proxy for firm performance are presented using regression framework. Due to missing OPM data, the original full sample of 145 IPOs was reduced to 109 IPOs. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is OPM growth – operating margin growth. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective OPM growth. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**-1.564**	**-1.490**	**0.671**	**0.928**	**0.00273**	**-0.110**	**-0.00141**	**-0.0293**	**-0.0140**
	(1.529)	**(1.773)**	**(0.555)**	**(0.764)**	**(0.777)**	**(0.518)**	**(0.0639)**	**(0.0616)**	**(0.0499)**
Size	-1.002	-0.579	-0.0335	-0.876	-0.452	-0.0899	-0.868	-0.452	-0.0907
	(0.639)	(0.600)	(0.260)	(0.542)	(0.459)	(0.248)	(0.548)	(0.456)	(0.249)
Leverage	14.05	12.51	-1.727	13.77	12.74	-1.770	14.29	12.50	-1.948
	(10.89)	(11.26)	(3.442)	(10.87)	(11.28)	(3.573)	(11.21)	(11.55)	(3.613)
Offer price	0.0517	0.0487	-0.0142	0.0534	0.0507	-0.0151	0.0539	0.0509	-0.0150
	(0.0442)	(0.0495)	(0.0154)	(0.0456)	(0.0514)	(0.0157)	(0.0458)	(0.0515)	(0.0158)
Underpricing	0.0272	0.0603	-0.0332	-0.0509	-0.0260	0.00419	-0.0629	-0.0157	0.0106
	(0.133)	(0.122)	(0.0809)	(0.0945)	(0.0685)	(0.0694)	(0.0965)	(0.0730)	(0.0767)
Age	-0.888	-0.651	-0.468	-0.982	-0.782	-0.414	-1.024	-0.753	-0.395
	(0.732)	(0.776)	(0.664)	(0.782)	(0.859)	(0.667)	(0.808)	(0.879)	(0.691)
PE backed	3.833	2.281	-1.448	3.585	1.821	-1.269	3.348	1.805	-1.248
	(3.466)	(4.067)	(1.212)	(3.088)	(3.629)	(1.090)	(3.013)	(3.528)	(1.071)
Constant	8.935	2.820	2.598	3.690	-1.008	4.466	4.916	-1.073	4.288
	(5.502)	(4.209)	(3.726)	(4.341)	(3.325)	(3.960)	(4.717)	(2.913)	(3.974)
Observations	109	109	109	109	109	109	109	109	109
R-squared	0.019	0.012	0.027	0.011	0.006	0.012	0.010	0.006	0.012

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Determinants of firm performance using EBITDA growth as proxy - reduced sample of 107 IPOs

The results for EBITDA growth as proxy for firm performance are presented using regression framework. Due to missing EBITDA data, the original full sample of 145 IPOs was reduced to 107 IPOs. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is EBITDA growth – growth in earnings before interest tax depreciation and amortization. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective EBITDA growth. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**-0.0725**	**-0.231**	**0.0128**	**-0.164**	**-0.958**	**0.112**	**0.0314**	**0.0564**	**0.0124**
	(0.0565)	**(0.186)**	**(0.187)**	**(0.215)**	**(1.385)**	**(0.651)**	**(0.0199)**	**(0.118)**	**(0.0731)**
Size	-0.206*	0.621	0.293	-0.200*	0.639	0.292	-0.203*	0.636	0.291
	(0.106)	(0.402)	(0.689)	(0.106)	(0.417)	(0.698)	(0.105)	(0.411)	(0.697)
Leverage	-0.0341	3.512*	3.926	0.0271	3.881*	3.882	0.168	3.868	4.008
	(0.802)	(1.947)	(3.177)	(0.829)	(2.251)	(3.263)	(0.847)	(2.361)	(3.270)
Offer price	0.00929**	-0.0231	0.0152	0.00969**	-0.0210	0.0150	0.00965**	-0.0223	0.0153
	(0.00462)	(0.0188)	(0.0158)	(0.00470)	(0.0170)	(0.0158)	(0.00474)	(0.0180)	(0.0157)
Underpricing	-0.0438**	0.133	-0.0318	-0.0509**	0.103	-0.0291	-0.0602***	0.0980	-0.0360
	(0.0211)	(0.0962)	(0.103)	(0.0214)	(0.0781)	(0.0982)	(0.0223)	(0.0670)	(0.0985)
Age	0.124	0.151	-0.969	0.107	0.0656	-0.960	0.0822	0.0669	-0.981
	(0.132)	(0.544)	(0.717)	(0.132)	(0.521)	(0.746)	(0.132)	(0.504)	(0.751)
PE backed	1.267	-5.093	-8.112	1.205	-5.397	-8.080	1.270	-5.116	-8.099
	(1.070)	(4.599)	(8.102)	(1.077)	(4.627)	(8.187)	(1.071)	(4.629)	(8.118)
Constant	1.815	-7.513*	-2.524	1.869*	-6.713	-2.654	1.724	-7.933*	-2.455
	(1.095)	(4.373)	(7.323)	(1.117)	(4.658)	(7.511)	(1.078)	(4.511)	(7.545)
Observations	107	107	107	107	107	107	107	107	107
R-squared	0.078	0.092	0.096	0.076	0.096	0.096	0.085	0.091	0.096

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

New regression estimates for CAR and BHAR as dependent variables, presented in Table 13 and Table 15 (Appendix B) respectively for growth in OPM measure and Table 14 and Table 16 (Appendix B) for growth in EBITDA measure, reveal that the mixed results could actually be specific to the performance measures used. Considering growth in OPM sample, the positive relationship between heat degree and performance measures CARs and BHARs, observed in main research, is still positive for InvestGr, while the relationship in case of EWU and NumIPO heat measures is still negative. The surprising finding is that heat degree coefficients for InvestGr across all 3 periods became significant at 10% using CAR as a dependent variable, and significant at 5% for 1 year using BHAR as a dependent variable. The heat degree for NumIPO also became significant at 10% for 5 years using BHAR as a dependent variable and significant at 10% for 3 years and 5 years using CAR as a dependent variable. Heat degree coefficients using EWU as a heat measure are still not significant. The similar relationship is found using growth in EBITDA as a performance measure, (see Table 14 and Table 16 (Appendix B)). This result is very puzzling, it would be expected to see less significant results as sample becomes lower. One possible explanation could be that, due to missing transactions, a considerable variation in CARs and BHARs has been removed. In order to understand what exactly influenced the increased significance, a deeper research is performed of sample changes in order to understand which part of the sample has been removed.

