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Herd Behavior on the Swedish Stock Exchange

Master Thesis in Finance (30 ECTS)

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Abstract

In this study the Stockholm Stock Exchange in Sweden is examined for herd behavior with a market wide approach. Three models, one created by Christie and Huang (1995) and the others created by Chang, Cheng and Khorana (1999), are applied to detect herd behavior from 1998 to 2009. Herd behavior is found in up-going market days, measuring on daily bases over the entire time frame. When breaking down the test period into annual sub-periods, herd behavior is evident in the bullish markets of 2005 and 2007. In days with the most extreme market movements herd behavior is found in large cap stocks but not in the small cap. The result indicates a tendency of an increasing level of herd behavior over the measured period, which can be attributed to the increased influence of institutional ownership. Moreover, the data was adjusted for thinly traded stocks and the result is contradictive to previous studies. The reduction of thinly traded stocks seems to have an increasing effect on the herd-measure, implying that the presence of thinly traded stocks puts a negative bias on the herd-measures.

Table of Contents

1 Introduction

This section introduces the phenomenon herd behavior in financial research and briefly presents the study's contents.

After reading the movie guide in a local newspaper, a couple decides to watch a top-rated action picture. Upon arrival at the movie theater they discover surprisingly that all seats are still available, while a comedy picture starting at the same time is almost sold out. This situation will most likely make the couple hesitate. Should they trust their own information or rely on the majority's choice of movie for the evening?

Investors in a stock market struggle with the same dilemma as the couple in the movie theatre. When the market trend is heading in a certain direction how confident are investors of their private judgment if it differs from the trend? A rational investor acts according to the private judgments of available information and would not be affected by psychological factors such as the current behavior of other investors. In reality, however, it is common that investors observe how others act and their private judgment might become affected. When investors neglect private information and base investment decisions on how others act, herd behavior is created.

The purpose of this study is to investigate whether herd behavior, measured with a market wide approach, can be found in the Stockholm Stock Exchange in Sweden (henceforth called by it official name the "*OMXS*") during 1998 to 2009.

Herd behavior is in this study measured as a decrease, or an increase at a less than proportional rate, of dispersion of cross-sectional stock returns in relationship to the market return. This form of herd behavior implies that investors act without regard of what is normally considered to be rational basis, such as stocks' fundamentals or historical patterns. It can, however, be argued that investors act rational if their intentions are profit maximizing. Knowing, for example, that other investors herd it might be the best move to join the herd. In other words investors can herd because they lose their rational judgment due to psychological reasons such as fear, or herd due to a rational investment strategy. In either case, prices shift from their real equilibrium and no longer reflect the true value of the companies. Intuitively this behavior can easily lead to issues like the creation of stock market bubbles. Investors' rationality or the underlying reasons to herd have, however, no effect on the implications of herd behavior. The presence of herd behavior is, due to the shift of prices out of equilibrium, a violation of rational asset pricing models and contributes to the assumptions of market inefficiency (Saastaminen, 2008 and Henker, Henker and Mitsios, 2006).

Herd behavior is, as Hwang and Salmon (2004) point out, frequently discussed in the context of bubbles and stock market crashes. However, empirical evidence has tended to connect herd behavior with emerging markets, rather than with bubbles in developed markets.

Chang, Cheng and Khorana (1999), for example, found herd behavior in the emerging markets of South Korea and Taiwan but not in the U.S.. Caporale, Economou, and Philippas (2008) are one of few studies that connect herd behavior to market crises, as they present evidence from the relatively developed stock market of Athens in Greece. Herd behavior has also been studied within Social Psychology. Andersson (2009), for example, show that investors have motivation and tendency to participate in herds. In the field of Behavioral Finance have most studies focused on detecting herd behavior and analyze what implications it ahs to a market. Professional investors have been in special attention, for example Wermers (1995) describes how institutional investors herd and Trueman (1994) finds herd behavior among stock analysts. Beginning in the early 90's a growing body of literature focused on detecting and measuring herd behavior with econometric analysis. These studies, this one included, are generally focused on the entire aggregated market using what is called a market wide approach. Results have shown that herd behavior is more common in emerging markets than in developed and to some extent also during periods of bubbles and crashes in the stock market (Saastaminen, 2008).

Investigating the Swedish stock market during 1998 to 2009 is especially interesting since it covers two periods of market crises. Saastaminen, 2008 states that in extreme market phases investors' rationality is under hard pressure which increases the possibility of herd behavior. Moreover, the Swedish stock market has developed vastly during the last decades. Increased interest from foreign capital and an implementation of a new pension system has made institutional ownership greater, simultaneously as the OMXS is still dominated by few companies in terms of market capitalization (Wiberg, 2008). The Swedish market is also considered to be developed. Knowledge about herd behavior is an important input when evaluating the market in terms of efficiency and the general behavior of investors. The existing knowledge about what role herd behavior has in the Swedish stock market is to date still scarce. The result of this study aims to contribute with new knowledge in this area.

The hypotheses are that herd behavior will be found around the time of the IT-bubble in the early 00's and during the financial crisis in the latter part of the 00's. This is assuming that investors are more prone to herd in periods of extreme movements of the stock market. This would correspond to the findings on the Athens's stock exchange in Greece by Caporale et al. (2008), who put special focus on their crisis of 1999. Another hypothesis is that herd behavior will be more present in large cap stock than small cap, because these stocks are more influenced by institutional investors. There are several studies showing that herd behavior is common among professional investors, for example Wermers (1995), Nofsinger and Sias (1999), Manganaro and Von Mertens (2007), and to some extent Lakonishok, Shleifer, and Vishny (1992).

To investigate the possible herd behavior in the Swedish stock market the OMXS stock returns are studied with three different models, one developed by Christie and Huang (1995), henceforth referred to as "*CH*", and the others by Chang, Cheng and Khorana (1999), henceforth referred to as "*CCK*". These are recognized methods for measuring herd beha-

vior with a market wide approach in stock markets and used in most up-to-date studies, for example Caporale et al. (2008), Demirer, Gubo, Kutan (2007), and Chiang and Zheng (2010). The models assume that herd behavior is connected to movements of the market return. The rational is that investors act rational in tranquil times, but looses their confidence and follow the trend in volatile periods. In short, the models examine the relationship between the dispersion of individual stock returns around the market return. When the market volatility is high the dispersion should increase, since stocks according to traditional financial theory have different sensitivity to the market return. If herd behavior is present, the dispersion would not be correlated to the market return as assumed and herd behavior can be distinguished.

In section 2, the subject of Behavioral Finance is introduced which leads on to a thorough presentation of herd behavior in stock markets. Section 3 familiarizes with the environment of the stock exchange and economical development of Sweden. Section 4 presents previous studies that are relevant for this paper. Section 5 describes the applied models and data description. In section 6 are the result and analysis presented, which is followed by a caveats discussion. Finally, section 7 contains conclusions and suggested further studies.

2 Behavioral Finance

This section is divided into three parts. It begins with an introduction of Behavioral Finance, which is followed by a thorough presentation of herd behavior in stock markets. The last part concerns the study's specific approach to measuring herd behavior.

Traditional financial theories are often focused on quantifying reality to make it more accessible to analyze. The focus is generally on hard measures, such as ratios, prices, returns, or growth rates. Usually this leads to a simplified reality as the number of explaining parameters in models are limited. This type of analysis excludes important input concerning softer measures, such as the human behavior behind numbers. During the 90's much academic focus shifted from traditional financial theories to models connecting human psychology with the behavior of financial markets. The field of Behavioral Finance was introduced, which Schiller (2003) describes as a mix of finance, social science, and psychology. It criticizes traditional financial theories and it is a direct opposition to the Efficient Market Hypothesis (henceforth called "*EMH*"), the cornerstone of many financial models. Barber and Odean (1999) view Behavioral Finance as a new set of theories that allow investors to be irrational and markets to be inefficient, thus help to attain deeper knowledge about financial markets.

The EHM has according to Shleifer (2000, p. 1) been "*the central proposition of finance for nearly thirty years*" and constitutes the base that most traditional financial theories are built upon. Fama (1970) introduced the theory with assumptions that asset prices fully reflects all available information including inside information, all investors have access to this information, investors act rational, and it implies impossibility to constantly beat the market. In practice markets were divided into three different forms depending on to what degree it fulfills criteria of the EMH. The theory does, however, present three degrees of efficiency weak, semi-strong, and strong. The weak form makes it theoretically possible to earn abnormal returns by analyzing historical prices and returns. The semi-strong form enables abnormal returns based on inside information. In a truly efficient market future stock prices cannot be predicted by current prices, since they already reflect all information and assume to follow a random walk as they immediately absorb all new information. That is, stocks going up are just as likely as down falls (Wärnerby, 2001). An important implication of a perfectly efficient market is, according to Fama (1970) that it rules out active investment strategies and infers that it is better to passively hold the market portfolio. It should be impossible for investors to constantly beat the market. The explanation why some market agents still show evidence of outperforming the market during a certain timeframe is natural. Due to the large number of market participants, some must beat the market, while others with less luck will perform inferior return compared to the market. Even though most markets are not classified as strongly efficient, traditional financial theory is built on the assumptions that the EMH holds. An example of these theories is the Capital Asset Pricing Model (Shlerider, 2000). Barber and Odean, (1999) claims that EHM conditions rarely reflect the reality and evidence of real investor behavior. According to Shlerider (2000, p.10) the existing knowledge in Behavioral Finance is "*only the tip of the iceberg*".

