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Presence of herd behavior in stock trading

Comparing different business sectors listed on the Swedish Stock Market

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ABSTRACT

This paper investigates the investment behavior among financial market participants. Using the methodology of *Cross-Sectional Absolute Deviation* (CSAD), focus is on the presence of herd behavior. Herding is a situation in which investors disregard their own private information and follow the actions of what they perceive other investors to be doing, thus basing their financial decisions on the collective.
With the method one is assumed to observe indication of herding towards the market return in periods of large market movements through a decrease in return dispersion. This is contrary to the idea of fully efficient financial markets. The phenomenon is controlled for at an industry-level, using a subset of 3 industries listed on the Stockholm Exchange in Sweden. The method is applied during the first 20-year period of the 21st century and the data consist of daily adjusted returns. No evidence of herding is found in any of the industries, regardless of the market exhibiting bull- or bear behavior.

Keywords: Behavioral finance, Herd behavior, Cross-sectional absolute deviation (CSAD)

Content

INTRODUCTION

In the late eighteenth century, a man named Adam Smith came to be one of (if not the) most influential person in economics ever to have existed. With his introduction of the "invisible hand" he concluded that markets, if left alone, inherently will fall towards an efficient equilibrium. This was initially relating to the traditional market but is very much analogous to the financial *Efficient market Hypothesis (*EMH*).* EMH has been a cornerstone of modern finance, going back all the way to Louis Bechelier and his 1900 PhD-dissertation "Theory of speculation" (Ahsan, 2012). The hypothesis states that share prices in the financial markets reflect every bit of information there are, thus assuming full rationality.[1]
This implies the redundancy of predicting trends using for example technical analysis to find arbitrage-opportunities, commonly known as "beating the market".
With the relative success of technical analysis, excess volatility and occurrences of financial bubbles that contradict the notion of EMH, the theory has its fair share of opponents and is in no terms an absolute doctrine.
As a result, behavioral finance emerged in the 1980´s, considering psychological effects that explain certain behaviors within the financial world and investor behavior[2]. Whilst behavioral economics has a broader scope, introducing psychology into traditional economic decision making, behavioral finance is particularly niched towards financial markets. The concept refers to any marketplace in which trading with different securities such as bonds, stocks and derivatives occur.[3]
It is via these marketplaces that most people hold and grow their wealth such as typical saving, pension funds etc. This makes the question of investor- and market behavior relevant to understand for all agents within an economy.

An important concept within behavioral finance is the notion of Herd behavior, according to which investors tend to follow the herd as opposed to their own subjective view of the market. In other words, they are largely influenced by instinct and collective thought rather than making an assessment based on their own information.[4]
This area has been thoroughly studied in various ways throughout the years, bringing about a big, but incoherent, piece of literature using different well-established methods for detection of the phenomena.

As the literature section will reveal, most previous research has focused on country-wide financial markets, suggesting very mixed results.
With a very large set of stocks mixed into an equally large set of industries and niches, the results tend not to give much qualitative information that can be utilized, neither for investors nor policymakers. Maybe there is only one industry exhibiting a high degree of herding, thus skewing the results when performed on whole financial markets. The variety in speculation in certain industries that do have potential for rapid growth as opposed to other more stable ones strengthen the hypothesis that herding might be an event occurring on an industry-level.

[1] https://www.investopedia.com/terms/e/efficientmarkethypothesis.asp
[2] https://seekingalpha.com/article/3999542-fly-history-of-behavioral-finance
[3] https://www.investopedia.com/terms/f/financial-market.asp
[4] https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/herd-mentality-bias/

Therefor this paper will analyze the phenomena on a more fundamental level. Namely in a subset of three distinct sectors of the economy listed on the Stockholm Stock Exchange all of which picked for their own specific reasons. Herding might be a industry-specific phenomenon, making this an interesting research question.

The first one is the technological industry.
The years constituting the Dot-com bubble, officially 1995-2001 are notorious for a period of high speculation and great optimism. Irrationality glows with its presence during this period, and several papers find strong evidence of herding during this period (Bergsten & Olsson, 2014; Sing, 2013). The emergence of the famous FANG-stocks (Facebook, Apple, Amazon, Netflix, Google) and potentiality of quick returns and rewarding growth makes the sector even more compelling to investigate.
The second sector is the industrial one, which to some extent stand in opposition to the technical sector. This because it is an industry that has been around for ages and do generally not exhibit rapid innovations and should thus not be as attractive to speculate in for high short-term profits.
Finance is the last sector that also has most, although limited, literature backing a presence of herding, such as by Cakan & Balagyozyan (2013) in the Turkish banking sector, and Nakagawa & Uchida (2011) in the Japanese banking sector.

Using data on 3 stocks in these respective sectors, I will utilize the method developed by Chang et al (2000), referred to as Cross-Sectional Absolute Deviation (CSAD). Through this method I will measure the dispersion of returns compared to that of the market (industry) return in times of large fluctuations using the theoretical framework of herd behavior brought forward by Christie & Huang (1995), advanced by Chang et al (2000) and to control for short-term herd behavior. Furthermore, the results will either suggest the rationality of market behavior aligned with EMH, or suggest irrationality in the form of herd behavior.
In interpretation of my findings, I will make comparisons between industries and discuss reasons for these differences using previous literature.
The relevance of this paper, and its contribution will become apparent in the empirical review in the scarcity of similar industry-level approaches to a question that very well might be industry-specific. Several papers suggest and prove the relevancy of this hypothesis, that herd behavior may be a phenomenon inherent to certain industries and not only on the level of whole financial markets (Bikhchandani & Sharm, 2011); (Bergsten & Olsson, 2014); (Choi & Sias, 2009).'

The results indicated no statistically significant presence of herding towards the extreme tails of market movements in neither of the industries controlled for. The results suggested rational markets acting according to the *Efficient Market Hypothesis*. Several explanations of the quality of information, regulatory legislation and authorities further enforced the distinction between developed and developing as to why herding empirically may appear like a phenomenon more frequently occurring in developing markets.