Figures 3 and 4, presented in Appendix C, present histogram plots of CARs and BHARs distributions across 28 return levels for each of the three periods for both growth in OPM and growth in EBITDA samples, respectively. The figures present the difference in the sample size, comparing to the original regression sample used for CAR and BHAR measures (145 observations) and the reduced samples (109 and 107 observations for growth in OPM and growth in EBITDA respectively). It can be observed that the highest number of transactions that were removed due to missing data comprises of the transactions in the middle of the sample distribution, when CARs and BHARs are close to zero. Since less focus is put on the middle of the sample due to removed transactions, it is understandable that more explanatory power is shifted to more extreme observations, which increases the significance of the coefficients on heat degree measures. It is luring to conclude that the statistically significant results are the indicators of the true relationship between IPO market heat and firm post-IPO performance. However, since sample has been reduced, it could still be possible that the significant relationship and the direction of the sign on the heat degree coefficients is induced by the sample bias. The results would be more trustworthy if the middle CAR and BHAR values, removed from main regression sample due to missing data, would coincide with the CAR and BHAR returns corresponding to the neutral period companies removed from the sample when assessing the distribution of company quality between hot and cold periods (described in the second part of the robustness analysis, section 6.2.). If this is the case, it could be concluded that the relationship between heat degree measures and firm performance measures is robust and is proven to be statistically significant when the neutral period companies are removed from the sample. The next section of the robustness analysis will test this assumption.

6.4 Robustness of the Regression Framework – More Extreme Selection of Hot and Cold IPOs

As has been assumed in the previous section, the regression results testing the relationship between heat degree and firm post-IPO performance could also be affected by the neutral period IPOs, which could affect the statistical significance of the results if those IPOs also have CARs and BHARs close to the middle values of the sample. In order to test whether this assumption is true, additional set of regressions is run using CARs and BHARs as dependent variables as before for each heat measure separately (due to different number of neutral periods), but reducing the regression sample to only cold and hot IPOs, removing the neutral period IPOs from the regression sample. Using this approach, the original full sample of 145 observations is reduced to 124 observations for InvestGr as heat measure, 84 observations for NumIPO and 143 for EWU. The lower sample size could introduce the sample bias issue, however, it is important to keep in mind that the CAR and BHAR values for hot and cold IPO companies, that are the most important assessing the relationship, are still left in the samples.

Tables 17 and 18 (Appendix D) present the results of the regressions. Looking at the results it could be concluded that the assumption that middle values of CAR and BHAR estimates to some extent correspond to the neutral period companies is correct. This is proven by the increased significance of the 3 years heat degree for NumIPO heat measure (significant at 10%) and increased significance in InvestGr measure for 1 year, which is significant at 10%. The remaining periods of interest (the periods when heat degrees became significant in the reduced samples) still do not have significant coefficient estimates, but the p-values of the coefficients became lower, especially for NumIPO, suggesting that the coefficients are becoming closer to being statistically significant when the neutral period observations are excluded. If the sample size is larger, the significance of those variables could increase.

Concluding, the results presented above show proof that the significance of the coefficients on heat degrees becomes higher when the neutral period is removed. Although the reduced sample used for growth in OPM and growth in EBITDA regressions (Tables 13-16, Appendix B) is not exactly the same as the sample that only includes hot and cold IPO period companies (Tables 17-18, Appendix D), since more than just neutral period companies are removed, it can still be concluded that there exists a relationship between heat degree and company post-IPO performance. However, the relationship can only be significantly estimated when the neutral period companies are removed from the analysis, making the estimates for CARs and BHARs of hot and cold period companies statistically stronger.

7. Discussion and Future Research

While the investigation of the Swedish IPO market in terms of hot and cold markets, presented in this paper, fails to find strong relationship between market heat and the firm quality, the empirical results yield some support for the existence of dispersion in firm quality across the hot and cold IPO markets and stress the importance of heat measure. Interestingly, contrary to results obtained by Yung et.al (2008) using the US data, the results are different depending on the specific heat measure used. Based on the heat measure using the IPO volume, the analysis shows that there is higher dispersion in variance of returns in cold markets compared to hot, which would suggest that if the issue is in the cold period, then the firm is more likely to obtain lower abnormal post-IPO returns. This was not the relationship found in US IPO market. This contrary result could be explained by the fact that the Swedish IPO market is significantly smaller than the US IPO market, which resulted in many empty quarters with no IPO observations at all (29 out of 96 quarters analyzed). Hence, more quarters were appointed to the cold market, which led to higher dispersion in the cold markets. As expected, using other heat measures that are more general to all IPOs and more independent of market size, such as EWU and InvestGr, the results are in accordance with the US data, suggesting that there is higher dispersion in variance of returns in hot markets.

Once the neutral period has been excluded from the sample, the results became more consistent with Yung et al. (2008) – the variance of abnormal returns shifted for NumIPO with hot period becoming more dispersed, the estimates for EWU and InvestGr became more statistically significant with hot period variances also more dispersed. This finding reveals that the Swedish IPO market is colder and more centered towards the neutral periods than the US IPO market. The relative coldness of the Swedish IPO market was also evidenced using NumIPO as heat measure in the regression framework, removing neutral period IPOs from the analysis. The coefficient estimates between heat degree and firm performance became significantly negative, suggesting that firms listing in hot issue markets are more likely to obtain lower post-IPO abnormal returns. This result proves the existence of adverse selection in the Swedish IPO market. However, the results differ across heat measures and the strong trend was only obtained using NumIPO as a heat measure under extreme separation criteria. This suggests that, although adverse selection is present in Swedish IPO market, it is weak and more research is needed in order to fully understand the mechanisms behind the IPO cyclicality and its implications in this market.

The analysis also revealed that more extreme approach needs to be applied in separating periods into hot and cold in the Swedish IPO market, in order to observe statistically significant trends similar to the ones observed in the US IPO market. For future research, an additional method to divide the sample into hot and cold periods more extremely could be to use highest and lowest quartiles of MA estimates, as suggested by Helwege and Liang (2004).

Furthermore, introduction of additional dependent and control variables could also improve the analysis and possibly increase the statistical significance of the heat degree coefficients. Additionally, the paper only considers market returns while testing hypotheses, one can apply Fama-French-Carhart 4 factor model or other alternative models to estimate abnormal returns in order to avoid possible cross-sectional dependence issues in market returns. Another possible improvement is to add additional proxies for demand for capital, such as GDP-growth and sales-growth as suggested by Lowry (2003) to investigate whether the positive relationship between demand for capital and IPO volume provided by InvestGr heat measure is consistent across alternative demand for capital measures.

8. Conclusions

This paper examines the Swedish IPO market in terms of the demand for capital and adverse selection hypotheses using the model developed by Yung et al. (2008). In this model, shocks to investment opportunities lead to time-varying adverse selection in the IPO market. The logic goes as follows: positive shocks lead to more firms entering the IPO market, the IPO market becomes more active, a hot wave starts to develop, creating the cyclical pattern of IPO issuance. The predictions provided by the demand for capital hypothesis are supported by empirical analysis of Swedish IPOs from 1993 to 2016. It is observed that there is a positive correlation between a proxy for firms´ demand for capital and the IPO volume, suggesting that more firms enter the IPO market due to increased demand for capital. The adverse selection hypothesis predicts that after introducing a shock to investment opportunities, more bad firms pool, which means that the marginal firm in a wave is of lower quality than the average pre-shock firm. It implies that the dispersion in firm quality should be high between hot and cold IPO markets. This was also observed in the Swedish market, as there was high cross-sectional dispersion in firms' long-run variance of returns between hot and cold periods. Using regression framework, the relation between the heat degree of IPO market and firm quality was also examined. It can be concluded that under general, less extreme hot and cold period separation, no statistically significant trends can be noticed assessing the relationship between heat degree and firm quality. However, if periods are separated in a more extreme way, excluding the neutral period companies, the statistical significance of the relationship increases. The relationship observed is mostly negative, suggesting that companies issuing in hot periods are more likely to be of lower quality. However, the overall results differ depending on the heat measure and firm quality measure used. This implies the importance of choice of heat and firm quality measures and especially the hot and cold period separation methodology, since the final result could differ depending on which approach is taken.