The view on investors' rationality is a central cornerstone of Behavioral Finance that constitutes a crucial distinction to the assumptions of the EHM. The question whether investors need to be fully rational in an efficient market in order for prices to be in equilibrium has been widely discussed. Shiller (1984) argues that irrational investors must not imply incorrect prices. Their trades may cancel each other out since they mostly trade with each other. This argument has, however, been criticized by psychological studies showing that irrational investors rather deviate towards the same direction. That is, noise traders buying and selling the same assets in correlated manners. This issue becomes especially severe when the noise traders meet socially, like most professional investors do. An interesting example that accentuates this phenomenon is the Norwegian fund company, Skagen Fonder, which is known for outperforming the market successfully. Its philosophy is to be located far away from financial clusters in order to avoid influence from other investors (Lange, Sand, and Svahn, 2009). Moreover, Shlerider (2000) points out that a market of perfectly rational investors is hard to achieve. Investors tend to peruse active investment behavior instead of the passive strategy suggested by the EHM, for example, investors follow advices of financial gurus, fail to diversify, sell equities for tax reasons, and follow stock patterns or other popular models. There are several examples why investors do not act rational. When new information arrives that is hard to analyze or not easily attained, all investors might not incorporate the new information in their stock valuations. As a result, prices in the market no longer reflect all available information and are incorrect. Another example is the prospect theory presented by Kahneman and Tversky (1979), which shows that investors act inconsequently in the same decision process depending on how the decision is presented. The subjective perception of risk could, for example, alternate depending on the estimated probability of a certain outcome.

2.1 Herd Behavior in Financial Markets

A number of studies within the field of Behavioral Finance have concentrated on herd behavior in financial markets. In literature it was introduced in the early 90's. Papers like Banerjee (1992) and Bikchandani et al (1992) introduces herd behavior in abstract environments. They show that after a certain number of agents have chosen the same action, all following agents will imitate that action disregarded their own private information (Cipriani and Guarino, 2007). Later, there has been a focus on studies that apply various econometric methods to detect herd behavior. The pioneers were Christie and Huang (1995) who presented a popular method that is still used today. Their study also constituted the base for the widely used approaches of Chang, Cheng and Khorana (1999). Another path of studies about herd behavior in financial markets has been within Social- Psychology, for example Andersson (2009). This path focuses on the human's underlying motives to herd and studies are often carried out with social experiments in arranged settings.

Herd behavior is often discussed in the context of the EMH. According to Hwang and Salmon (2004) the presence of herd behavior in a market is a disagreement to assumptions of the EMH. They argue that herd behavior pushes asset prices away from the equilibrium proposed by traditional financial theory, such as the Capital Assets Pricing Model, leading to prices that no longer reflect the true value of companies. This is why herd behavior is often used in the context of extreme market behaviors, especially in times of crashes and bubbles. Even though the term "*herd behavior*" is frequently used it is a rather vague expression. Outside the academic world it is often used without an appropriate definition. It originates from comparison between investor behavior and animal characteristics, inferring that investors would follow each other blindly like sheep or lemmings do when herd behavior (Bikhchandani and Sharma, 2001). In academic studies alternative definitions have usually been preferred. Banerjee (1992, p. 798) says that "*Everybody doing what everyone else is doing even when their private information suggests doing something else*". Another definition is provided by Demirer, Gubo, and Kutan (2007, p.3) who explains that "…*a behavior pattern that is correlated or co-integrated across individual investors, firms in an industry or even country stock markets*". Bikhchandani and Sharma (2000) simply say that "*herd behavior is the obvious intent by investors to copy the behavior of other investors*". These definitions are all similar and refer to the common idea that investors neglect their obtained information to act based on the action of others. Hwang and Salmon (2007) explain that this could be to follow another agent, a market trend, or other signals of how other investors act in the market. Saastamoinen (2008) does, however, use a slightly different definition that refers directly to a common way of measuring herd behavior, as saying "*a decrease of dispersion of stock returns, or increase of dispersion at a less-than-proportional rate with the market return*". This definition leaves out the rational of how herd behavior is created and how investors are assumed to act. It simply focuses on a technical method of detecting herd-behavior. In this paper both types of definitions applies. The used methods are similar to Saastamoinen's, thus his definition is appropriate. An assumption in this paper is that Saastamoinen's definition is a result of the investor behavior described in the others' definitions. This is why both ways of defining herd behavior are appropriate in this paper. The reason Saastamoinen uses this technical definition is because he questions the relationship between the measures and confirmed herd behavior, which is interesting and discussed further in the Caveats section.

In order to grasp the underlying reasons of the creation of herds, market agents can be divided into private and professional investors. Private are non- professionals that invest savings for future consumption or with speculative reasons attempt to profit from the stock market. Professional investors are primary institutional investors, like mutual funds. Both these categories can herd but tend to have various reasons. According to Shiller (1984) private investors might feel that they have inferior information and knowledge of, for example macroeconomic trends or equity valuation techniques. Wiberg (2008) points out that this informational advantage of the professional investors has lead to the expression "*informed investors*". For private investors it is easy to be influenced by the professional investors, as they believe that the majority might have superior information. Professional investors might herd because they are often compared with peers. Devenow and Welch (1996) claim that studies involving the agent principal problem can show that professional investors

might follow each other due to the risks of being completely wrong compared to their peers. The benefit of being the only one to be right is not as great as the risk of being the only one to be wrong. Lakonishok (1992) describes the tendency with a quote from a pension fund manager taken from the Wall Street Journal in 1989; "*Institutions are herd behavior animals. We watch the same indicators and listen to the same prognostications. Like lemmings, we tend to move in the same direction at the same time. And that, naturally, exacerbates price movements*". Researchers sometimes separate the underlying motives of herd behavior into rational and irrational behavior, occasionally called spurious respectively intentional herd behavior. Investors acting rational believe that it is the best move to follow the majority since they are convinced that others possess more information or superior analytic skills. If investors follow this logic it can be argued that they actually make a rational choice when following the majority (Hwang and Salmon, 2007). This type of herd behavior can be distinguished if considering whether the investor intentionally would adopt a similar behavior if put in an identical situation again (Caparrelli et al., 2004). Irrational behavior, on the contrary, refers to investors that act without any rational motivation. An example could be investors that panic in a sudden market drop and choose to sell only to limit losses. That is, the investor neglects the obtained information to follow the majority in the current market trend. It can be described as a primitive behavior, where investors act without reasoning rationally, thus like herd behavior animals. Previous studies sometimes separate these two different types of herd behavior. The method of Hwang and Salmon (2007) allow a distinction between these different types. This is, however, not necessarily positively since it builds on assumptions which are difficult to estimate when information about all individual investors are inaccessible. More common is to neglect the roots of herd behavior and focus on the implications of the issue, for example Caporale, et al. (2008), Saastamoinen (2008), and Chang, Cheng and Khorana (1999) use this approach.

The question about rationality among investors that participate in herds is of little importance for most studies of herd behavior. The implications of herd behavior to the market are still the same and there is no difference when detecting herd behavior. This study focuses, like Caporale, et al. (2008) on methods that make no distinction of individual motives to herd. There is discussion of possible roots but the major focus is rather on detecting herd behavior and analyzes its implications on the market. The implications of herd behavior are mainly related to market conditions that cannot be explained by traditional financial theory. Herd behavior leads to mispricing of stocks, thus, prices that no longer reflect the true value of a company. Additionally, it is often caused by irrationality, as investors might act on impulses and not analysis. Henker et al., 2006, describes herd behavior as a root to inefficient market conditions. An implication for investors when herd behavior is present is that a larger number of securities are needed in order to achieve the same degree of diversification as in a herd free market (Demirer, Gubo, Kutan, 2007).

Past studies have, as mentioned, focused more on emerging markets than on the connection to bubbles, but the relationship is often discussed in context of empirical research. One of these studies is Devenowa and Welch (1996) who claim that herd behavior is a contributing factor to the creation of financial bubbles. Another is Hwang and Salmon (2004,

pp.586) who say that *"herd Behavior can become dominant and the extreme effects of herd behavior in terms of mispricing can arise leading to bubbles and subsequent crashes. Herd behavior cannot therefore be ruled out on the basis of theoretical analysis and we need to rely on empirical evidence to determine the importance of herd behavior in practice*".

The connection between herd behavior and institutional investors has been widely discussed. Several studies show that they tend to be cautious with decisions based solely on their own opinions. Darfelt and Mendel (2008) summarize a few examples. The first is Shiller and Pound (1989) that show how institutional investors are significantly influenced by advices from other professionals, especially for volatile stock investments. Secondly, they point out Grinblatt, Titman, and Wermers (1995) that present evidence that 77% of mutual fund investors are momentum investors. Finally, they mention Wermers (1999) that finds evidence of herd behavior in small cap stocks in trades by growth- oriented funds.