THEORETICAL FRAMEWORK

This section will present the underlying theory needed to grasp the concept of herd behavior. The Efficient market hypothesis will be brought forward, thereafter explaining the general sense of how behavioral finance emerged as well as its theoretical implications. The section will end with the branch of behavioral finance in which this paper is built upon, as well as different types of herd behavior.

Efficient market Hypothesis

Modern portfolio theory is a well-established mathematical framework that attempts to construct compositions of financial assets, i.e. portfolios, as to maximize the expected return/risk-ratio. Within this school of thought, many of the core points can be captured by the *Efficient Market Hypothesis*.
This theory has its roots in the 1960s and builds on the notion that markets are fully efficient. It is also a cornerstone in modern financial theory, suggesting that every bit of relevant information is reflected in the assets pricing of that time. One of the academics most related to the emergence of the Efficient Market hypothesis (EMH) is the American economist Eugene Fama. In his 1970 paper "*Efficient capital Markets: A review of Theory and Empirical Work"*, Fama introduced three different forms of efficiency; Weak, semi-strong and strong (Fama, 1970). They consider the different extent to which information is reflected in the pricing of financial assets.
Weak Efficiency suggests that the future price of different securities have no connection to that of past information or prices. So even in its weakest form, this theory completely disregards any potential benefit in utilizing technical analysis[5]. This concept is often analogous to the *Random Walk Theory* where stock prices are believed to take random movements in a way that makes all predicting methods futile. [6]
Semi-strong efficiency means that prices fully reflect all information that is publicly available, whereas *strong efficiency* goes as far as saying that even insider information are fully reflected in the security pricing and cannot give an investor any form of advantage (Fama, 1970).
So conclusively this theory reflects a situation in which it is impossible to gain advantages nor beating the market through practices such as market timing and risk-adjusted stock selection. The only way in which higher returns can be realized is through riskier investments, but even this reflects a fully rational pricing model.

The problem with the reliability of the EMH is the huge body of contradictory literature, with a fair bit of research confirming as well as rejecting it. It also inherently implies the redundancy of portfolio managers and investors to search for undervalued securities.
Other shortcomings of EMH is its inability to explain certain anomalies in the financial world, such as some investor beating the market without acquiring higher risk, and the presence of excess volatility. Other unexplainable occurrences are that of speculative bubbles, taking the

[5] Technical analysis is a financial method by which one attempts to predict future price movements using historical prices and market statistics. Aside from fundamental analysis that focus on the assets true value, the methodology use trends, moving averages and other tools that modern portfolio theory assumes useless.
[6] https://www.investopedia.com/terms/r/randomwalktheory.asp

2008 financial crisis as an example where investors acted in an irrational manner in favor of potential arbitrage. A situation in which EMH would claim an instant automatic adjustment of asset prices to fundamental levels.[7]
To explain these anomalies, there exists several schools of thought that attempt to account for the shortcomings of the Efficient Market Hypothesis, one of which being Behavioral Finance.

Behavioral finance

Behavioral finance arose as an attempt to integrate mainly Sociology and Psychology into finance. Formally dating back to early 1900s through such works as Le Bon´s *The Crowd: A study Of The Popular Mind* which mainly aimed towards psychology but later became a very much influential work taking introduced concepts of crowd psychology into finance.
Later in 1912, George Selden produced the work *Psychology Of The Stock Market* that based upon the belief that the movements of prices on exchanges are dependent to a very considerable degree on the mental attitude of the investing and trading public.
Another important, mainly psychological, work that laid the foundation of today´s behavioral finance was that of Festinger et al (1956). The author´s theory of *cognitive dissonance* illustrate the rise of change in belief when two simultaneously held cognitions are inconsistent. For example when one expects due to rationally a certain movement but the opposite occurs and the dissonance that arise due to it.
However, in the 1990s the field became much more popularized with many academic papers published alongside of big advancements within the field.

This discipline attempts to explain the patterns and emotions involved in the decision-making processes of investors (Ricciardi & Simon, 2000). In simple terms, it studies the financial markets as well as trying to explain market anomalies that standard finance theory like EMH cannot. An example is the January effect where there exists a perceived seasonal increase in financial asset prices which typically follows a drop in prices during the month of December[8] that cannot fully be explained by the fundamental values.
In classical finance people are rational, they have no cognitive biases, do not feel any pain of regret and possess full self-control. In reality, normal investors are often affected by these biases, know the pain of regret and even the classical FOMO (Fear of Missing Out).
This is what behavioral finance is trying to account for, the reality of events that contradict previous academic research, literature and theories.
Behavioral finance generally includes five main concepts, two of which will be mentioned for illustrative purposes aside of the central concept of herding.[9]

[7] https://www.nasdaq.com/articles/investing-basics-what-efficient-market-hypothesis-and-what-are-its-shortcomings-2015-10-15
[8] https://www.investopedia.com/terms/j/januaryeffect.asp
[9] https://www.investopedia.com/terms/b/behavioralfinance.asp

Self-Deception/Self-attribution:
According to this concept one's abilities to continuously learn and process additional new information are limited as one's own capabilities and knowledge is self-deceived. Very much analogous to the established Dunning-Kruger-effect in which the cognitive bias leads people of low cognitive abilities to overestimate their capabilities and knowledge, and vice versa. In principle, this arises due to overestimation of one's own skill levels and failure in recognizing the expertise of others.[10]
With a sample of 889 articles, Costa et al (2007) studied the presence of overconfidence in finance. Using this bibliometric analysis, they found a huge body of literature suggesting the presence of this type of self-deception within financial trading.

Anchoring:

Another cognitive bias/error which presents us with situations in which investors use irrelevant or outdated information in financial choices[11]. Here the psychological benchmark holds a disproportionally large part of the investors decision-making, generally through irrelevant or inaccurate information. An example is the holdings of an investment that has lost its value, where the information and prior prospects of the investments still outweighs new updated information.
The influence of anchoring on financial decision-making, a bias that results in Self-deception, is also confirmed by the bibliometric analysis by Costa et al (2017).