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10. Appendices

Appendix A: CAR and BHAR variances for Adjusted Separation Sample of 271 IPOs

Table 9: CAR and BHAR variances across hot and cold markets, quarters classified using sample of 271 IPOs

The table shows the number of IPO firms and the CAR and BHAR variances across hot and cold markets using the 3 heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO-number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The variances for 3-month, 6-month, 9-month and 12-month returns are presented for hot and cold periods separately. The classification of quarters into cold and hot are performed by comparing the four quarters moving average MA(4) with the historical average of each heat measure going back to 1993. If it is 30% above the historic average, then the quarter is classified as hot, otherwise the quarter is classified as cold. Only the IPOs for which the return data is available, is considered in the methodology of hot and cold classification. Due to missing return data, 271 companies are used in cold and hot classification and to calculate the CAR and BHAR variances displayed in the table. All 271 IPOs are appointed to either hot or cold period issue based on the quarter in which the IPO takes place. N represents the numbers of cold and hot IPOs within each hot and cold heat-group. The p-values are shown using F-test.

CAR and BHAR variances across hot and cold markets

	Heat measure is InvestGr			**Heat measure is NumIPO**			**Heat measure is EWU**		
Return	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value	Cold quarters	Hot quarters	F-test: p-value
	N=63	N=208		N=154	N=117		N=112	N=159	
3-Month CAR	**0,0530**	**0,0952**	**0,0077**	0,0831	0,0878	0,7439	0,0891	0,0837	0,7131
3-Month BHAR	**0,0530**	**0,1179**	**0,0003**	0,0916	0,1185	0,1356	0,1119	0,0986	0,4608
6-Month CAR	0,1578	0,2088	0,1964	0,2163	0,1646	0,1209	**0,1334**	**0,2387**	**0,0012**
6-Month BHAR	**0,1545**	**0,3551**	**0,0002**	**0,3886**	**0,2075**	**0,0004**	**0,1299**	**0,4311**	**0,0000**
9-Month CAR	0,2243	0,3044	0,1583	**0,3278**	**0,2251**	**0,0334**	**0,1756**	**0,3580**	**0,0001**
9-Month BHAR	**0,1964**	**0,8506**	**0,0000**	**0,9813**	**0,3458**	**0,0000**	**0,1971**	**1,0447**	**0,0000**
12-Month CAR	0,3605	0,4422	0,3468	**0,4879**	**0,3314**	**0,0286**	**0,2717**	**0,5276**	**0,0002**
12-Month BHAR	**0,2069**	**1,0405**	**0,0000**	**1,1508**	**0,4908**	**0,0000**	**0,2844**	**1,2667**	**0,0000**

Appendix B: Additional Tests - Reduced Samples using CAR and BHAR

Table 13: Determinants of firm performance using CARs as proxy - OPM growth sample of 109 IPOs

The results for CARs as proxy for firm performance are presented using regression framework for the OPM growth sample of 109 IPOs. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is CAR-Cumulative abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective CAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**0.0409***	**0.0517***	**0.0689***	**-0.0866**	**-0.298***	**-0.308***	**0.00242**	**0.0193**	**0.0184**
	(0.0212)	**(0.0301)**	**(0.0390)**	**(0.0743)**	**(0.150)**	**(0.159)**	**(0.00996)**	**(0.0179)**	**(0.0206)**
Size	0.0185	0.00962	0.167***	0.0157	0.00762	0.163***	0.0150	0.00508	0.161***
	(0.0268)	(0.0501)	(0.0563)	(0.0273)	(0.0521)	(0.0583)	(0.0273)	(0.0507)	(0.0565)
Leverage	-0.270	-0.0838	0.0301	-0.226	0.0800	0.197	-0.256	0.0667	0.170
	(0.299)	(0.526)	(0.682)	(0.302)	(0.540)	(0.704)	(0.284)	(0.538)	(0.682)
Offer price	0.00517**	0.00458	-0.00180	0.00516**	0.00466	-0.00173	0.00510**	0.00441	-0.00198
	(0.00214)	(0.00331)	(0.00354)	(0.00212)	(0.00340)	(0.00360)	(0.00211)	(0.00332)	(0.00353)
Underpricing	-0.0233**	-0.0984***	-0.0759***	-0.0221*	-0.0994***	-0.0760***	-0.0218*	-0.102***	-0.0784***
	(0.0117)	(0.0165)	(0.0169)	(0.0117)	(0.0166)	(0.0169)	(0.0123)	(0.0177)	(0.0188)
Age	-0.0264	0.0366	-0.110	-0.0269	0.0270	-0.118	-0.0251	0.0224	-0.122
	(0.0498)	(0.0822)	(0.0832)	(0.0497)	(0.0806)	(0.0842)	(0.0493)	(0.0804)	(0.0844)
PE backed	-0.175	-0.127	-0.237	-0.184*	-0.186	-0.294	-0.161	-0.101	-0.206
	(0.112)	(0.228)	(0.223)	(0.108)	(0.207)	(0.238)	(0.108)	(0.212)	(0.223)
Constant	-0.404	-0.517	-1.699**	-0.184	0.0101	-1.114*	-0.294	-0.339	-1.479**
	(0.348)	(0.566)	(0.679)	(0.386)	(0.619)	(0.656)	(0.357)	(0.580)	(0.671)
Observations	109	109	109	109	109	109	109	109	109
R-squared	0.098	0.099	0.126	0.093	0.129	0.142	0.086	0.107	0.125

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: Determinants of firm performance using CARs as proxy - EBITDA growth sample of 107 IPOs