2.2 The Market Wide Approach

Herd behavior is generally studied through one of two different approaches. The first, which this study follows, is often called "*market wide herd behavior*" (Caporale et. al., 2008) since it focuses on cross sectional correlations of the entire stock market. It can also include studies that adjust for thinly traded stocks or focus on the entire distribution of a larger subsample, such as a sector. Henker, et al. (2006) points out that in this sense it does not detect single investor behavior, instead it concentrates on tendencies of the entire market or distribution of the measured population. If herd behavior is present on the market wide level, returns of individual stocks will be more than usually clustered around the market return. This implies that investors neglect their private opinions and received information in favor of the market consensus.

The alternative approach refers to detecting special subgroups of investors behaving similarly or study herd behavior on the individual investor's level. That could, for example, be to study capital allocation of mutual funds, recommendations of stock analysts, or to monitor the behavior of a single trader. Henker, et al. (2006) says that regardless of how herd behavior is detected, in the end it leads to the same implications on the market. Assets become mispriced and out of equilibrium. In brief Hwang and Salmon (2007) explain that the market wide approach focuses more on measuring the quantity of herd behavior, while the other aims to answer who is leading and following the herd.

In this study the concept of herd behavior is measured with three similar models, one constructed by CH and the others by CCK. These methods are frequently used measures to detect herd behavior with the market wide approach. Since the approach only looks at the asset-specific component of returns, it ignores other forms of herd behavior. Herd behavior might, for example, be explained by the common component of returns, as when pric-

es of all assets in a market change in the same direction. Bikchanani and Sharma (2000) points out that these methods search for a specific type of herd behavior and do not provide answers about the existence of other forms of herd behavior in the market.

Even though CH and CCK are the recently most used methods, there are previous studies that have used similar techniques with dispersion of stock returns although not in attempt to search for herd behavior. CCK presents a few examples. The first are Bessembinder et al. (1996) who apply the absolute deviation of individual firm returns from a market model expected returns as a proxy for firm-specific information flows. Another are Connolly and Stivers (1998) who work with the stock market's cross-sectional dispersion to measure the uncertainty with respect to underlying market fundamentals. A third example is Stivers (1998) who use the cross-sectional return dispersion as a measure of the uncertainty faced by imperfectly informed traders when trying to understand common factor innovations from news and prices.

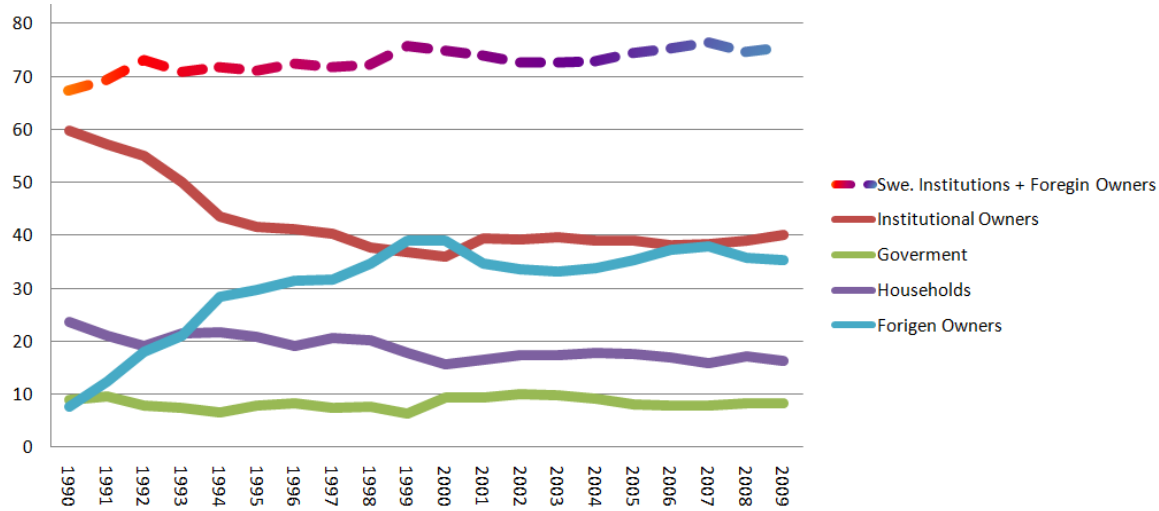
Measuring herd behavior with the market wide approach has several advantages over other measures used to obtain empirical evidence of herd behavior. Hwang and Salmon, (2004) points out a few examples. First, it is practical in the sense that it is based on observed data, as other measures often need detailed records of individual trading activities. Another advantage is the existence of similar studies on other markets using the same theories and methods. This enables effective comparison where new knowledge easier can be obtained.

3 The Case of the OMXS

This section presents the economical environment and the stock exchange in which this study is performed.

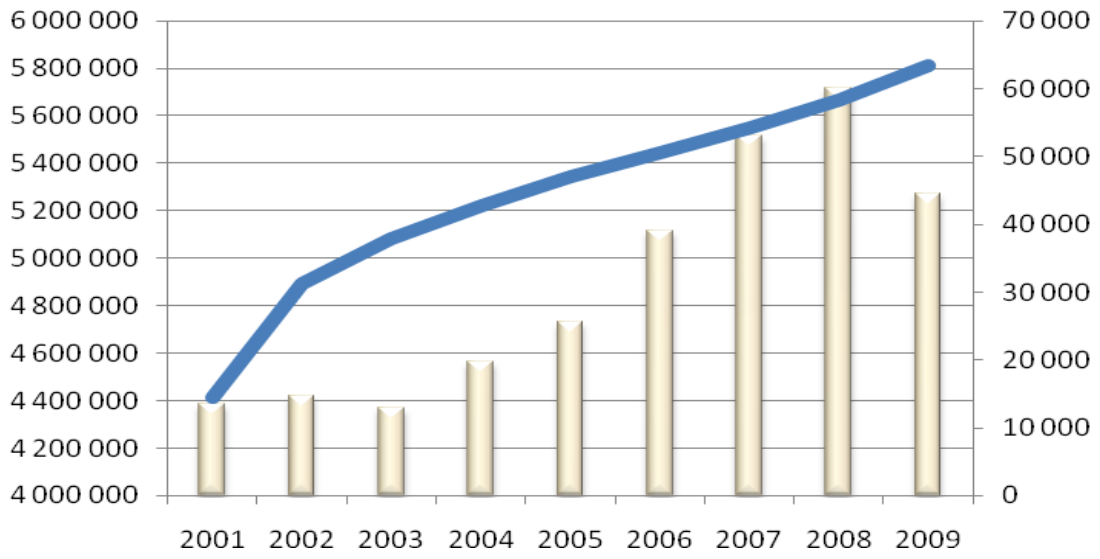
The Swedish stock market has undergone significant changes during the last decades. The 90's started with a financial turmoil. Högfeldt (2003) explains that in the early 90's the Swedish economy was struck by a financial crises related to the bank and real-estate sectors. The interest rate rose to extremely high levels and the Swedish currency had to be devaluated due to extensive speculation. Sweden changed from a fixed to a floating currency and the government temporarily took over several of the largest banks in order to rescue the financial system. During the 80's and in the early 90's the ownership structure of the stock market changed considerably. As can be seen in figure 1 foreign capital entered the market rapidly after a revoke of restrictions. Figure 1 indicates a drop of Swedish institutional investors, however, most of the foreign capital is from institutions and the total proportion of institutional ownership is about 75% of the stock market capitalization. In the publication "*Financial Market 2010*" published by Statistics Sweden presents statistics of the Swedish stock market. The mutual funds are one of these institutional owners and stand for about 20-30% of the total market capitalization. This is in much an effect of changes in the pension system in 2000 that enabled institutions to invest large amounts into the financial markets. Figure 2 presents a particular part of the increasing amount of mandatory pension savings that have been allocated to the stock market. According to Engström (2004) this pension system ensures inflows of more than SEK 13 billion per year and has resulted in a vast increase of mutual fund companies in the Swedish market. Moreover the Swedish mutual fund industry is relatively young and less sophisticated than, for example in the U.S.. The Swedish mutual funds are also characterized by a high proportion, 70%, of equity funds.