Intuitively, both sub-categories of Behavioral Finance and its effect on the financial market stand in contrast to the rational investor assumed in the *Efficient Market Hypothesis.*

Herding

The 3rd concept of behavioral finance investigated is the one central for this paper. The definition of herd behavior in finance is a situation in which investors copy the behavior of other investors.
First and foremost, herding can be divided into 2 types.
What is often referred to as *Spurious Herding,* also called *rational herding,* occurs when groups are facing similar information and acts upon this information in the same manner. This phenomenon is not so much a psychological one as it is a rational one. Fundamentals change and investors act in a similar way, somewhat aligned with traditional EMH-theory. It differs in that the change in asset pricing still necessarily will not follow the fundamentals arising from the new information in the form of a disproportional change in price. So when new positive information arise, several investors might react by buying the asset in a way that drives up the price further than the new information rationally can account for.
Intuitively, herd behavior can appear to be positive for passive investors who can follow more well-educated knowledgeable people. This is referred to as *Reputation-based Herding* and is a form of rational herding as well.

[10] https://www.verywellmind.com/an-overview-of-the-dunning-kruger-effect-4160740
[11] https://www.investopedia.com/terms/a/anchoring.asp

The other type is *Intentional herding*. Here, the herd behavior is a result of investors disregarding their own information and base their financial decisions on other investors and their information. Alternatively referred to as *The Bandwagon Effect,* this cognitive bias direct people to think or act in a manner more cohesive with the collective. There exist various psychological explanations such as the *Network Effect* were something has more value when possessed by many people. Additionally, *Fear-Of-Missing-Out,* and *Safety in Numbers* where a potential loss is not as psychologically damaging as if you were to possess the financial asset in minority.[12]
Just as these biases can be harmless in realizing short-term gains, they play a significant role in explaining the emergence of bubbles unexplained by the *Efficient Market Hypothesis.* Examples are that of informational cascades, where at first new information result in more investors in a rational manner. Due to the increased number of investors, and increase in asset price, more individuals buy the asset solely imitating that of other investors (herding) with little new information added. This creates a Positive Feedback Loop in which the asset price keeps rising by sheer herd behavior, eventually crashing such as the Dot-com bubble. [13]

This paper will investigate herding both aspects of herding. Intentional and Spurious herding are overlapping in rationality and economical interpretation. Assuming two investors having the same information, whereas one exhibit a higher interpretational ability, the other investor will naturally herd towards that investor's decision. Which in principle is a fully rational choice but still incohesive with *EMH* as the new asset price already should reflect that new information and disincentivize the last investor. Following this section, no further distinctions between different concepts of herding will be presented due to herding's already innate effect on the market, in contrast to *EMH.*

[12] https://simplicable.com/new/herd-behavior
[13] https://www.investopedia.com/articles/investing/052715/guide-understanding-information-cascades.asp

LITERATURE REVIEW

This section provides some previous literature on the topic of herd behavior, for that of both developed- and emerging market as well as different business sectors.

literature review

In 1995, Christie and Huang developed the cross-section standard deviation (CSSD) to search for whether herd behavior seemed to be present in periods of market stress. Prior to this, some empirical evidence supported the notion of herd behavior, partly put forward through the work of Shiller and Pound (1986). Through their straightforward method of surveying institutional investors, authors assessed the degree to which they would be susceptible to word-by-mouth communication in finance. Shiller and Pound found indication of contagion of interest, often found described in simple epidemic models. Meaning that institutional investors are significantly influenced by the actions of their peers in a manner much like that of epidemics.

Loosely building on previous work, Christie and Huang (1995) took to price analysis to control for the presence of herd behavior in pricing and equity returns. Just as in our paper, they assumed price dispersion to decrease in periods of large market movements, as people hypothetically tend to cluster around market consensus (market return). This stand in opposition to the rational asset pricing model, whereas individuals are predicted to increase dispersion in periods of big market movements (Christie & Huang, 1995). Particularly situations of large market movements where researched. This is where periods of stress tend to cloud the judgement of the individual and lead people to follow the herd, thus disregarding one's own believes. Christie and Huang found an increase of dispersion during large market movements, in favor of the more established rational asset pricing model.

Building on the work of Christie and Huang (1995), Chang et al (2000)[14] further developed the method for detecting herd behavior. CCK found that the computations from using CSSD appeared to be sensitive to outliers and thus bias the results, an issue that could easily be circumvented by measuring the dispersion in absolute values instead.
They extended the literature towards the market in general, as opposed to that of institutional investors, by examining the behavior in the US-, Hong Kong-, South Korea-, Japan- and Taiwanese markets. By the employment of the non-linear regression also used in this paper, they found no significant evidence of herd behavior in the US-, Japans and Hong Kong market. However, in the two emerging markets in South Korea and Taiwan, dramatically different results were found. Both countries documented the presence of a smaller equity return dispersion (i.e. herding) during extreme up- and down price movements. Additional results showed that the difference in market capitalization did not play a significant role when such effect where present.

[14] The Paper produced by Chang, Cheng & Khorana (2000) including methodology the developed, namely Cross-sectional standard deviation (CSAD) may be referred to as "CCK" at various occasions in this paper.

In line with these previous studies, Bergsten and Olsson (2014) took to make a cross-country comparison of emerging- and developed markets. Using the method by Chang et al. (2000), they also found evidence of herd behavior for the emerging markets of Hong Kong and Brazil, as opposed to Sweden and Schweiz where the evidence where presented as weak. Another emerging market is investigated by Vo and Phan (2016), looking into the Vietnamese market. Using the method proposed by Chang et al. (2000), authors confirm the presence of herd behavior in both respective markets.

In terms of more developed markets, Caparrelli et al. (2010) took to investigate the Italian market, using the now well-established methods of CCK and Christie and Huang (1995). Particularly extreme market conditions were investigated, i.e. high price fluctuations, and findings suggested herding to be present in both extreme ups- and downs. Opposite of CCKs findings, they found herding to be more expressed in stocks with higher market capitalization. Authors suggest an explanation in terms of "infrequent trading" but do note that the question remains to be identified through subsequent research.