The results for CARs as proxy for firm performance are presented using regression framework for the EBITDA growth sample of 107 IPOs. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is CAR-Cumulative abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective CAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**0.0403***	**0.0505***	**0.0556**	**-0.0630**	**-0.221**	**-0.273***	**0.00117**	**0.0128**	**0.0155**
	(0.0212)	**(0.0297)**	**(0.0382)**	**(0.0738)**	**(0.151)**	**(0.149)**	**(0.00971)**	**(0.0177)**	**(0.0198)**
Size	0.0176	0.0105	0.171***	0.0141	0.00586	0.165***	0.0141	0.00517	0.165***
	(0.0269)	(0.0504)	(0.0576)	(0.0276)	(0.0518)	(0.0589)	(0.0275)	(0.0507)	(0.0575)
Leverage	-0.187	0.0845	0.107	-0.160	0.176	0.219	-0.177	0.172	0.212
	(0.292)	(0.499)	(0.665)	(0.294)	(0.506)	(0.685)	(0.280)	(0.505)	(0.664)
Offer price	0.00430*	0.00546*	-0.00196	0.00437**	0.00582*	-0.00149	0.00426*	0.00551*	-0.00189
	(0.00221)	(0.00322)	(0.00368)	(0.00220)	(0.00328)	(0.00373)	(0.00218)	(0.00325)	(0.00371)
Underpricing	-0.0212*	-0.104***	-0.0749***	-0.0200*	-0.105***	-0.0768***	-0.0194	-0.106***	-0.0779***
	(0.0116)	(0.0162)	(0.0175)	(0.0116)	(0.0162)	(0.0174)	(0.0124)	(0.0176)	(0.0196)
Age	-0.00722	0.0245	-0.0752	-0.00799	0.0140	-0.0890	-0.00504	0.0144	-0.0879
	(0.0508)	(0.0773)	(0.0858)	(0.0508)	(0.0760)	(0.0864)	(0.0501)	(0.0759)	(0.0873)
PE backed	-0.168	-0.198	-0.245	-0.172	-0.238	-0.297	-0.156	-0.174	-0.217
	(0.111)	(0.224)	(0.226)	(0.106)	(0.211)	(0.237)	(0.107)	(0.214)	(0.223)
Constant	-0.398	-0.522	-1.803**	-0.205	-0.0754	-1.267*	-0.292	-0.357	-1.617**
	(0.349)	(0.571)	(0.690)	(0.391)	(0.621)	(0.655)	(0.360)	(0.580)	(0.680)
Observations	107	107	107	107	107	107	107	107	107
R-squared	0.072	0.113	0.128	0.064	0.126	0.142	0.060	0.112	0.128

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Determinants of firm performance using BHARs as proxy - OPM growth sample of 109 IPOs

The results for BHARs as proxy for firm performance are presented using regression framework for the OPM growth sample of 109 IPOs The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is BHAR, buy-and-hold abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective BHAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**0.0920****	**0.0574**	**0.0487**	**-0.0715**	**-0.183**	**-0.456***	**0.00739**	**0.00172**	**0.0247**
	(0.0449)	**(0.0376)**	**(0.0532)**	**(0.0960)**	**(0.291)**	**(0.271)**	**(0.0124)**	**(0.0352)**	**(0.0181)**
Size	0.0107	-0.00225	0.182***	0.00345	-0.00567	0.181***	0.00282	-0.00716	0.177***
	(0.0354)	(0.0715)	(0.0498)	(0.0363)	(0.0737)	(0.0552)	(0.0366)	(0.0726)	(0.0531)
Leverage	-0.457	0.131	1.134	-0.430	0.228	1.389	-0.411	0.136	1.329
	(0.532)	(0.619)	(0.867)	(0.546)	(0.638)	(0.974)	(0.532)	(0.752)	(0.935)
Offer price	0.00591	0.00749	-0.00207	0.00582	0.00751	-0.00190	0.00575	0.00740	-0.00226
	(0.00426)	(0.00663)	(0.00387)	(0.00423)	(0.00668)	(0.00394)	(0.00423)	(0.00667)	(0.00384)
Underpricing	-0.0339*	-0.0297	-0.0178	-0.0295	-0.0288	-0.0212	-0.0312	-0.0270	-0.0238
	(0.0198)	(0.0287)	(0.0160)	(0.0195)	(0.0270)	(0.0164)	(0.0197)	(0.0280)	(0.0176)
Age	-0.0232	-0.0180	-0.0760	-0.0185	-0.0217	-0.0933	-0.0223	-0.0147	-0.0957
	(0.0969)	(0.100)	(0.0995)	(0.0979)	(0.0938)	(0.0960)	(0.0963)	(0.0869)	(0.0977)
PE backed	-0.401**	-0.244	-0.136	-0.391**	-0.272	-0.237	-0.369**	-0.225	-0.109
	(0.175)	(0.280)	(0.411)	(0.166)	(0.251)	(0.427)	(0.161)	(0.290)	(0.408)
Constant	-0.207	-0.460	-2.118***	0.124	-0.0700	-1.389**	0.0461	-0.308	-1.935***
	(0.415)	(0.658)	(0.592)	(0.467)	(0.718)	(0.529)	(0.416)	(0.668)	(0.614)
Observations	109	109	109	109	109	109	109	109	109
R-squared	0.058	0.039	0.121	0.041	0.041	0.161	0.041	0.033	0.131

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Determinants of firm performance using BHARs as proxy - EBITDA growth sample of 107 IPOs

The results for BHARs as proxy for firm performance are presented using regression framework for the EBITDA growth sample of 107 IPOs. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The dependent variable is BHAR, buy-and-hold abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective BHAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	**0.0892****	**0.0558**	**0.0331**	**-0.0482**	**-0.0867**	**-0.424**	**0.00507**	**-0.00690**	**0.0204**
	(0.0444)	**(0.0383)**	**(0.0590)**	**(0.0971)**	**(0.279)**	**(0.256)**	**(0.0120)**	**(0.0335)**	**(0.0168)**
Size	0.00846	-0.00961	0.171***	0.000808	-0.0145	0.168***	0.000474	-0.0138	0.167***
	(0.0374)	(0.0741)	(0.0510)	(0.0387)	(0.0755)	(0.0548)	(0.0386)	(0.0754)	(0.0540)
Leverage	-0.469	0.144	0.986	-0.445	0.182	1.158	-0.431	0.102	1.122
	(0.514)	(0.616)	(0.824)	(0.522)	(0.630)	(0.894)	(0.509)	(0.718)	(0.862)
Offer price	0.00503	0.00913	-0.00101	0.00502	0.00923	-0.000225	0.00497	0.00900	-0.000867
	(0.00474)	(0.00725)	(0.00420)	(0.00476)	(0.00703)	(0.00423)	(0.00471)	(0.00708)	(0.00416)
Underpricing	-0.0313	-0.0369	-0.0194	-0.0272	-0.0353	-0.0252	-0.0283	-0.0310	-0.0255
	(0.0210)	(0.0307)	(0.0170)	(0.0211)	(0.0283)	(0.0174)	(0.0213)	(0.0298)	(0.0183)
Age	0.00558	-0.0332	-0.0492	0.0101	-0.0342	-0.0751	0.00761	-0.0205	-0.0694
	(0.111)	(0.107)	(0.111)	(0.113)	(0.0976)	(0.102)	(0.112)	(0.0913)	(0.107)
PE backed	-0.387**	-0.298	-0.102	-0.373**	-0.304	-0.199	-0.358**	-0.287	-0.0777
	(0.176)	(0.282)	(0.409)	(0.168)	(0.263)	(0.420)	(0.163)	(0.301)	(0.405)
Constant	-0.187	-0.375	-2.077***	0.109	-0.108	-1.381**	0.0539	-0.254	-1.934***
	(0.444)	(0.698)	(0.617)	(0.514)	(0.750)	(0.532)	(0.448)	(0.705)	(0.649)
Observations	107	107	107	107	107	107	107	107	107
R-squared	0.049	0.049	0.109	0.032	0.045	0.147	0.032	0.044	0.117

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.01

Appendix C: Distributional Patterns when Reducing Samples

Figure 3: Analysis of reduction in IPO sample-from original sample to OPM growth regression sample

The figure compares the distribution of CARs and BHARs when changing the sample size from original sample (145 IPOs) to the OPM growth sample (109 IPOs). The methodology used to create the distributional tables is to split the abnormal returns into different return levels and then count the NumIPO (number of IPOs) belonging to each return level. Blue columns present the original regression sample and the orange columns present the OPM growth sample. The number of IPOs for each return level is shown for 1 year, 3 years and 5 years CARs and BHARs.