Figure 1. Ownership structure of listed companies in the OMXS



Data received from Statistics Sweden

Figure 2. The number of premium pension savers is the blue line with the left Y-axis as scale. The balance of their average savings in SEK is indicated by the columns using the right side Y-axis as scale

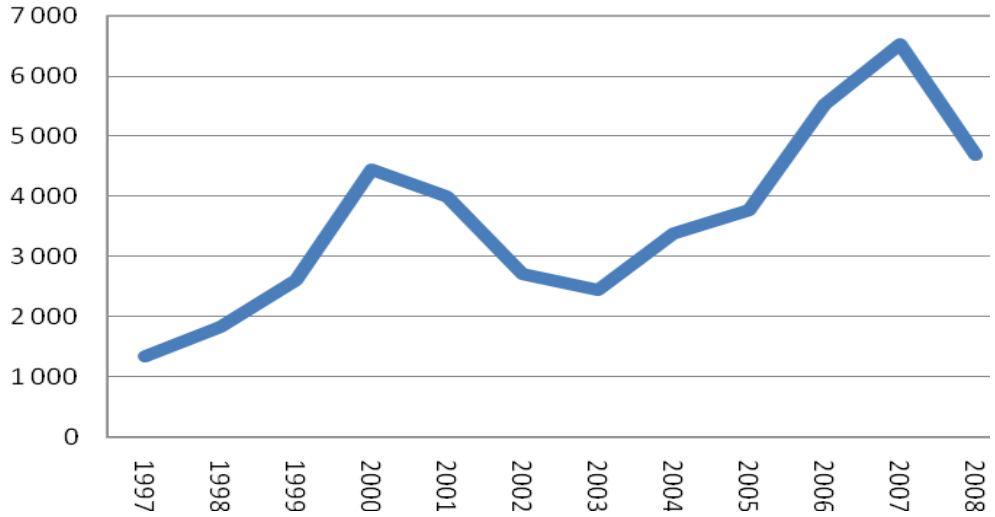


Data received from Statistics Sweden

During 1998 to 2009 the Swedish stock market experienced two major bubbles. Kindleberger (1978) describes a bubble as "... *a sharp rise in price of an asset or a range of assets in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers-generally speculators, interested in profits from trading in the asset rather than its use as earning capacity*".

The first bubble took place in the early 00's. The OMXS reached an all time high in the beginning of 2000, with an increase of 300% in less than five years according to Sjöberg (2002) who summarizes the Swedish IT-bubble. Technology stocks, especially companies with products and services related to the Internet had sky rocked on the market. The rapid growth of Internet usage among the population created hype around these companies and stock valuation became highly speculative. The hype did not last forever, about a half year later stocks begun to drop hefty under a high increase of stock market turnover, as can be observed in figure 3. Much of the venture capital, which had been allocated into companies with little regard to their current earnings, was starting to run out. As investors realized that many of the former hot stocks with anticipated bright future failed to even provide revenue, the IT-bubble was at this point a fact.

Figure 3. Turnover of the OMXS in billion SEK



Data received from Statistics Sweden

The second bubble crashed in 2008 after a few bullish market years. The crash has been called the financial crisis since it forced several globally established financial institutions to file for bankruptcy and struck hard on most mature stock markets. Several governments, Sweden among them, provided aid to financial institutions to supported the financial system and maintain its function. Bergström (2009) points out that the issues in Sweden were in much a direct result from the failure of the U.S. banking system where the crises begun with too risky credit policies. For some of the Swedish banks a major issue was exposure to the troubled Baltic countries which was a main reason for the governmental support directed to several domestic banks. The global recession affected Swedish industries much due to their reliance on a high level of export. This caused domestic unemployment rates to increase. Prior the crash, in late 2007, the OMXS was traded on high levels and experienced a high increase in stock market turnover. In the end of 2008 it had dropped with above 40% and the turnover had decreased significantly.

The structure of the OMXS is characterized by a domination of a few multinational companies in terms of market capitalization. Wiberg (2008) points out that Sweden is one of the few countries that use a dual class share system, where stocks to a great extent have different vote rights. Dahlquist and Robertsson (2001) claim that the more powerful type of stock is less traded compared to the regular stock type and often owned by a smaller number of investors. Moreover, according to the "*Financial Market 2010*" published by the Statistics Sweden foreign investors in the OMXS allocate about 90% of their capital to the large cap firms. The large cap stocks are even more popular among Swedish institutional investors that dedicate about 95% of their total investments to them. Swedish households, however, only allocate about 80% of their stock market exposure to the large cap stocks. In terms of efficiency the Swedish market is according to Claesson (1987) classified as semi-efficient, which implies that prices adjust to public information and that neither fundamental nor technical analysis are reliable techniques to achieve excess returns.

4 Empirical Studies of Herd behavior

Following are summaries of selected previous studies of herd behavior in chronological order. They are selected either because they have contributed with important research progress, or due to relevancy for comparison with this study. The first two studies below are presented further in the Methods and Data section, as they constitute the base of the empirical data analysis.

In 1995 Christie and Huang published the paper "*Do Individual Return Herd around the Market*" and presented a model to detect market wide herd behavior in stock markets. Their method was based on cross sectional standard deviation of stock returns that indicates if stock returns are more than usually clustered around the market return. The model differentiates between normal and extreme phase of the stock market and assume that investors are more likely to herd during the latter one. CH applied the model on the US stock market in 1995 and found evidence of a herd free market. CH was the pioneering study that used econometric analyses with a market wide approach to detect herd behavior in stock markets. Most up to date studies still use this method or methods that to a great extent are based on the theories of CH.

Chang, Cheng, and Khorana published in 2000 "*An Examination of Herd Behavior in Equity Markets: An International Perspective*" and presented two models that have become widely used. The first was simply a slight modification of CH's model. The second was based on CH's assumptions but in much altered. This new model was more sophisticated as it could capture herd behavior not only in days with the most extreme market return. CCK applied the model and analyzed the stock markets in the U.S., Hong Kong, South Korea, Taiwan and Japan between 1963 and 1997. Their results indicated no evidence of herd behavior in U.S. and Hong Kong, partial evidence of herd behavior in Japan and significant evidence of herd behavior in the emerging markets of South Korea and Taiwan.

An alternative model to capture herd behavior was developed by Hwang and Salmon (2004). In contrary to CH and to some extent CCK they based their model on the assumption that herd behavior is just as common in normal stock market phases as in the extreme. In addition, they claim that herd behavior can be relative and not absolute. Their model are influenced by CH and CCK but is based on beta-values. Hwang and Salmon used daily stock returns from 1993 to 2002 and found significant herd behavior in the South Korean market. The method has been used in a few other studies, for example Caparrelli et al. (2004) use it as a third measure along with CH and CCK.

Caparrelli et al. (2004) published a study of the Italian stock market using all three of the presented methods above. The result with the CH and CCK approach indicated the presence of herd behavior during extreme market conditions. They also detected stronger evidence of herd behavior in large cap stocks compared to small cap stocks with the measure of Hwang and Salmon (2004).

Herd behavior can be measured with various time approaches. Henker et al. (2006) measured herd behavior with an unusual approach as measuring on the intraday level. They searched the Australian stock market and found no evidence of herd behavior. The short term nature of herd behavior as been highlighted in several studies, for example Caporale et al (2008) who measured on daily, weekly, and monthly basis. However, not many studies have used the intraday approach of Henker et al (2006).

Kallinterakis (2007) presented a study of the emerging Vietnamese market with a main focus on the effects of thinly traded stocks on the measures of herd behavior. The result based on the methods of Hwang and Salmon (2004) suggests that thinly traded stocks have a positive bias over herd behavior. Moreover, he highlights that most studies with detected herd behavior have been focused on emerging markets. As explanation he mentions that emerging markets often are characterized by incomplete regulatory frameworks, thus friendly to a high level of rumors and manipulation.

Caporale et al. (2008) studied the stock exchange of Athens in Greece for herd behavior between 1998 and 2007. They used the methods of CH and CCK and tested with daily, weekly, and monthly data. The study accentuates the short- term nature of the issue as they with most success captured herd behavior on daily intervals over the entire time interval. Moreover, they broke down the intervals into semiannual sub periods and found herd behavior during the stock market crisis of 1999. They conclude that investors has become more rational since 2002 due to institutional reforms and increased presence of foreign institutional investors.

The Finish stock exchange in Helsinki which is geography located close to the Swedish was examined by Saastamoinen (2008). He used the CH and CCK methods but introduces a quantile regression estimate to detect herd behavior. The model has the advantages of taking the entire distribution into account, being robust to the presence of outlines, and allowing data not to be normally distributed. Even though the model is interesting, it is still new, rather unverified, and in need of more critical evaluation. Saastamoinen's study used large cap companies and found no herd behavior. When testing in periods of market stress, herd behavior is found in periods of bear market. A reason for this is explained by Saastamoinen (2008, p. 16), "*One cause for this finding could be the observation period, which coincides with an economic expansion and a bull market. As the stock market is effectively forecasting future earnings, the fear that the business cycle is turning into a downward trend might spark sell-offs*"

Chiang and Zheng (2010) published a study applying CK and CCK with a global prospective, comparing countries in Latin America, Asia, the U.S., and a number of other advanced countries. They found that stock return dispersions in the U.S. play a significant role in explaining the non-US market's herd behavior activity. Moreover, they found that herd behavior with CCK's Linearity Method in all investigated markets besides the U.S. and Latin America, which only present herd tendencies in periods of crisis. Their result show that crisis triggers herd behavior first in the origin crisis country and then expand to neighboring countries.

5 Methods and Data

This section begins with a presentation of the used methods with belonging theories and assumptions, and is followed by a description of the used data.

The OMXS was measured with three methods. One developed by Christie and Haung (1995), to simplify reading henceforth named after its way of measuring herd behavior, thus "*the Dummy Method*". The two other methods were developed by Chang, Cheng and Khorana (2000), henceforth called "*the Modified Dummy Method*", and "*the Linearity Method*". These are the three most frequently used and recognized methods for measuring market wide herd behavior in stock markets, which so pointed out by Saastamoinen (2008), thus the natural choice to apply in this study.