Hwang and Salmon (2004) developed a new approach to detect herd behavior in which they assume that betas of individual assets will be biased and absent from equilibrium value when investors are herding towards the market., thus accounting for changes in fundamentals. They applied this method on the US- and South Korean market and found herding to be significantly present in large market movements, independent of market conditions. Evidence also enforce the results of Chang et al (2000), Christie and Huang (1995) and Caparrelli et al. (2010) in that herding is significant for both large ups- and downs.

Messis and Zapranis (2014) proceeds using the approach of Hwang and Salmon (2004) towards the Greek financial market with a subset of stocks representing 95% of the market capitalization of the Athens General Index. They found evidence of herding over the period 1998-2003 as well as in the early days of 2008 up until the last selected month of that year, that is align with previous research.

Herd behavior in the Greek stock exchange is further investigated by the work of Caporale et al. (2008), that instead take the more applied approach of CSAD by Chang et al (2000). A dataset of daily, weekly and monthly returns showed the strongest evidence of herding in the daily intervals thus supporting the idea the short-term nature of the phenomenon. Additional findings suggested a significant increase in herd behavior during and after the stock market crisis in 1999, slowly indicating more rational behavior since 2002.

Mobarek et al (2014) examined country specific herding behavior in several European countries. They report insignificant results for the period but do note the presence of the effect during crises and asymmetric market conditions also suggesting herd behavior in Nordic countries during the eurozone crisis.

Aside of the general presence of herd behavior, several papers have conducted a distinction between movements up- and down and in controlling for extremes found significantly different results.

Using the method of CCK authors concluded that herding appeared in upward movements for big size stocks in the Indonesian stock market. The phenomenon was also present during normal downturns but not during extreme ones (Purba & Faradyunawati, 2011). Interestingly, Rizal & Damayanti (2019) found that herding only occurs during falling market conditions only, although with the use of a GARCH-test (Autoregressive conditional heteroskedasticity).

Herding seemed more prominent during rising markets in Asia and India respectively (Tan et al 2007); (Prosad et al, (2012), whilst other papers suggest the opposite (Bergsten & Holmén, 2014);(Lindhe, 2012). Furthermore, Degirmen and Songur (2012) made the distinction for developed and developing (rising) markets. Authors found that events resulting in herd behavior, such as negative contagion effects and lower quality information appeared more in developing countries. On the contrary, bubbles are more likely to occur in developed countries for reasons unexplained by the authors.

Demirer et al (2010) is one of few papers looking to industry-specific herding, in 18 sectors. The linear model by Christie and Huang (1995) provided no evidence of investor herding, aside the electronic sector. Nevertheless, the nonlinear model by CCK found herding in all the 18 industries in the Taiwanese developing market. Authors found herding to be more prominent during periods of large downward movements. They hypothesize the results to be due to limited diversification opportunities, which is especially important in periods of market losses.

Most of the very limited industry-specific research have been done on the finance-industry. Among these are the papers by Cakan & Balagyozyan (2013) and Nakagawa & Uchida (2011) that found herding behavior in the Turkish banking sector and Japanese banking sector respectively. Additionally, most research done on industry-level are towards institutional investor behavior in terms of exhibiting herding in between industries as opposed to within (Choi & Sias, 2009)

As can be seen above, the empirical literature are very mixed suggesting different indications and results. Noteworthy however, is that most papers have an approach investigating whole markets as opposed to industry-specific research for herd-behavior.
So, although a big piece of literature is present, I feel safe to say that an industry-level approach is very much relevant in contributing to the present literature. Which do indicate herd-behavior or absence of it not only during crises, but also in developed markets.

METHODOLOGY

This section will begin with an introduction to the method as well as general characteristics, building towards the model used in this paper in the next sub-section.

Method

Christie and Huang (1995) (CH) where amongst the first to note the relevancy of risk dispersion in finding indications for herd behavior. They developed the *Cross-Sectional Standard Deviation (CSSD)* method, considering the equally weighted power of the difference in firm return and market return in time *t.*
They suggested that during periods of large market price movements, typical rational asset pricing models would suggest increased levels of dispersion with an increase in the absolute value of the market return as individual assets differ in responsiveness to market return. However, herd behavior is characterized as suppression of one's own beliefs and base the investment decisions on the collective. So, in situations of large market fluctuation, the dispersion would decrease in the presence of herding according to Christie and Huang.

The issue with this model is its sensitivity to outliers, so Chang, Cheng & Khorana (2000) (CCK) refined the model and proposed a slight alternative test of herding. Capturing the dispersion in absolute terms, they had the *Cross-Sectional Absolute Deviation* measure, much more established in academics. This model also builds on the intuition that rational asset pricing models assume a linear relationship between market return and equity return dispersion.
Additionally, CCK argued that the return dispersion is likely to exhibit a nonlinear relationship towards the market return, thus performing a multivariate regression with a nonlinear coefficient. This extends the notion of Christie and Huang who only regarded the diminishing of dispersion.
As a result, herd behavior and rational asset pricing produce conflicting results regarding the behavior of return dispersion and its correlation with market movements.

As the theoretical implication is that herding is most prevalent in periods of market stress, following equations will only include the extreme tails of the distribution of market returns as suggested by Christie & Huang (1995); Chang et al (2000); Purba & Faradynawati (2011). It is during these events that the predictions of rational asset pricing and herd behavior are most conflicting.

Cross-sectional Absolute Deviations

This thesis employs this strategy whereas the statistic is calculated as follows:

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}\left|r_{i,t} - r_{m,t}\right| \qquad \text{Eq. 1}$$

Where **N** is the set of observations, in this case firms, in the sample. Additionally, $r_{i,t}$ is the observed logged return for firm ***i*** at time ***t*** and $r_{m,t}$ the logged index returns corresponding to that specific industry in time ***t***. If herding toward the market return is present, the dispersion will act contrary to how fluctuations are explained by *rational asset pricing model.*
In other words, in periods of market fluctuations one would rationally expect increasing dispersion and a linear relationship at that. This because the innate nature of different securities and their differences in sensitivity to the market return (Christie and Huang 1995). Results should acknowledge, if statistically significant, an either-or situation as herding would be indicated by a decrease in return dispersion, at a decreasing rate, during market movements.