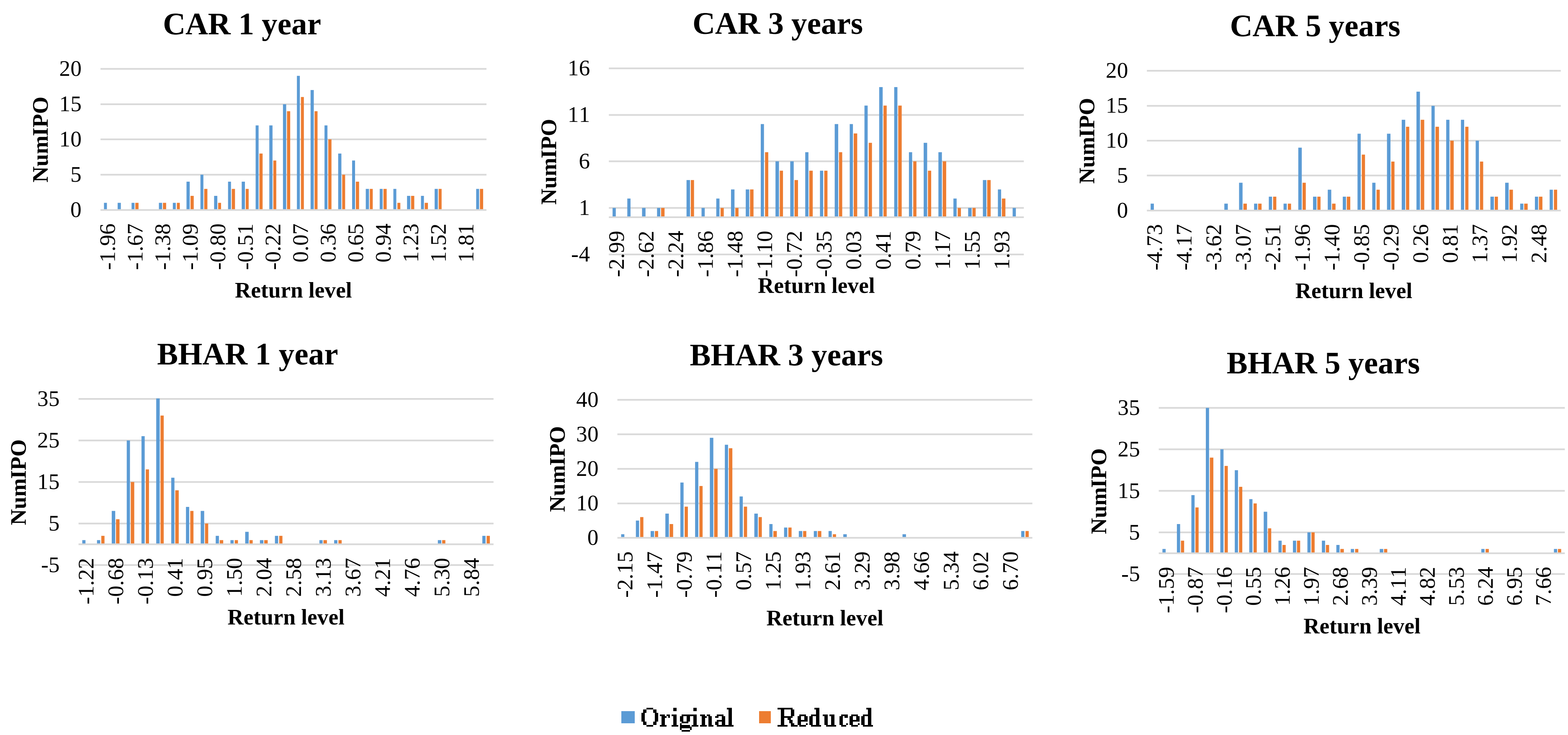
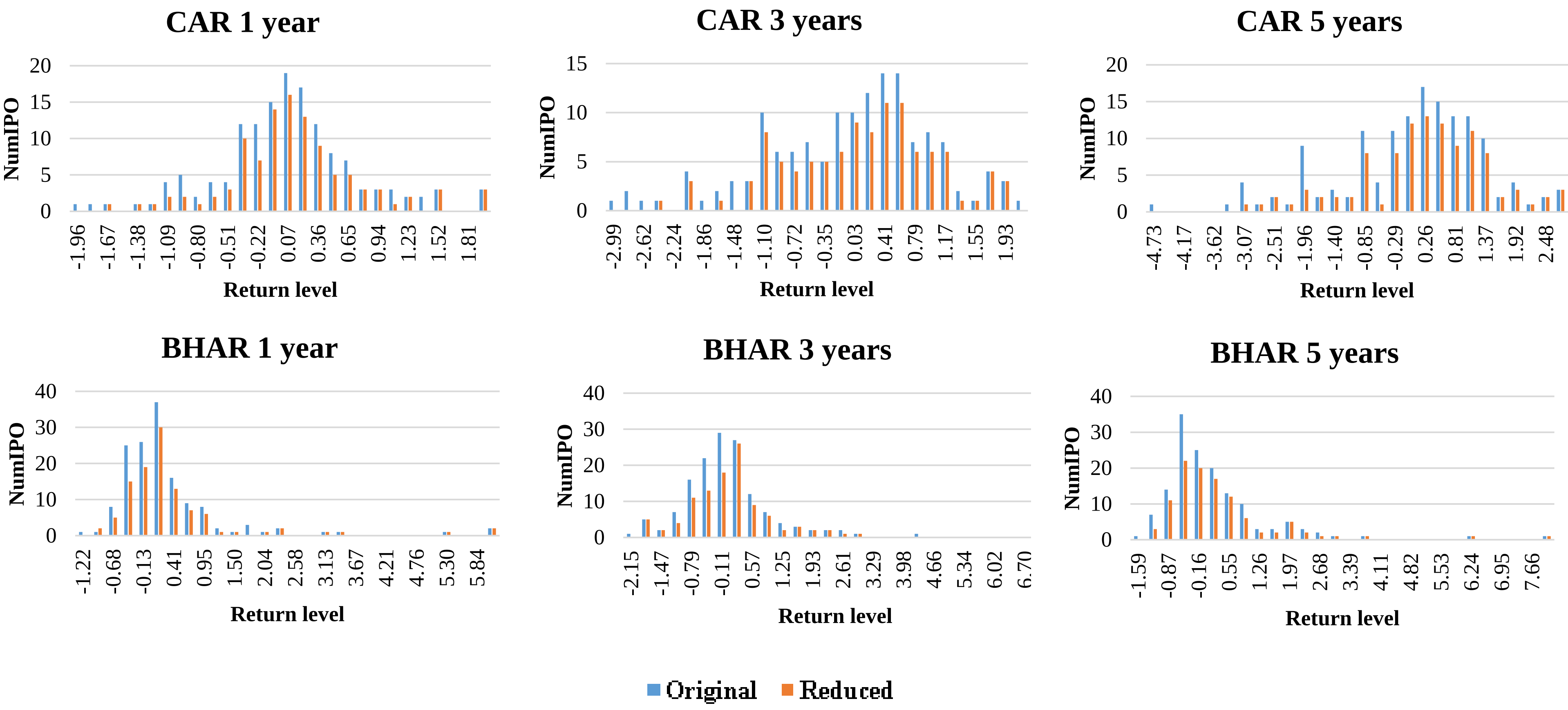