5.1 The Dummy Method

In the paper "*Following the Pied Piper:"Do Individual Return Herd around the Market*", published in 1995, Christie and Huang presents a method based on equity returns for discovering herd behavior in a stock market. The method is market focused, which means that it measures investors' tendency to follow the mean of the entire market. It implies a behavior where individuals suppress their own opinions in favor of the market trend, causing individual returns to cluster closer around the market returns. CH claims that investors act rational in periods of tranquil stock market phases, but act irrational and herd in extreme phases in terms of market movements. This is an important assumption of the method since it only measures potential presence of herd behavior during these extreme market periods.

The measure for how close a set of individual stock returns are to the market return is called cross sectional standard deviation or dispersion. In other words, it explains the average closeness of individual stock returns to the mean of a portfolio. A market fully explained by herd behavior would be moving in perfect unison with the market mean and, consequently, has dispersion equal to zero. In a herd free or fully efficient market, where rational asset-pricing theories holds perfectly, dispersion varies with the market. A normal state of the market can, according to Henker et al. (2006), be defined with models such as the Capital Asset Pricing Model. It suggests that dispersion in extreme phases of stock markets should increase since individual stocks varies in sensitivity to the market return. In the Capital Asset Pricing Model this is showed by stocks different beta values. However, if herd behavior is present the dispersion decreases, due to that individual stock returns gather around the market return. Herd behavior can in this sense be regarded as a direct opposition of rational asset pricing models and contradictive to the assumptions of an efficient market. The cross sectional standard deviation, CSSD, is measured with:

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N}(R_{i,t} - R_{m,t})^2}{N-1}} \quad \textbf{(1)}$$

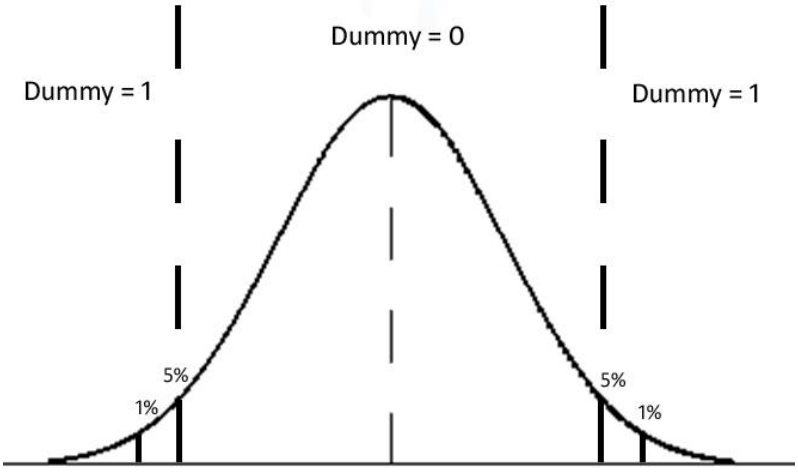
,where $R_{i,t}$ is the observed stock return of firm i at time t, $R_{m,t}$ is the cross-sectional average return of the N returns in the market portfolio at time t, and N is the number of stocks in the portfolio.

To determine the presence of herd behavior a dummy variable technique is used. The CSSD returns are regressed against a constant and two dummy variables to identify the extreme market phases with the following formula:

$$CSSD_t = a + b_1 D_t^L + b_2 D_t^U + e_t \quad \textbf{(2)}$$

,where D^L is market with a "*1*" if the market return on day t lies in the extreme 1% and 5% lower or upper tails of the distribution of market returns, and marked "*0*" otherwise. The set up is illustrated in Figure 4, where the boundaries of each dummy variable are marked . The dummy variables' function is to capture differences in herd behavior in extreme up or down periods versus relatively normal market periods. The α coefficient represent the average dispersion of the sample excluding the regions corresponding to the two dummy variables. Presence of herd behavior is determined by statistically significant negative values for b_1 or b_2. The rational is that D^L and D^U represents the dummy variables indicating extreme phases of the market return. If CSSD values are lower during these phases CSSD and $R_{m,t}$ move in opposite direction indicated by a negative value of the coefficient. For example, if b_1 or b_2 has a negative relation to the CSSD estimate, herd behavior is implied to be present. In that case it means that in the most extreme market days the CSSD measure actually decreases.

Figure 4. Construction of the dummy variables that are used in equations 2 and 4



5.2 The Modified Dummy Method and the Linearity Method

In the paper "*An Examination of Herd Behavior in Equity Markets: An International Perspective*" published in 1999 CCK uses a modified version of CH's method and presents a new measure to detect herd behavior in stock markets. In contrast to CH, CCK perform the dummy-variable test with the cross-sectional absolute deviation, abbreviated CSAD, as a measure for dispersion. The CSSD is an intuitive measure for detecting herd behavior, but it can be severely biased by outliners. The CSAD measure solves this issue and is, therefore, an important compliment when performing the dummy variable tests (Caporale et al., 2008). The CSAD is expressed as:

$$CSAD_t = \frac{\sum_{i=1}^{N} \left| R_{i,t} - R_{m,t} \right|}{N} \quad \textbf{(3)}$$

, where $R_{i,t}$ is the observed stock return of firm i at time t, $R_{m,t}$ is the cross-sectional average return of N stocks in the portfolio at time t, and N is the number of stocks in the portfolio.

The CSAD alternative is tested with the same regression formula as the CSSD measure:

$$CSAD_t = a + b_1 D_t^L + b_2 D_t^U + e_t \quad \textbf{(4)}$$

, where D^L marked with "*1*"if the market return on day t lies in the extreme 1% and 5% lower or upper tails of the distribution of market returns, and "*0*" otherwise. Presence of herd behavior is determined by statistically significant negative values for b_1 or b_2.

The entirely new measure presented by CCK, the Linearity Method, also uses the CSAD to estimate dispersion but include the whole distribution. This means that the method does not only assume herd behavior in the most volatile periods, as it can detect herd behavior even in smaller market movements. It includes two parameters of the market return as it claims that the relationship between dispersion of individual assets returns and market return is non-linear in the case of herd behavior.

In a herd free market the absolute value of the market return should move in the same direction as the dispersion in the individual asset returns, hence an increasing linear relationship. In the presence of herd behavior, however, it is likely that correlation among individual asset returns and corresponding dispersion decrease or, at least, increase at a less than proportional pace as the market return. The $R^2_{m,t}$ is included in the equation in order to cover this relationship, which can be observed in relatively large movements of market returns. In summary the method reveals if the dispersion of returns decreases if the market return increases.

To test the relation following regression equation is used:

$$CSAD_t = a + \gamma_1 \left| R_{m,t} \right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \quad \textbf{(5)}$$

,where $R_{m,t}$ stand for market return. A significantly negative γ_2 coefficient implies evidence of herd behavior.

The relationships between CSAD and market return might be asymmetric and herd behavior can be tested for in the bull respectively bear markets side of sample period. The test is constructed in the same way as for the entire market, although divided into two parts depending on the sign of the corresponding market return:

$$CSAD_t^{UP} = \alpha + \gamma_1^{UP} | R_{m,t}^{UP} | + \gamma_2^{UP} (R_{m,t}^{UP})^2 + \varepsilon_t \ , \qquad \text{if } R_{m,t} > 0 \quad \textbf{(5a)}$$

$$CSAD_t^{DOWN} = \alpha + \gamma_1^{DOWN} | R_{m,t}^{DOWN} | + \gamma_2^{DOWN} (R_{m,t}^{DOWN})^2 + \varepsilon_t \ , \quad \text{if } R_{m,t} < 0 \quad \textbf{(5b)}$$

,where significant and negative γ_2 coefficients implies evidence of herd behavior.

Three methods have been presented to detect herd behavior in stock market. In previous studies they are often used simultaneously. It is common that one of the methods might indicate herd behavior when the other fails. In this situation the result from the Linearity Method should be favored since it is more advanced than the dummy methods. The argument is logical when considering the models' construction. The dummy methods only allow herd behavior to be present in days regarded as extreme volatile. The Linearity Method, on the other hand, consider more days since it focuses on the relationship between movements of $R_{m,t}$ and CSAD.

5.3 Data Description

This paper measures herd behavior on the stock exchange of Stockholm in Sweden from January 1998 until November 2009. The timeframe covers two highly interesting periods of the Swedish stock market, namely the IT-bubble in the beginning of the 00's and the financial crises in the late 00's. These two periods characterized by high volatility and extreme bear and bull periods are extra interesting since herd behavior is used as an explanation for bubbles and similar extreme situations (Andersson, 2009).

The data was collected as daily closing prices from all listed companies at OMXS during the time interval. It was assembled from the Thomson Reuters owned database Datastream and provided to the author by a specialist at the Thomson Reuters customer service. Companies that had been delisted during the time interval were also included.