The following multivariate regression will be used:

$$\mathrm{CSAD}_t^{\mathrm{UP}} = \alpha + \gamma_1^{\mathrm{UP}}\left|R_{m,t}^{\mathrm{UP}}\right| + \gamma_2^{\mathrm{UP}}(R_{m,t}^{\mathrm{UP}})^2 + \varepsilon_t, \qquad \text{Eq. 2}$$

$$\mathrm{CSAD}_t^{\mathrm{DOWN}} = \alpha + \gamma_1^{\mathrm{DOWN}}\left|R_{m,t}^{\mathrm{DOWN}}\right| + \gamma_2^{\mathrm{DOWN}}(R_{m,t}^{\mathrm{DOWN}})^2 + \varepsilon_t, \qquad \text{Eq. 3}$$

Where ***a*** is the intercept, γ_1 the coefficient for the equally weighted market return (industry index) at time *t,* and ε_t the conventional error term.

Main coefficient of focus is γ_2 for the squared log return of the market and will indicate either the presence or absence of herd behavior. A negative and statistically significant Y_2 should imply evidence of herding towards that market meaning that the dispersion is decreasing at a decreasing rate. A positive γ_2 would suggest that dispersion increases at a decreasing rate which is perfectly rational during normal market conditions, whereas a coefficient equal to zero or insignificant displays a linear relationship in accordance to the EMH (Chang et al. 2000).

So, herding is indicated by a situation in which the individual stocks and their market movements will concentrate itself to a smaller set of stock/-s suggested by the herd. If this where to happen less dispersion during the market movement would occur. In turn this would suggest investors buying a stock based on other investors/the herd, illustrated through the instant price movement given by the squared market return-coefficient and thus absence of an "efficient" linear relationship.

Whilst investigating herding in periods of market stress, Christie and Huang (1995) stressed the possible nature of an asymmetric relationship in extreme highs- and lows. We therefore utilize Equation 1 and 2 in making a distinction between these two situations. A sample of the 10% largest market movements, UP and DOWN respectively, are used for the regression.

DATA

All data in this paper is retrieved from the Nasdaq official webpage[15].

I have confined this paper to include 3 distinct industries. In these respective industries, a subset of three large-cap stocks has been sampled. To ensure further reliability and less variation, the three stocks chosen all represent the most traded ones under the assumption of the company having been listed on the Stockholm Exchange OMX for at least 20 years in all respective indexes. All the three indexes conclude a total of 20 stocks within that industry.

To circumvent the potential issue of stock splits and dividends, only adjusted closing-prices have been used to account for the most basic corporate actions. By restricting the sample to daily closing price computations, we capture the short-term nature of the phenomenon.

SECTOR	INDEX	Number of observations	Subset used
Finance	N FINANCIALS EUR PI	5,010	1,002
Technology	*N TECHNOLOGY EUR PI*	5,021	998
Industrial	*N INDUSTRIALS EUR PI*	5,021	1,006

Comprise the data used for computations in STATA

As an estimator of the market return in the financial sector, the OMX index *N FINANCIALS EUR PI* is used. With an original total of 5,010 daily observations, the extreme up- and down movements will total to 20% of the observations, i.e. 1,002 observations. The samples representing this industry will comprise of *Nordea Bank ABP, Swedbank A* and *SEB A.*

As a representation of the technological sector, we use the OMX index *N TECHNOLOGY EUR PI* represented by the daily performance of *Ericsson B, ENEA AB* and *Hexagon B.* The base sample here is 5,021 observation, resulting in the usage of 998 observations total.

Lastly, the OMX *N INDUSTRIALS EUR PI* index-returns will represent the market return for the industrial sector. The total of 5,021 observations, a sample of 1,006 will represent the highest 20% return fluctuations. Furthermore, *Skanska B, Volvo B* and *Assa Abloy* are the 3 highest stocks within the index in terms of revenue and trades.

All computations will be regressed through STATA, a standard statistical software package. STATA has the potential for all computations and raw data processes needed and is used widely among researchers and academics mainly within the fiends of economics, sociology, political science, biomedicine and epidemiology[16]

[15] http://www.nasdaqomxnordic.com/
[16] https://en.wikipedia.org/wiki/Stata

Descriptive statistics

Table 1
Summarized statistics of the returns (R_m) and cross-sectional absolute deviation (CSAD) for the Industrial-, financial- and technological stock markets.

Market/ Variable	Number of observations	Mean return (%)	Standard deviation	Minimum	Maximum
Industrial $R_{m,t}$ $CSAD_t$	5,022	.15329 . -.001059	.0998786 .1009013	-.094319 -6.93171	.1018533 .8302719
Financial $R_{m,t}$ $CSAD_t$	5,019	.03425 .00185	1.519078 .0231769	-.085195 -.1789228	.1113317 .2395777
Tech $R_{m,t}$ $CSAD_t$	5,003	.05538 -.0001975	.0243198 .0296519	-.1363591 -.282345	.2655735 .1769417

This table displays the daily mean for the market return and Cross-sectional Standard Deviation (CSAD) under the same period for all industries. Additionally, the number of total observations and data on the most extreme movements are included from each industry.

From Table 1 we can draw various conclusions. First, we can see that the industrial segment on the stock market has had a highest daily mean return of ~0,15% during the years of 2000-01-01 to 2020-01-01. The period in which we obtained our sample happened to occur during the Dotcom Bubble that eventually came to crash in 2001 through 2002[17]. Our sample in not including much of the short-term rise, as opposed to the period when the bubble burst which intuitively explain the low mean return in relation to the generally stable Industrial segment. Additionally, the subprime mortgage crisis in 2007 along with the European sovereign debt crisis that followed along could very well explain an inferior performance of the Swedish finance index.
Looking at the standard deviation, i.e. the dispersion of data points around the mean, the largest one is found within the financial segment, 1.52, also possibly explained by the market shocks surrounding this industry. Aside from a brief dive during the 2008 crisis, after the dot com crash in 2002 the technological industry has had a somewhat steady growth, with the lowest standard deviation of 0.023, reaching the dotcom peak again in April 23, 2015.