Figure 4: Analysis of reduction in IPO sample-from original sample to EBITDA growth regression sample

The figure compares the distribution of CARs and BHARs when changing the sample size from original sample (145 IPOs) to the EBITDA growth sample (107 IPOs). The methodology used to create the distributional tables is to split the abnormal returns into different return levels and then count the NumIPO (number of IPOs) belonging to each return level. Blue columns present the original regression sample and the orange columns present the EBITDA growth sample. The number of IPOs for each return level is shown for 1 year, 3 years and 5 years CARs and BHARs.



Appendix D: Additional Tests - Extreme Period Separation Rules: CAR and BHAR

Table 17: Determinants of firm performance using CARs as proxy - quarters classified using stricter decision rules

The results for CARs as proxy for firm performance are presented using regression framework when applying stricter decision rules in the cold and hot classification of quarters. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The classification is performed by comparing the four quarters moving average MA(4) with the historical average of each heat measure going back to 1993. In this analysis, stricter decision rules are applied in the hot and cold classification: if the MA(4) is 50% above the historic average, then the quarter is classified as hot. If the MA(4) is 10% lower than the historic average, then the quarter is classified as cold. The remaining quarters are classified as neutral quarters. All 145 IPOs in the full regression sample are appointed to hot, cold or neutral period issue based on the quarter in which the IPO takes place. The IPOs classified into neutral periods are excluded in the analysis, resulting in different amount of observations for each of the three heat measures. The dependent variable is CAR, cumulative abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective CAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	0.00475	0.0335	0.0394	-0.0352	-0.240*	-0.177	-0.00889	-0.0106	-0.00662
	(0.0250)	(0.0333)	(0.0431)	(0.0787)	(0.143)	(0.161)	(0.00907)	(0.0159)	(0.0181)
Size	0.0503*	0.102**	0.221***	0.0184	0.0488	0.182**	0.0449*	0.0851*	0.216***
	(0.0301)	(0.0512)	(0.0643)	(0.0222)	(0.0490)	(0.0714)	(0.0270)	(0.0497)	(0.0602)
Leverage	-0.417	-0.143	-0.122	-0.308	0.00195	0.293	-0.480*	-0.557	-0.288
	(0.344)	(0.492)	(0.655)	(0.322)	(0.642)	(0.908)	(0.268)	(0.513)	(0.604)
Offer price	-0.00155	-0.00188	-0.00478	0.00277**	0.00811***	0.00351	-0.000643	-0.00109	-0.00350
	(0.00229)	(0.00359)	(0.00303)	(0.00138)	(0.00288)	(0.00367)	(0.00222)	(0.00350)	(0.00314)
Underpricing	0.000963	-0.0742***	-0.0602***	0.364*	0.799***	0.478	0.00429	-0.0659***	-0.0552***
	(0.0117)	(0.0171)	(0.0150)	(0.198)	(0.293)	(0.363)	(0.0131)	(0.0198)	(0.0179)
Age	0.0542	0.132	0.0986	-0.0359	-0.122	-0.157*	0.0609	0.108	0.0487
	(0.0544)	(0.0834)	(0.0967)	(0.0464)	(0.0829)	(0.0931)	(0.0507)	(0.0813)	(0.0897)
PE backed	-0.0149	-0.133	-0.129	0.0985	-0.0880	-0.0447	0.00595	-0.0277	-0.100
	(0.145)	(0.239)	(0.257)	(0.128)	(0.236)	(0.293)	(0.134)	(0.227)	(0.225)
Constant	-0.549*	-1.491***	-2.730***	-0.244	-0.484	-2.011**	-0.595**	-1.256**	-2.607***
	(0.307)	(0.522)	(0.745)	(0.256)	(0.566)	(0.778)	(0.289)	(0.525)	(0.693)
Observations	124	124	124	84	84	84	143	143	143
R-squared	0.036	0.125	0.179	0.124	0.201	0.218	0.044	0.083	0.148

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.01

Table 18: Determinants of firm performance using BHARs as proxy - quarters classified using stricter decision rules

The results for BHARs as proxy for firm performance are presented using regression framework when applying stricter decision rules in the cold and hot classification of quarters. The table displays 1 year, 3 years and 5 years regressions of the 3 different heat measures: InvestGr- quarterly change in Real Private Non-residential Fixed Investment Index, NumIPO- number of IPOs per quarter, EWU-equally weighted underpricing per quarter. The classification is performed by comparing the four quarters moving average MA(4) with the historical average of each heat measure going back to 1993. In this analysis, stricter decision rules are applied in the hot and cold classification: if the MA(4) is 50% above the historic average, then the quarter is classified as hot. If the MA(4) is 10% lower than the historic average, then the quarter is classified as cold. The remaining quarters are classified as neutral quarters. All 145 IPOs in the full regression sample are appointed to hot, cold or neutral period issue based on the quarter in which the IPO takes place. The IPOs classified into neutral periods are excluded in the analysis, resulting in different amount of observations for each of the three heat measures. The dependent variable is BHAR, buy-and-hold abnormal return. The explanatory variables are Heat degrees (defined as MA(4) of the corresponding heat measure divided by its historic average), Size (defined as logarithm of one plus sales), Leverage (total debt divided by total assets), Offer price (price at which the issue was offered to public), Underpricing (first day return), Age (defined as logarithm of one plus age at the time of the IPO), PE-backed (dummy variable indicating if the issue was private equity backed). The coefficients for heat degrees presented are the estimated relationship from the regression between each heat degree and the respective BHAR. The robust standard errors are presented in the parenthesis below. Significance levels (p-values) are indicated by stars.