The data used in the models was adjusted by excluding stocks characterized by thin trading, thus bias the results towards liquid stocks. Kallinterakis (2007) defines thinly traded stocks as securities that show an illiquid trading pattern over time. In this study thinly traded stocks is defined as stocks that have above 70% days with zero return within the interval, considered their own life time. A total of 108 stocks were eliminated during the entire time frame. Henceforth expressions as "the entire market" and "all considered stocks" refers to all stocks subtracted by the eliminated thin traded stocks, thus a sample of the original population of stocks at OMXS.

Previous studies discuss the effects of thinly traded stocks on herd behavior. Caporale et al. (2008) points out that it would be interesting to test their study when adjusting for thinly traded stocks. Hwang and Salmon (2005) and Henker et al. (2006) excluded thinly traded stocks. Kallinterakis (2007) presents a study with a main focus on the impact of thin trading on measures of herd behavior. He found that correcting for thinly traded stocks depresses the presence of herd behavior. That is, existing stocks with thin trading results in a positive bias on estimations (see the Empirical Studies of Herd behavior section). A reason for adjusting for thinly traded stocks in this study is the Swedish system of A- and B-stocks. This is a dual class system where shares can have different vote rights. In this way voting power can be separated from the capital invested, which enables ownership control with a relative small fraction of the equity. The A-stocks are often owned by a small amount of powerful investors and less frequent traded (Bjurgren, Eklund, and Wiberg, 2007). They are affected by different price drivers than regular stocks and constituted a large part of the excluded stocks.

Parallel tests without adjusting for thinly traded stocks were, however, also performed (see the Appendix). Differences of the result are discussed in the Result and Analysis section.

In the early 00's a new way of sorting stocks was introduced as the OMXS. Large and small stocks had earlier been divided between the A-list and the O-list. The new arrangement in-

troduced three levels; large, medium, and small cap. The raw data was received in the new manner, but the delisted companies missed information about list belonging. Due to this lack of information the tests separating the different caps exclude delisted companies.

Following two tables are descriptive statistics that covers all considered data in the performed tests, presented in the Result and Analysis section.

Table 1 describes data that was used in tests focusing on the entire market, using all stocks at OMXS after adjustments. A total of 2971 observations were considered, when defining an observation as a trading day. The CSSD and the CSAD were the observed parameters per trading day, which first was calculated from stocks' daily returns. In that sense the actual amount of observations were about 772 000, which is the total amount of considered stock returns. The maximum amount of stocks on a trading day were 275 and the minimum where 215 in the interval. The CSSD means the cross sectional standard deviations of the stocks' daily returns with respect to the market return. The CSSD and its sibling the CSAD, the cross sectional absolute standard deviation, are the tests vital measure for detecting herd behavior and in the Result and Analysis section interpret by different types of comparison between trading days. The $R_{m,t}$ stands for the market return, or more exactly the return of the considered stocks on a daily level. The maximum return on a single trading day was 9,3% and largest drop was -8,6%.

Table 1: Descriptive Statistics covering All Stocks during 1998 to 2009

	No.stocks	CSSD	CSAD	$R_{m,t}$
Observations in days		2971	2971	2971
Max	275	0,149	0,059	9,3%
Min	215	0,013	0,009	-8,6%
Mean	259,353	0,032	0,020	0,03%
Median	263	0,029	0,019	0,107%
St.dev.	12,146	0,015	0,007	0,0124

CSSD = Cross sectional standard deviation, CSAD= Cross sectional absolute deviation

Table 2 has an equivalent set-up as table 1. The data is, however, limited to stocks from the Large respectively the Small Cap, which corresponds to a set of tests found in the Results and Analysis section. The distinguish between the largest and smallest stocks in the market effectively enable analysis attributed to stock size.

Table 2: Descriptive Statistics covering Large and Small Cap during 1998 to 2009

	Large Cap				Small Cap			
	No.stocks	CSSD	CSAD	$R_{m,t}$	No.stocks	CSSD	CSAD	$R_{m,t}$
Observations in days		2971	2971	2971		2971	2971	2971
Max	80	0,079	0,052	10,3%	101	0,223	0,081	8,7%
Min	60	0,007	0,005	-6,8%	41	0,013	0,010	-9,3%
Mean	73,573	0,020	0,014	0,10%	79,365	0,038	0,025	0,00%
Median	74	0,018	0,013	0,10%	80	0,034	0,022	0,1%
Stdev	5,9	0,008	0,005	0,013	15,851	0,018	0,010	0,014

CSSD = Cross sectional standard deviation
CSAD= Cross sectional absolute deviation

Additionally, all data was in some test separated according to up or down going market days (the so called bull and bear analysis in the Result and Analysis section). The separation was simply based on whether the $R_{m,t}$ measure was positive or negative for the given trading day.

6 Result and Analysis

In this section the result of conducted regression tests are presented. The first tables describe the set-up and the interpretations of variables more extensively compared to the following rounds of tests. Evidence of herd behavior in the tables is highlighted in bold.

As a first step in the analysis tests were conducted on the entire measured time frame including bull and bear market separation. These tests are found in section 6.1. In section 6.2 the time interval was broken down into annual sub-periods to detect and attribute potential herd behavior to specific time periods. In section 6.3 tests were conducted on large and small cap stocks to search for deviations related to stock size. After the presented test results, section 6.4 contains a discussion about the impact of thinly traded stocks. The last section, 6.5, consists of caveats that are relevant to the result.

6.1 Tests Covering the Entire Period of 1998 to 2009

The first round of tests measures herd behavior over the entire timeframe, 1998 to 2009. The broad test period enables further analysis as it provides answer if herd behavior has impact on the Swedish market when considering all trading days within the interval.

The left columns of table 3 show regression results of CH's Dummy model. It indicates evidence of a herd free market, since the B_1 and B_2 are positive and the t-values are significant. The 1% respectively the 5% criterion refers to test with 1% or 5% of the $R_{m,t}$ distribution marked as extreme market phases, thus with "*1*" as a dummy variable. The α parameter represents the rest of the population, the normal phases of the stock market, hence marked with the dummy variable "*0*" in the test. The adjusted R square value is used to explain the models' goodness of fit. That is, the percentage of variance in the dependent variable that is explained collectively by the independent variables. It is useful as a quality indicator, especially in comparison to the other models since two of the models use the same dependent variables. Not surprisingly the higher value of adjusted R square is found with the 5% criterion model since it contains additional dummy variables marked with "*1*". That is, the 5% criterion model explains the dependent variables variance to a higher degree than test with the 1% criterion.

Table 3: The Dummy Models covering 1998 to 2009

	The Dummy Model $CSSD_t = a + b_1D_t^L + b_2D^U{}_2 + e_t$		The Modified Dummy Model $CSAD_t = a + b_1D_t^L + b_2D^U{}_2 + e_t$	
	1 % criterion	5 % criterion	1 % criterion	5 % criterion
α	0,033***	0,031***	0,020***	0,019***
	(120,654)	(115,862)	(163,828)	(165,184)
B_1 (L)	0,016***	0,010***	0,013***	0,009***
	(6,143)	(8,298)	(10,409)	(17,425)
B_2 (U)	0,027***	0,021***	0,021***	0,015***
	(10,301)	(18,121)	(17,802)	(29,488)
Adj.R^2	0,045	0,0114	0,0124	0,274

Note: ***,**, and * equals significance on the 1%, 5%, and the 10% level in the t-table
CSSD = Cross sectional standard deviation, CSAD= Cross sectional absolute deviation

The columns to the right in table 3 present CCK's Modified Dummy Model tests. Positive coefficients with significant t-values are observed, thus evidence of a herd free market. The adjusted R square values indicate that the Modified Dummy variable has higher goodness of fit than the original. An explanation could be that the CSAD is less affected by outliners.

The result of the CCK's Linearity Model is presented in table 4. The test presented in the left side column corresponds to the same data as the tests of table 3, while the middle and right column separates the sample into days with bull and bear market trends. Conversely to the results of the dummy models, the Linearity Model covering all days indicates evidence of herd behavior over the entire time frame. The Y_2-coefficient is negative and the t-value is significant. The result of the bull and bear market breakdown reveals asymmetry as they present evidence of herd behavior only in the bull market days. Indications of herd behavior can be spotted during bear periods as well, but with too weak significance to be confirmed. In this kind of situation, with contradicting test results, the outcome from the Linearity Model should be favored since it is more advanced compared to the dummy models. This argument is logical when considering the models' constructions. The dummy models only allow herd behavior to be present in days with the most extreme market movements. The Linearity Model on the other hand consider more days since it focuses on the relationship between movements of $R_{m,t}$ and CSAD. Consequently, the results of the dummy models are not regarded evidence of a herd free market. It is rather a demonstration of the dummy models' weaknesses.