In spite of the financial crisis starting around September 2008, the Swedish OMX financial index experienced its highest return of 11% for one day. Consequently, the highest dive of the 20-year period came only a few days later in October 6th resulting in an 8,5% loss.
The maximum return of 26% in tech came in October 15th, whilst the quickest downfall of 13% came during the dot-com bubble bursting in 21st of August 2002.
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[17] https://www.investopedia.com/terms/d/dotcom-bubble.asp

RESULTS

As previously discussed, movements compatible with the *Efficient Market Hypothesis* and *Rational Asset Pricing* would display an increase in dispersion between the individual stocks and the market (CSAD) in periods of large movements. On the contrary, situations in which the CSAD decrease/increase at a decreasing rate would signify herd behavior. So, if we find the non-linear market return coefficient to be negative and significant this would indicate irrational responses to market movements, decrease in dispersion, and thus herding towards the market return.

In Table 2 we find the squared market return coefficient to be negative for the financial market during upward movements. However, due to the insignificance of the results no herding behavior has been observed in favor of EMH.

Table 2 – Financial

Regression result of Daily cross-sectional absolute deviation (CSAD) on the linear and squared market return. Sample includes the 10% extreme **upward** market movements.

Source	SS	df	MS	Number of obs	=	501
				F(2, 498)	=	83.14
Model	1334.40099	2	667.200494	Prob > F	=	0.0000
Residual	3996.23424	498	8.02456675	R-squared	=	0.2503
				Adj R-squared	=	0.2473
Total	5330.63523	500	10.6612705	Root MSE	=	2.8328

CSAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IndexlogR	-.7221815	.3122273	-2.31	0.021	-1.335627	-.1087364
IndexlogR2	-.0495732	.0338087	-1.47	0.143	-.1159984	.016852
_cons	.2732638	.5701129	0.48	0.632	-.8468593	1.393387

This table reports statistical relevant information of the following regression model:
$CSAD_t = \alpha + \gamma_1 |r_{m,t}| + \gamma_2 r_{m,t2} + \varepsilon_t$
Where $R_{m,t}$ is the absolute value of an equally weighted Index representing the Financial Industry at time t and $R^2_{m,t}$ is the squared value. A negative and significant $R^2_{m,t}$ would imply herding towards the market return.

Looking at Table 3, for the 10% highest one-day dips in value, we find a similar result in a negative but insignificant squared market return coefficient. Again, an absence of herd behavior is observed in favor of rational behavior even in the most extreme of movements.

Table 3 – Financial

Regression result of Daily cross-sectional absolute deviation (CSAD) on the linear and squared market return. Sample includes the 10% extreme **downward** market movements.

Source	SS	df	MS		
				Number of obs	= 502
				F(2, 499)	= 69.15
Model	1495.2699	2	747.634949	Prob > F	= 0.0000
Residual	5395.36308	499	10.8123509	R-squared	= 0.2170
				Adj R-squared	= 0.2139
Total	6890.63298	501	13.7537584	Root MSE	= 3.2882

CSAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IndexlogR	-1.891759	.4793042	-3.95	0.000	-2.833462	-.9500557
IndexlogR2	-.0654199	.0572266	-1.14	0.254	-.1778546	.0470148
_cons	-2.47772	.8361736	-2.96	0.003	-4.120575	-.8348656

This table reports statistical relevant information of the following regression model:
$CSAD_t = \alpha + \gamma_1 |r_{m,t}| + \gamma_2 r_{m,t2} + \varepsilon_t$
Where $R_{m,t}$ is the absolute value of an equally weighted Index representing the Financial Industry at time t and $R^2_{m,t}$ is the squared value. A negative and significant $R^2_{m,t}$ would imply herding towards the market return.

Table 4 presents us with the situation of extreme downward movements in the Technological sector on the Swedish stock market. As in all regressions the Cross-Sectional Standard Deviation and logged index return presents a significant relationship. But as with the financial sector, the findings suggest absence of any herd behavior towards the market return. A positive non-linear market return could be explained rationally but the statistically insignificance of the results are in favor of rational asset pricing and movements regardless.

Table 4 – Technology

Regression result of Daily cross-sectional absolute deviation (CSAD) on the linear and squared market return. Sample includes the 10% extreme **downward** market movements.

Source	SS	df	MS		
				Number of obs	= 498
				F(2, 495)	= 164.40
Model	2539.64525	2	1269.82262	Prob > F	= 0.0000
Residual	3823.39231	495	7.72402486	R-squared	= 0.3991
				Adj R-squared	= 0.3967
Total	6363.03756	497	12.8028925	Root MSE	= 2.7792

CSAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IndexlogR	-1.102386	.2449211	-4.50	0.000	-1.5836	-.6211734
IndexlogR2	.0003524	.0191589	0.02	0.985	-.0372905	.0379952
_cons	-.7304177	.6459897	-1.13	0.259	-1.999638	.5388023

This table reports statistical relevant information of the following regression model:
$CSAD_t = \alpha + \gamma_1 |r_{m,t}| + \gamma_2 r_{m,t2} + \varepsilon_t$
Where $R_{m,t}$ is the absolute value of an equally weighted Index representing the Financial Industry at time t and $R^2_{m,t}$ is the squared value. A negative and significant $R^2_{m,t}$ would imply herding towards the market return.

Table 5, however, exhibits a negative relationship to the dispersion of returns. Although as the correlation is slightly weaker than being weakly significant at the 10% level (P<0.1) we must disregard any herding here.

Table 5 – technology

Regression result of Daily cross-sectional absolute deviation (CSAD) on the linear and squared market return. Sample includes the 10% extreme **upward** market movements.