	InvestGr			NumIPO			EWU		
VARIABLES	1yr	3yrs	5yrs	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Heat degrees	0.0631*	0.0358	0.0158	0.00797	-0.223	-0.147	-0.000602	-0.00896	0.00987
	(0.0347)	(0.0361)	(0.0541)	(0.0908)	(0.233)	(0.197)	(0.0101)	(0.0259)	(0.0150)
Size	0.0363	0.0486	0.124***	0.0356	0.00638	0.0696*	0.0363	0.0232	0.140***
	(0.0336)	(0.0573)	(0.0351)	(0.0242)	(0.0790)	(0.0414)	(0.0254)	(0.0517)	(0.0379)
Leverage	-0.557	-0.196	1.097	-0.504	-0.274	0.945	-0.655	-0.247	0.621
	(0.671)	(0.677)	(1.001)	(0.344)	(0.794)	(0.799)	(0.418)	(0.513)	(0.686)
Offer price	0.000652	0.00421	-0.000361	0.00185	0.0141**	0.00412	0.00115	0.00531	0.000586
	(0.00224)	(0.00409)	(0.00208)	(0.00142)	(0.00676)	(0.00446)	(0.00203)	(0.00377)	(0.00211)
Underpricing	-0.0142	-0.0179	-0.0215**	0.471*	1.271*	-0.520	-0.00943	-0.0126	-0.0252**
	(0.0128)	(0.0200)	(0.00975)	(0.262)	(0.693)	(0.392)	(0.0127)	(0.0209)	(0.0116)
Age	0.0454	0.0239	0.0453	-0.0254	-0.150	-0.142	0.0479	0.0225	0.00315
	(0.0974)	(0.0946)	(0.102)	(0.0482)	(0.125)	(0.0891)	(0.0824)	(0.0822)	(0.0884)
PE backed	-0.252	-0.208	0.166	0.0147	-0.210	0.235	-0.199	-0.103	0.0138
	(0.189)	(0.293)	(0.406)	(0.154)	(0.372)	(0.379)	(0.166)	(0.268)	(0.361)
Constant	-0.355	-0.876*	-1.733***	-0.407	-0.146	-0.802*	-0.330	-0.648	-1.845***
	(0.302)	(0.474)	(0.452)	(0.255)	(0.651)	(0.423)	(0.273)	(0.495)	(0.470)
Observations	124	124	124	84	84	84	143	143	143
R-squared	0.025	0.043	0.107	0.113	0.173	0.162	0.023	0.047	0.098

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.01

Appendix E: List of Final Sample of 271 IPOs

List of the final sample of Swedish IPOs used in the study from year 1993-2016:

Company name	**Issue date (YYYY-MM-DD)**	**Company name**	**Issue date (YYYY-MM-DD)**
A-Com AB	1999-11-04	Boss Media AB	1999-06-24
Absolent Group AB	2014-09-26	Boule Diagnostics AB	2011-06-23
AcadeMedia AB	2016-06-15	Brandworld Sverige AB	2010-03-29
Acando AB	1995-06-08	Bravida Holding AB	2015-10-16
ADDvise Group AB	1998-03-27	Brighter AB	2012-02-03
Aerocrine AB	2007-06-15	BTS Group AB	2001-06-06
Ainax AB	2004-06-08	Bufab AB	2014-02-21
Alelion Energy Systems AB	2016-06-21	Bulten AB	2011-05-20
Alfa Laval AB	2002-05-17	Byggmax Group AB	2010-06-02
Alfaskop AB	1997-02-24	C-Rad AB	2007-07-23
Alimak Group AB	2015-06-17	Camurus AB	2015-12-03
All Cards Service Center AB	1998-05-12	Capacent Holding AB	2015-10-02
Allenex AB	2006-12-12	Capio AB	2015-06-30
Allgon AB publ	2000-05-02	Castcom AB	2000-04-17
Arctic Gold AB	2009-07-15	Castellum AB	1997-05-23
Arete AB	1997-12-19	Celsius Industrier AB	1993-06-14
Arise AB	2010-03-24	Centrecourt AB	2000-10-25
Arjo AB	1993-12-31	Check Point Holding AB	1997-06-18
Artimplant AB	1997-11-05	Clean Motion AB	2016-05-26
Attendo AB	2015-11-30	CLX Communications AB	2015-10-08
Audio Development Informations	2000-09-21	Cognosec AB	2016-09-22
Autodiagnos AB	1997-12-29	Coldator FreshCool International	2000-06-07
Availo AB	2000-05-30	Collector AB	2015-06-10
Avega AB	2007-10-26	Com Hem Holding AB	2014-06-17
Avensia AB	2000-06-15	Coor Service Management Holdin	2015-06-16
Axfood AB	1997-06-27	Corem Property Group AB	1997-06-24
Axis Communications AB	2000-06-27	Cryptzone AB	2008-02-04
B3IT Management AB	2016-06-13	CTT Systems AB	1997-11-11
Bactiguard Holding AB	2014-06-19	CyberCom Group AB	1999-12-01
Besqab AB	2014-06-12	Cyxone AB	2016-06-07
Biacore International AB	1996-12-03	D Carnegie & Co AB/Old	2001-06-01
BIMobject AB	2014-01-13	Dahl International AB	1996-06-04
Binar AB	1997-06-17	Decim AB	1998-07-07
BioGaia AB	1998-05-28	Devicom AB	2007-06-29
BioInvent International AB	2001-06-12	DGC One AB	2008-06-16
Biora AB	1997-02-10	DIBS Payment Services AB	2007-06-18
Biotage AB	2000-06-21	Dignita Systems AB	2016-06-21
BIP Bottnia Internet Provider	1998-06-15	Din Bostad Sverige AB	2000-07-14
Bluemarx AB	2000-05-09	Dios Fastigheter AB	2006-05-22