Table 4: The Linearity Model covering 1998 to 2009

	All Days	Bull- days	Bear- days
	$CSAD_t=a+Y_1\lvert R_{m,t}\rvert$ $+Y_2R_{m,t}^2+e_t$	$CSAD_t=a+Y_1^{UP}\lvert R_{m,t}\rvert^{UP}$ $+Y_2^{UP}(R_{m,t}^2)^{UP}+e_t$	$CSAD_t=a+Y_1^{DOWN}\lvert R_{m,t}\rvert^{DOWN}$ $+Y_2^{DOWN}(R_{m,t}^2)^{DOWN}+e_t$
	2971 observations	1656 observations	1315 observations
α	0,016***	0,015***	0,017***
	(91,843)	(66,219)	(65,767)
Y_1	0,539***	0,715***	0,371***
	(23,287)	(23,326)	(11,019)
Y_2	**-1,688*** **	**-2,441*** **	-0,694
	(-3,460)	(-3,837)	(-0,966)
Adj.R^2	0,36	0,468	0,262

Note: ***,**, and * equals significance on the 1%, 5%, and the 10% level in the t-table
CSAD= Cross sectional absolute deviation

The result can be compared to the findings of Chiang and Zheng (2010), see section 4. They found herd behavior in several larger developed markets but not in the U.S.. The Swedish market can as Claesson (1987) concluded be regarded as semi-efficient. In this sense the result corresponds to Chiang and Zheng (2010) and implies that the Swedish market is not as efficient as the U.S. but is similar to other developed markets or possibly worse.

6.2 Yearly Breakdown Tests

This round of tests compliments the test of 6.1 as they enable pinpointing of the found herd behavior to specific years. Since the dummy models did not indicate herd behavior over the entire time frame, they are excluded from this section of annual breakdown test.

The result in table 5 shows a herd free market from 1998 to 2000, although only on the 10% level. The period of 2001 to 2009 presents with two exceptions both herd behavior and anti herd behavior, although with insignificant t- values. The first exception is found in 2005, as herd behavior is found on the 10% level. The second is in 2007 and indicates strong evidence of herd behavior. The adjusted R square levels for the years with herd behavior are relatively low. The data do not reveal an explicit explanation, but it could be due to exterior factors, such as volatility or a high turnover which can be found during 2007.

Table 5: The Linearity Model, Yearly Breakdown

	$CSAD_t=a+Y_1\|R_{m,t}\|+Y_2R_{m,t}^2+e_t$			
	α	Y_1	Y_2	Adj. R^2
1998	0,018*	0,261***	1,756*	0,416
	(36,957)	(4,429)	(1,754)	
1999	0,019*	0,291**	10,718*	0,301
	(33,549)	(2,132)	(1,748)	
2000	0,023*	0,246**	5,359*	0,369
	(32,653)	(2,347)	(1,719)	
2001	0,022***	0,433***	-0,488	0,502
	(45,708)	(8,534)	(-0,531)	
2002	0,021***	0,521***	-0,874	0,468
	(33,991)	(6,449)	(-0,451)	
2003	0,018***	0,341***	4,778	0,358
	(38,379)	(3,217)	(1,043)	
2004	0,014***	0,338***	-3,460	0,195
	(44,312)	(4,400)	(-1,011)	
2005	0,012***	0,347***	**-10,486***	0,09
	(41,674)	(3,579)	(-1,709)	
2006	0,013***	0,262***	-0,233	0,45
	(52,269)	(6,303)	(-0,252)	
2007	0,013***	0,340***	**-5,963****	0,117
	(37,633)	(5,132)	(-2,566)	
2008	0,017***	0,333***	0,856	0,469
	(27,944)	(5,524)	(0,878)	
2009	0,017***	0,410***	0,930	0,402
	(28,549)	(5,147)	(0,451)	

Note: ***,**, and * equals significance on the 1%, 5%, and the 10% level in the t-table
CSAD= Cross sectional absolute deviation

In the Introduction, section 1, herd behavior was assumed to be evident during the IT-bubble and the financial crises. This turned out to be only partly correct. Throughout the rise of the IT-bubble evidence of a herd free market could be detected. However, during the top of the bubble prior the financial crisis in 2007 herd behavior was detected. Considered the herd free market result in the beginning of the test period and the herd behavior found in the letter part, it seems to be a possible development towards increased irrational behavior over time. Simultaneously, this timeframe can be characterized as a rather tranquil time after the major changes in the 80's and 90's. The financial environment of Sweden did, however, continue to develop after the 90's. Institutional ownership continued to slightly increase its proportion of the ownership distribution, see figure 1. Additionally, an increasing amount of pension savings were allocated to the stock market via mutual funds, see figure 2. This is a reason for their considerable proportion of the total amount of institutional investments. The increasing tendency for the Swedish stock market to herd is especially interesting since the institutional ownership have grown stronger prior and during the measured time frame. Another interesting aspect, which Engström (2004) pointed out, is that Swedish mutual fund industry is still young, implying that professional investors generally have less experience compared to, for example, their American colleagues. Considered that professional investors herd because they are more afraid of the risk of being totally off track than they value the chance of superior performance, it implies that the relatively low level of experience might increase the herd motive.

The annual breakdown tests provide another interesting observation. In the first years of the test period, up to 2000, there was a steady bull market, see figure 5. Afterwards the development was less stable with longer periods of bear trends. This period presents weak evidence of a herd free market during 1998 to 2000, followed by insignificant results with two deviating years with herd behavior. Interestingly, the years of herd behavior are 2005 and 2007 which come in a time when a bull trend had stabilized after a long period of bear trend. Although with insignificant t- values, the test presents possible herd behavior during volatile bull and bear periods followed by herd free conditions when the market turns around, as in 2003 and 2008 to 2009. This observation indicates that investors at OMXS seem to herd more during instable times. Moreover, it implies a possible positive correlation between herd behavior and bull trends after periods of bear market. It could also indicate a tendency for herd free conditions after a severe bear market.

Figure 5. Historical Stock Market Development in Sweden and the U.S.

Blue = OMXSPI of Sweden, Red = S&P 500 of U.S.
Data retrieved from finance.yahoo.com, February 2010

6.3 Large and Small Stock Separation

In the sections 6.1 and 6.2 herd behavior was found and pinpointed to certain years. In the following tests stocks are separated according to large or small cap belonging with respect to the official OMXS lists. This enables detection of asymmetries in the previous result attributed to stock size. The test was conducted in the same manner as the tests in section 6.1, which means that no annual breakdown tests were performed. This is due to the small samples sizes a separation would create leading to result with poor quality.

The left side of table 6 presents the separation of large and small cap stocks tested with the dummy models over the entire time frame. The models fail to detect herd behavior, but suggest evidence of a herd free market in both types of stocks. Throughout the stock size separation tests with dummy variables low adjusted R square values can be found. Similarly as in the test with the dummy variables in section 6.1, the adjusted R square is highest with the 5% criterion.

On the right side of table 6 the Modified Dummy Model presents evidence of herd behavior. Negative coefficients are found in large cap stocks with the 5% criterion, although with a low adjusted R square value. The rest of the test result indicates a herd free market. A reason for the found herd behavior could be that the large cap stocks are more exposed to institutional investors, especially via foreign capital which has been pointed out by Ridder (2008). Consequently, the result suggests that institutional investors have higher tendency to herd in days with the highest movements of the market.

Table 6: The Dummy Models covering Large & Small Cap stocks during 1998 to 2009

	$CSSD_t=a+b_1D_t^L+b_2D^U{}_2+e_t$				$CSAD_t=a+b_1D_t^L+b_2D^U{}_2+e_t$			
	1 % criterion		5 % criterion		1 % criterion		5 % criterion	
	Large	Small	Large	Small	Large	Small	Large	Small
α	1,638***	0,037***	1,591***	0,036***	2,583***	0,024***	2,683***	0,023***
	(72,26)	(119,47)	(67,24)	(115,26)	(48,80)	(145,71)	(48,82)	(145,06)
B_1 (L)	1,327***	0,016***	0,577***	0,010***	-0,583	0,016***	**-1,193***	0,010***
	(85,71)	(5,16)	(5,60)	(7,24)	(-1,07)	(9,70)	(-4,99)	(14,91)
B_2 (U)	2,162***	0,054***	1,025***	0,034***	-0,017	0,032***	**-0,888***	0,021***
	(9,63)	(17,95)	(10,02)	(25,39)	(-0,03)	(19,76)	(-3,74)	(30,72)
Adj.R^2	0,04	0,103	0,04	0,185	0,00	0,138	0,012	0,273

Note: ***,**, and * equals significance on the 1%, 5%, and the 10% level in the t-table
CSSD = Cross sectional standard deviation, CSAD= Cross sectional absolute deviation

The result of the Linearity Model presented in table 7 provides evidence of herd behavior over the entire interval in both large and small cap stocks. Again the Linearity Model succeeds to detect herd behavior when the dummy models failed. There is a low adjusted R square value in the test on large cap but a much higher in the small cap test, suggesting a large difference in goodness of fit.