Source	SS	df	MS	Number of obs	=	500
				F(2, 497)	=	130.87
Model	2582.99331	2	1291.49665	Prob > F	=	0.0000
Residual	4904.69574	497	9.86860311	R-squared	=	0.3450
				Adj R-squared	=	0.3423
Total	7487.68905	499	15.0053889	Root MSE	=	3.1414

CSAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IndexlogR	-.7140419	.1541174	-4.63	0.000	-1.016844	-.41124
IndexlogR2	-.0137747	.0085211	-1.62	0.107	-.0305165	.002967
_cons	-.4613016	.5189259	-0.89	0.374	-1.480861	.5582574

This table reports statistical relevant information of the following regression model:
$CSAD_t = \alpha + \gamma_1 |r_{m,t}| + \gamma_2 r_{m,t2} + \varepsilon_t$
Where $R_{m,t}$ is the absolute value of an equally weighted Index representing the Financial Industry at time t and $R^2_{m,t}$ is the squared value. A negative and significant $R^2_{m,t}$ would imply herding towards the market return.

Lastly, looking at regression 1.A and 1.B in the Appendix, we have the industrial segment and their correlation between the CSAD and non-linear market return. Again, the null hypothesis cannot be rejected, and we conclude that no significant herding could be found in any of the three industries investigated.

DISCUSSION

Our results showed no evidence of herding in any of the industries investigated. This section will provide us with possible explanations for this, build upon previous literature and findings, as well as potential shortcoming with the used methodology.

Although no statistically significant levels of herding could be found, the industry coming closest was that of the technological one, namely in periods of extreme upward market movements. Several papers focusing on the dot-com bubble have been conducted, whereas most papers suggest herd behavior being amongst the factors driving this event (Prieto & Perote, 2017; Singh, 2012; Demirer & Zhang, 2018). Whether our results approaching this conclusion because of this is beyond the scope of this paper since our sample period began during the crisis.

Relating to the literature review, the degree of mixed results is very extensive. However, substantial empirical research and evidence exist that might explain our results and findings. Among all the papers employing the same or different methods, the most agreed upon finding is that herding seem to be more prevalent in developing markets as opposed to developed. Herding in its simplest form arises because one's tendency to disregard his or her own information in favor of other people's actions and their information. When Sueyman Degirmen and Mehmet Sonhur (2012) started investigating the differences in herding between developed and developing countries, they concluded this to be one of the main reasons. They build upon the notion that every trader receives a private signal with private information. This private information is the amount of information that one personally analyzes and extract from the public information that is available, which in principle every agent has access to. Intuitively, the more effort an agent put into the research, the more accurate his signal will prove to be. Furthermore, acquiring information gradually cost more and more due to the marginal time one must put into it. Now, let us assume agents investing the absolute maximum effort to retrieve all this information such as the state of the economy, fundamentals, asset price history etc. So, the accuracy of the signals rest on the quality of the information obtained.
Degirmen and Sonhur argue that the risk for this information not reflecting the true value of the asset is higher in emerging markets within developing nations. Reason for this might be inadequacy of authority regulations, lower quality financial reports resulting from poor legal systems etc. Hence, the precision of the private signals will result in lower accuracy in developing countries, even in the presence of full research effort. An investor will always keep investigating until his marginal utility is in parity with his marginal search cost. As a result, the extent to which an investor researches are not as far in the developing markets as they are in the developed ones. The absence of high-quality information could very well lead to herding, or at least an increase in volatility potentially captured by the methodology used in this paper. The excess of volatility, that could trigger short-term herding, particularly present in emerging markets is enforced further by the finding of Fang et al (2019).

The notion regarding the relevance of quality information is also mentioned as an explanation by Chang et al (2000) who developed CSAD and found similar results, i.e. presence of herding only in emerging markets.
Building on the concept of private information, Cipriani and Guarino (2008) investigated "financial contagion" arising from informational cascades spreading from one market to another. They found that the probability of incorrect cascades depends on the quality and precision of the private information. This could further result in financial contagion, a situation in which the price of an asset is correlated with that of another one aside from any fundamentals (Degirmen & Sonhur, 2012). Additionally, financial contagion through the US was found to affect emerging market such as Turkey and the BRIC (Brazil, Russia, India and China) respectively (Balcilar, 2015; Jin & An, 2015). Other effects differentiating developed from developing countries are that of hot money, which is an inflow of capital from investors seeking short term-returns. Chari and Kehoe (1997) argue that this arise from "frictions" in information, and with that hot money excess volatility arise much align with the herding we test for here.

So, to summarize, the quality of one's private information that tends to be lower in developing countries can lead to herd behavior due to higher volatility around fundamentals as well as the occurrence of contagion effects. To put our results in perspective with this, there is a high degree of transparency between the companies and the public, unspecific to sectors. Corruption, fraud and insider trading/information is actively worked against and largely prevented through various institutions like the *Securities and Exchange* Commission (SEC) in the US or *Finansinspektionen* in Sweden. Along with a well-established legal system and various institutions, the type of herding arising from imperfect- or low-quality information are marginally absent compared to developing countries with emerging stock markets.

All of this establish the notion that developed markets are much more align with the *Efficient Market Hypothesis* and that the pricing of these assets does reflect all information publicly available. And since the information generally is more accurate that that of emerging markets, investors have less incentives to disregard their own information. The degree of efficiency proposed by Eugene Fama is beyond this paper, but a fair bit of empirical evidence suggest a much higher efficiency than that of developing markets.
This might also explain the findings of herding in all 18 industries on the Taiwanese market but is not explicitly mentioned in the paper (Demirer et al. 2019). Additionally, the authors notion of limited diversification opportunities in the Taiwanese financial market distinguish the developing markets from the developed further.