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Company name	Issue date (YYYY-MM-DD)	Company name	Issue date (YYYY-MM-DD)
Direct Conversion AB	2006-02-01	Horda Ab-B SHS	1995-07-03
Dometic Group AB	2015-11-25	Human Care AB	2000-07-10
DTG Sweden AB	2007-10-25	Humana AB	2016-03-22
Duni AB	2007-11-14	IAR Systems Group AB	1999-01-04
Dustin Group AB	2015-02-13	ICA Gruppen AB	2005-12-08
Eastnine AB	2007-11-09	Image Systems AB	1999-04-28
Ekomarine AB	2010-04-27	Independent Media Group AB	1997-10-15
Electra Gruppen AB	2006-04-05	Indutrade AB	2005-10-05
Eltel AB	2015-02-06	Insplanet AB	2006-06-07
Endomines AB	2007-06-19	Internationella Engelska Skola	2016-09-29
Eniro AB	2000-10-10	Intrum Justitia AB	2002-06-07
Enorama Pharma AB	2016-06-10	inWarehouse AB	1997-04-02
Entra Data AB	1997-02-14	Inwido AB	2014-09-26
Enzymatica AB	2011-06-14	IRO AB	1995-06-22
Eriksson Development and Innovation	2008-01-24	JC Group AB	2000-04-19
Evolution Gaming Group AB	2015-03-20	JLT Mobile Computers AB	1997-12-18
eWork Group AB	2008-05-22	Jobline International	2000-09-14
EXINI Diagnostics AB	2009-08-10	Johnson Pump International AB	1997-06-19
Fagerlid Industrier AB	1995-03-17	Kancera AB	2011-02-25
Fastighets AB Balder	1999-10-12	KappAhl AB	2006-02-23
FB Industri Holding AB	1997-12-22	Karlshamns AB	1997-06-05
Footway Group AB	2015-07-13	Karolin Machine Tool AB	1998-04-03
Gant Co AB	2006-03-28	Karolinska Development AB	2011-04-15
GARO AB	2016-03-16	Klovern AB	1997-06-19
Gibeck Louis AB	1997-12-12	Kontakt East Holding AB	2006-11-26
Global Health Partner AB	2008-10-03	Kungsleden AB	1999-04-14
GlobalFun AB	2008-03-26	Labs2 Group AB	1997-12-09
GomSpace Group AB	2016-06-16	Lawson International AB	1996-11-22
Goodtech Projects & Services AB	1999-05-10	Layerlab AB	2010-05-17
Granges AB	2014-10-10	LB Icon AB	1998-06-22
Guide Konsult AB	1998-05-27	LBI International AB	1999-06-23
Gymgrossisten Nordic AB	2006-12-09	LeoVegas AB	2016-03-17
H1 Communication AB	2008-06-26	Lexmark Enterprise Software Sv	1999-06-22
Hancap AB publ	2015-04-09	LGP Allgon Holding AB	1997-06-05
Hemtex AB	2005-10-06	Lifco AB	2014-11-21
Hexpol AB	2008-06-09	LPI Precision AB	1997-12-22
HIQ International AB	1999-04-12	Mabi Rent AB	2010-06-16
HMS Networks AB	2007-10-18	Magnolia Bostad AB	2015-06-09
Hoist Finance AB	2015-03-25	Maha Energy AB	2016-07-29

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Company name	Issue date (YYYY-MM-DD)	Company name	Issue date (YYYY-MM-DD)
Malka Oil	2007-12-13	Peak Performance	1996-10-07
Malmbergs Elektriska AB	1999-03-12	PiezoMotor Uppsala AB	2016-06-09
MaxFastigheter i Sverige AB	2016-06-29	Platzer Fastigheter AB	2013-11-29
Maxkompetens Sverige AB	2015-11-23	PLM AB	1995-11-13
Meda AB	1995-06-27	Poolia AB	1999-06-23
Medirox AB	1998-06-05	Prevas AB	1998-05-29
Mekonomen AB	2000-05-29	Prime Living AB	2015-06-12
Melker Schorling AB	2006-09-05	Probi AB	2004-11-08
Mind AB	2000-06-13	Proffice AB	1999-10-11
MQ Holding AB	2010-06-18	Profilgruppen AB	1997-06-19
Mycronic AB	2000-03-09	Pronyx AB	1997-04-14
Naturkompaniet AB	1999-04-21	Q-Med AB	1999-12-06
NAXS Nordic Access Buyout Fund	2007-04-05	Recipharm AB	2014-04-03
Nederman Holding AB	2007-05-16	RedBet Holding AB	2006-07-05
Neonet AB	2000-10-20	Resco	1996-10-31
Nepa AB	2016-04-26	Resurs Holding AB	2016-04-29
Netwise AB	2000-09-28	Rnb Retail and Brands AB	2001-06-26
New Wave Group AB	1997-12-11	RusForest AB	2006-08-01
NK Cityfastigheter AB	1997-03-21	Sagax AB	1999-04-06
Nobia AB	2002-06-19	Sardus AB	1997-04-07
Nobina AB	2015-06-17	Scandi Standard AB	2014-06-27
Nordax Group AB	2015-06-17	Scandic Hotels AB	1996-12-17
Nordic Mines AB	2006-12-15	Scandic Hotels Group AB	2015-12-02
NordIQ Goteborg AB	2011-12-27	Scandinavia Online	2000-06-07
North Atlantic Natural Resource	1997-06-24	Scandinavian Clinical	2007-11-22
Note AB	2004-06-23	Scandinavian PC Systems AB	1997-06-06
Novavax AB	2010-11-10	Scania AB	1996-04-01
Novotek AB	1999-06-29	Scanworld Travelpartner AB	2007-06-27
NP3 Fastigheter AB	2014-12-04	Scibase Holding AB	2015-06-02
Nuevolution AB	2015-12-04	Scirocco AB	2006-12-07
OptiMail AB	1998-07-01	SeaNet Maritime Communications	2007-06-28
Orc Group AB	2000-10-19	Sectra AB	1999-03-01
Orexo AB	2005-11-09	Semcon AB	1997-05-26
OrganoClick AB	2015-02-16	Sendit AB	1997-09-26
Pallas Group AB	2010-05-28	Sportjohan AB	2010-03-02
Pandox Fastigheter AB	1997-06-23	SRAB Holding AB	1997-06-12
Pandox AB	2015-06-18	Stillfront Group AB	2015-12-08
Paradox Interactive AB	2016-05-31	Svenska Orient Linien	1997-10-29
Partnertech AB	1997-06-12	Swedbank AB	1995-06-09

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Company name	Issue date (YYYY-MM-DD)
SwedenCare AB	2016-06-14
Swedish Orphan Biovitrum AB	2006-09-15
Swedol AB	2006-06-12
Systemair AB	2007-10-12
TDC Nordic AB	2000-03-16
Teleca AB	1997-02-21
Telelogic AB	1999-03-08
Tethys Oil AB	2004-04-06
TF Bank AB	2016-06-14
The Lexington Co AB	2015-02-10
Thule Group AB	2014-11-26
Ticket Travel Group AB	1997-04-25
Tilgin AB	2006-12-15
Tobii AB	2015-04-24
Toyota Material Handling Europe	1995-11-27
TradeDoubler AB	2005-11-08
Transmode AB	2011-05-27
Troax Group AB	2015-03-27
Trygga Hem Skandinavien AB	2008-05-27
Venue Retail Group AB	1997-07-01
Vinovo AB	2007-10-11
Vision Park Entertainment AB	1997-09-24
Vitrolife AB	2001-06-26
Vostok Gas Ltd	1997-03-06
Water Jet Sweden AB	2007-07-06
Wayfinder Systems AB	2005-10-21
Waystream Holding AB	2015-11-12
WeSC AB	2008-05-19
West International AB	2007-10-22
Wilkenson Handskmakar'n AB	1997-10-27
World Class Seagull Internatio	2008-06-02
Xbrane Biopharma AB	2016-02-03
Xintela AB	2016-03-22
Y.C.O. BUSINESSPARTNERS AB	2007-05-02
Zapp AB	1999-12-06
Zenergy AB	2015-10-19
Zodiak Media AB	1997-04-14

End of Appendix.