Table 7: The Linearity Model covering Large & Small Cap stocks during 1998 to 2009

	$CSAD_t=a+Y_1\|R_{m,t}\|+Y_2R_{m,t}^2+e_t$	
	Large Cap	Small Cap
α	(2,599***	0,019***
	(26,379)	(78,638)
Y_1	0,067***	0,656***
	(2,690)	(21,323)
Y_2	**-0,076***	**-1,879***
	(-2,915)	(-3,055)
Adj. R^2	0,003	0,356

Note: ***,**, and * equals significance on the 1%, 5%, and the 10% level in the t-table
CSSD = Cross sectional standard deviation, CSAD= Cross sectional absolute deviation

6.4 The Adjustment for Thinly Traded Stocks

In all performed test data was adjusted for thinly traded stocks, see section 5.3. Parallel tests without adjusting for thinly traded stocks were also performed, see Appendix, resulting in differences that are interesting to highlight. A main assumption by Kallinterakis (2007) was that thinly traded stocks are an issue primarily for emerging markets. The Swedish market is characterized as developed, yet there are motives to study the impact of thin trading. The OMXS is, according to Claesson (1987) semi-efficient and more cyclic than for example the U.S. market, see figure 5. Another justifying reason is the Swedish system with dual stock types, where shares of the same company can have different vote rights. As pointed out by Bjurgren et al. (2007) the stocks with high voting power are generally owned by fewer investors and less frequently traded.

Kallinterakis (2007) found that the presence of thinly traded stocks imposed a positive bias over the estimates, in other words more herd behavior. Conversely, adjusting for thinly traded stocks resulted in decreased evidence of herd behavior. The test results of this paper do, however, suggest the opposite. The result is inconsistent but there are clear tendencies. After adjusting for thinly traded stocks, higher t-values in absolute terms can be found when the coefficients are negative, implying stronger evidence when there is presence of herd behavior. Simultaneously, the results of tests not adjusting for thinly traded stocks

show tendencies of increased evidence of a herd-free market. That is, higher significant levels of the t-values when the coefficients are positive. Throughout the test there are higher values of the adjusted R square when not adjusting for thinly traded stocks.

6.5 Caveats

Hwang and Salmon (2004) present criticism towards the models of CH and CCK. They question CH assumtion that herd behavior is only present in extreme phases of the stock market. They express it as "*market stress does not necessary imply that the market as a whole should show either large negative or positive returns*" and "*without any large movement in the whole market we may still observe considerable reallocation towards particular sectors*."

Additionally, they question the use of dummy variables since it is requires a subjective opinion on what is extreme. They also point out that the methods do not reflect other inputs than returns, saying "*since the method does not include any device to control for movements in fundamentals it is impossible to conclude whether it is herd behavior or independent adjustment to fundamentals that is taking place and therefore whether or not the market is moving towards a relatively efficient or an inefficient outcome*".

Moreover, Hwang and Salmon (2004) stress that a cross sectionals approach can be questioned since it is not independent of time series volatility. They point out an example: "*even if we find a negative relationship between the cross- sectional standard deviation of individual stock returns and the dummy variables, we could not be sure whether it originates from changes in volatility (measured over time) or herd behavior*". For the same reason Saastamoinen (2008) also criticize CCK's "*Linearly Method*" for not providing conclusive proof of herd behavior. Bikhchandani and Sharma (2001) criticize all statistical approaches to measure herd behavior as they "…*is merely picking up responses of participants to publicly available information*". This criticism is vital for the validity of the result in this study and to some extent question the found evidence of herd behavior. The risk is that found herd behavior might be due to investors independently cluster around the same stocks, if they are making the same conclusions of available information. The methods say that herd behavior is the explaining factor of the indicating negative estimates. The presented criticism rather says that herd behavior is a likely explanation, but that the methods do not exclude other factors.

Even though Hwang and Salmon (2004) present harsh criticism, it is important to note that they were inspired by CH and CCK when they developed an alternative method (Kallinterakis, 2007). Studies after Hwang and Salmon (2004) have often chosen to only use CH and CCK, for example Caporale et al. (2008), Saastamoinen (2008), and Chiang and Zheng (2010).

Furthermore, some studies, for example CH on the U.S. market, make sub-samples based on industries. That type of analysis would be interesting in the Swedish market as well. However, the amount of stocks in each sub-sample in Swedish market be too few and would result in poor quality results.

7 Conclusions

The results of this study show that herd behavior is present in the OMXS during the period of 1998 to 2009. There are periods within the interval where herd free market conditions are present, mainly in the end of the 90's. The most evident periods of herd behavior are in the bullish markets of 2005 and 2007. Consequently, there is tendency of increasing levels of herd behavior over the measured period, which can be explained by the increased impact of institutional investors. This conclusion is contradictive to Caporale et al. (2008) who say that the increased influence of institutional investors and foreign capital improved the efficiency on the market of Athens. This difference is not likely to be related to institutional investors' prone to herd, but rather related to differences of the two domestic markets.

Comparing large and small cap stocks the result is ambiguous. The result when measuring herd behavior during the most extreme days in terms of market movements indicates herd behavior in large cap stocks. Simultaneously, herd behavior is found in both large and small cap stocks measuring broader, with the Linearity Model. It is also noted that a major difference between the large and small cap is the presence of institutional investors. Considered these circumstances it can be concluded that institutional investors are more prone to herd than private investors, especially in the most extreme market conditions. Moreover, the result questions the findings of Kallinterakis (2007) that thinly traded stocks imposes a positive bias on the herd measure, but is not evident enough to be totally contradictive.

This study contributes with new knowledge about the role of herd behavior on the Swedish stock exchange. Further studies are, however, needed in order to gain deeper insight. It would be interesting to apply Chiang and Zheng (2010) approach that uses the U.S. market as the herd leading index. Moreover, studies focused on other samples of the Swedish market would be interesting as a complement to this study.

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9 Appendix

9.1 Non- adjusted Test Results

Descriptive Statistics covering All Stocks during 1998 to 2009

	No.stocks	CSSD	CSAD	$R_{m,t}$
Observations in days		2971	2971	2971
Max	341	0,134	0,063	9,3%
Min	285	0,007	0,001	-8,6%
Mean	317,819	0,032	0,020	0,1%
Median	317	0,029	0,018	0,1%
St.dev.	12,10,705	0,013	0,007	0,011

The Dummy Models covering 1998 to 2009

	The Dummy Model $CSSD_t= a +b_1D_t^L+b_2D^U_2+e_t$		The Modified Dummy Model $CSAD_t= a +b_1D_t^L+b_2D^U_2+e_t$	
	1 % criterion	5 % criterion	1 % criterion	5 % criterion
a	0,032***	0,030***	0,020***	0,019***
	(141,220)	(137,514)	(165,097)	(166,431)
B_1 (L)	0,015***	0,010***	0,014***	0,009***
	(6,856)	(9,481)	(11,737)	(19,113)
B_2 (U)	0,029***	0,021***	0,022***	0,015***
	(13,241)	(22,221)	(19,089)	(30,239)
Adj.R^2	0,069	0,159	0,143	0,291

Note: ***,**, and * equals significance on the 1%, 5%, and the 10% level in the t-table

The Linearity Model covering 1998 to 2009

	All Days	Bull- days	Bear- days
	$CSAD_t=a+Y_1\|R_{m,t}\|$ $+Y_2R_{m,t}^2+e_t$	$CSAD_t=a+Y_1^{UP}\|R_{m,t}\|^{UP}$ $+Y_2^{UP}(R_{m,t}^2)^{UP}+e_t$	$CSAD_t=a+Y_1^{DOWN}\|R_{m,t}\|^{DOWN}$ $+ Y_2^{DOWN}(R_{m,t}^2)^{DOWN}+e_t$
	2971 observations	1656 observations	1315 observations
a	0,015***	0,014***	0,017***
	(93,528)	(69,538)	(65,331)
Y_1	0,618***	0,795***	0,426***
	(24,937)	(24,746)	(11,646)
Y_2	**-1,752*** **	**-2,170*** **	-0,482

	(-2,989)	(-2,808)	(-0,567)
Adj.R^2	0,415	0,527	0,312

Note: *,**, and *** equals significance on the 1%, 5%, and the 10% level in the t-table

Table 8: The Linearity Model, Yearly Breakdown

	$CSAD_t=a+Y_1\|R_{m,t}\|+Y_2R_{m,t}^2+e_t$			
	a	Y_1	Y_2	R^2
1998	0,017*** (36,070)	0,371 (5,493)	2,161* (1,602)	0,394
1999	0,017*** (35,214)	0,510** (3,673)	6,737** (0,971)	0,448
2000	0,023*** (35,214)	0, 275** (2,614)	7,169* (2,168)	0,369
2001	0,021*** (50,639)	0,502 (9,935)	0,078 (0,073)	0,602
2002	0,020*** (35,216)	0,671 (8,078)	-1,604 (-0,693)	0,564
2003	0,017*** (40,051)	0,471 (4,344)	3,970 (0,723)	0,434
2004	0,013*** (51,697)	0,381 (5,478)	-2,721 (-0,815)	0,301
2005	0,012*** (50,279)	0,313 (3,718)	**-6,312*** (-1,123)	0,144
2006	0,013*** (60,022)	0,289 (7,432)	-0,126 (-0,138)	0,526
2007	0,013*** (49,031)	0,289 (5,211)	**-3,245**** (-1,562)	0,266
2008	0,016*** (28,975)	0,380 (6,139)	1,670 (1,501)	0,583
2009	0,017*** (33,004)	0,386 (5,126)	2,560 (1,220)	0,466