The data used consisted of the most traded stocks during that period, which also came to represent large-cap companies. Our results where contrary to Caparrelli et al (2010) who found herding to be present only among large-cap companies and not among small-cap, proposed the reason to be infrequent trading but acknowledged the need to identify it academically.
However, there is arguments for this being a small-cap phenomenon as well. I used the most traded stocks during this period, not the most volatile which tends to be attributed smaller stocks. The smaller oversight, less familiarity to investors, and speculative potential could potentially lead to herding. Taking the higher risk/ reward-ratio explainable by EMH aside,

small-cap companies do inhibit characteristics like developing markets, potentially leading to herd behavior.

Important to have in mind is also the way in which we have controlled for herding. As mentioned, various types of herding behavior arising for different reason exist. This paper merely controls for herding towards the market in general, i.e. mimic the behavior of the market through returns. In the context of this type of herding, the most prominent explanation for the absence is presented above.

Although there exist relevant literature backing the findings of this paper, we should have in mind that several methods exist that test for the same type and different types of herding. Papers employing other methods to detect herding towards particularly the market indices find similar conclusions that this phenomenon presents itself more frequently in developing financial markets(Wang, 2008). But little empirical research has been done on industry-level, and our samples are not necessarily representative for a whole industry. As the samples represented the most traded stocks, we should keep in mind the various forms that herding can manifest itself in as well as distinctions between firms such as market capitalization, fundamentals and day-to-day volatility.

CONCLUSION

This section will conclude the thesis, define the contributions and present suggestions for further research.

Conclusion

This paper set out to examine any presence of herd behavior towards the market return. Using the empirically established method *Cross-Sectional Absolute Deviation* brought forward by Chang et al.(2000) we take our focus towards the Swedish Stock Exchange. Aside from most papers within the fields that focus on markets, the scope of this paper surrounded that of particular industries. Three industries where chosen, Industry, technology and finance. Empirical evidence suggested herding to be most prominent during periods of market stress, which is why a subset of extreme daily adjusted returns where sorted to be used in the regressions. Accounting for possible asymmetry in upward- respective downward movements, a distinction for these presented themselves in the form of two regressions for every industry.

Our results showed no significant herding in either industry regardless of the directional movement. Aside from the very mixed empirical evidence, a well-researched and backed literature exist that manage to put a distinction to developed and developing markets in a rational manner. This theory is put forward as a reasonable explanation for the results in favor of the *Efficient Market Hypothesis*, aside from any short coming with the methodology.

Contribution

This thesis contributes to the existing literature in that it narrowed in on herd behavior in industries listed on a developed financial market. We investigated the idea that this type of herding very well might be a phenomenon inherent to certain industries more open to speculation, that exhibit higher fluctuations or likelihood of higher short-term returns. Afterall, industries listed on the financial markets differ and the relation investors have to them differ as well. As financial markets are one of the main ways in which individuals acquire wealth, it is very much relevant to have as broad of an understanding of it as fully possible.

Suggestions for further research

Previous studies have mainly had their attention on country-wide financial markets, and only put a clear geographical distinction as well as that of developed/developing markets. Just as there exist various types of herding, various methods exist to control for them as well. To illustrate, the data from adjusted closing prices were used in this paper, but volume trading, moving beta-coefficient and several others are all relevant and have their own distinct advantages and disadvantages. Much of the methodologies already in use are much applicable

to a sector-specific level as well. Additionally, the robustness of my results could be interesting, by using a larger sample and additional variables. Moreover, this paper conducted the method over a period of 20 years. With a high literature backing the increased likelihood of herding during crises, an interesting notion is the degree to which herding differs between industries in periods of large whole-market movements such as the financial crisis or the European sovereign debt crisis. Lastly, as most research suggest the presence of herding in emerging markets, taking an industry-specific approach might result in interesting findings of much utility for both investors and policymakers.

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APPENDIX

2.A

Table 6 – Industry

Regression result of Daily cross-sectional absolute deviation (CSAD) on the linear and squared market return. Sample includes the 10% extreme **upward** market movements.

Source	SS	df	MS	Number of obs	=	503
				F(2, 500)	=	4943.54
Model	42055.1882	2	21027.5941	Prob > F	=	0.0000
Residual	2126.77285	500	4.2535457	R-squared	=	0.9519
				Adj R-squared	=	0.9517
Total	44181.961	502	88.0118746	Root MSE	=	2.0624

CSAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IndexlogR	-1.128133	.0803314	-14.04	0.000	-1.285961	-.970304
IndexlogR2	.0006506	.0003861	1.69	0.093	-.000108	.0014092
_cons	.3451323	.2198942	1.57	0.117	-.0868982	.7771629

This table reports statistical relevant information of the following regression model:
$CSAD_t = \alpha + \gamma_1 |r_{m,t}| + \gamma_2 r_{m,t2} + \varepsilon_t$
Where $R_{m,t}$ is the absolute value of an equally weighted Index representing the Financial Industry at time t and $R^2_{m,t}$ is the squared value. A negative and significant $R^2_{m,t}$ would imply herding towards the market return.

2.B

Table 7 – Industry

Regression result of Daily cross-sectional absolute deviation (CSAD) on the linear and squared market return. Sample includes the 10% extreme **downward** market movements.

Source	SS	df	MS	Number of obs	=	503
				F(2, 500)	=	4938.65
Model	39811.7232	2	19905.8616	Prob > F	=	0.0000
Residual	2015.31219	500	4.03062438	R-squared	=	0.9518
				Adj R-squared	=	0.9516
Total	41827.0354	502	83.3207877	Root MSE	=	2.0076

CSAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IndexlogR	-1.034184	.0777256	-13.31	0.000	-1.186893	-.8814748
IndexlogR2	-.0002605	.0003786	-0.69	0.492	-.0010043	.0004833
_cons	-.2357048	.2238215	-1.05	0.293	-.6754513	.2040416

This table reports statistical relevant information of the following regression model:
$CSAD_t = \alpha + \gamma_1 |r_{m,t}| + \gamma_2 r_{m,t2} + \varepsilon_t$
Where $R_{m,t}$ is the absolute value of an equally weighted Index representing the Financial Industry at time t and $R^2_{m,t}$ is the squared value. A negative and significant $R^2_{m,t}$ would imply herding towards the market return.