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# Herding behaviour in the US and Germany

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**ABSTRACT:**

This study examines herding behaviour in the US and German stock markets within a chosen sample period of 2000-2020. The study material is based on data from two stock indices: Dow Jones Industrial Average (US) and DAX (Germany). The sample size from both indices is equal, since these both indices have 30 stocks. The main variables in this study are logarithmic returns, standard deviation, and absolute standard deviation. The methodological framework is based on a CSAD (cross-sectional absolute deviation) model developed by Christie and Huang (1995) and Chang et al. (2000). This model observes the nonlinear relationship between the return of an individual stock in relation to the return of the market portfolio.

Bikhchandandi and Sharma (2001) describes herding as a phenomenon where an investor leaves out individual preferences and thoughts from his or her decision-making process and instead relies on common market consensus. This study paper aims to find out if herding behaviour occurs throughout the sample period, only during individual years, or not at all. It is also studied whether herding behaviour appears more strongly during the days when markets go up or down and if systematic herding behaviour is observed during market crises. The chosen sample period is extremely interesting because it includes many extra ordinary market conditions like IT crisis, Financial crisis, the European sovereign debt crisis, and the Covid-19 crisis. All these events had a strong impact on market prices and caused high volatility. This paper provides an in-depth study of the theory and literature around the topic. Based on the result it is analyzed which market characteristics could lead to the occurrence of possible herding behaviour.

In conclusion it can be stated that herding behaviour does not occur in either market when looking the whole sample period as a single entity. Dividing the sample period into individual years, only 2008 shows signs of herding behaviour in the US. Results also shows that no special herding behaviour was observed during market crises. Also differences between the days when markets were rising or falling were insignificant. The results of the study are generally in line with other studies, but some inconsistencies can be observed. Herding behaviour challenges the efficient market hypothesis, and from the results we can state that herding behaviour is observed in the US in 2008. Thus, investors who have invested in the Dow Jones index are not as rational as investors who have invested in the German DAX index.

**KEYWORDS**: Behavioural finance, herding behaviour, stock markets, Dow Jones, DAX

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**TIIVISTELMÄ:**

Tämä tutkimus tutkii laumakäyttäytymistä Yhdysvaltojen ja Saksan osakemarkkinoilla vuosien 2000-2020 aikana. Tutkielman datana toimivat osakeindeksit Dow Jones Industrial Average (Yhdysvallat) ja DAX (Saksa). Molemmat indeksit sisältävät kolmekymmentä osaketta, ja datana käytetään päiväkohtaisia hintatuottoja. Pääasiallisina muuttujina toimivat logaritminen tuotto, keskihajonta ja absoluuttinen keskihajonta. Metodologiana toimii Christien ja Huangin (1995) sekä Changin ja muiden (2000) kehittämä CSAD-malli (cross-sectional absolute deviation). Kyseinen malli tarkastelee epälineaarista suhdetta yksittäisen osakkeen tuoton välillä suhteessa markkinaportfolion tuottoon.

Laumakäyttäytymisellä tarkoitetaan sijoittajan toimintaa, jossa sijoittaja hylkää henkilökohtaisen intuition ja päättää sen sijaan seurata markkinoiden konsensusta. Tämä tutkielma pyrkii selvittämään, esiintyykö laumakäyttäytymistä, kun koko tarkasteluperiodia tarkastellaan yhtenä kokonaisuutena ja yksittäisinä vuosina, onko laumakäyttäytyminen epäsymmetristä nousu- ja laskupäivien aikana ja havaitaanko systemaattista laumakäyttäytymistä markkinakriisien aikana. Tutkielman kahdenkymmenen vuoden data (2000-2020) on äärimmäisen mielenkiintoinen, koska se pitää sisällään muuan muassa IT-kriisin, vuoden 2008 globaalin finanssikriisin, euroalueen velkakriisin ja vuonna 2020 meidät kaikki yllättäneen koronakriisin, joilla oli hyvin voimakas ja nopea vaikutus osakkeiden markkinahintoihin. Tutkielmassa perehdytään syvällisesti teoriaan ja kirjallisuuskatsaukseen ja tuloksien perusteella analysoidaan ominaisuuksia, jotka ovat johtaneet mahdolliseen laumakäyttäytymisen esiintyvyyteen.

Tutkielman johtopäätöksenä esitetään, että laumakäyttäytymistä ei esiinny kummassakaan markkinapaikassa tarkasteltaessa tarkasteluperiodia yhtenä kokonaisuutena. Jakamalla tarkasteluperiodi yksittäisiin vuosiin ainoastaan vuosi 2018 Yhdysvaltojen osalta osoittaa laumakäyttäytymisen merkkejä. Tarkasteltaessa nousu- ja laskupäiviä ja kriisejä ei laumakäyttäytymistä havaita. Tutkielman tulokset ovat pääsääntöisesti linjassa muiden tutkimusten kanssa, mutta myös ristiriitaisuutta havaitaan aikaisempien tutkimusten kanssa. Laumakäyttäytyminen haastaa perinteistä tehokkaiden markkinoiden hypoteesia, ja kun Yhdysvaltojen osalta havaitaan laumakäyttäytymistä vuonna 2018, todetaan, että Dow Jones -indeksiin sijoittaneet sijoittajat eivät toimi yhtä rationaalisesti kuin Saksan DOW -indeksiin sijoittaneet sijoittajat

**AVAINSANAT:** Laumakäyttäytyminen, käyttäytymistieteellinen rahoitus, osakemarkkinat, Dow Jones, DAX

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## Abbreviations

| | |
|---|---|
| B | Beta Factor |
| CAPM | Capital Asset Pricing Model |
| CMA | Conservative Minus Aggressive |
| CML | Capital Market Line |
| CSAD | Cross Sectional Absolute Deviation |
| CSSD | Cross Sectional Standard Deviation |
| EMH | Efficient Market Hypothesis |
| HML | High Minus Low |
| RMW | Robust Minus Weak |
| SMB | Small Minus Big |
| UMD | Momentum Factor |

# 1 Introduction

The general behaviour and human activity inevitably influence another people. The extent, varies, but at least on some level since humans tends to follow another people's behavioural patterns naturally. This can happen either on purpose or subconsciously. People for example create teams and groups in many different circumstances and for many different purposes. These kind of actions increases the social cohesion among people. This happens naturally since people have the basic need for feeling togetherness. Acting alone without any kind of support network can get people to feel unsecure. Thereby people often seek safety by trying to join some kind of social community where he/she can find other individuals with similar interests. From the first steps of human evolution, we have become accustomed to acting as a group and taking inspiration from others. Many animals act as a pack for example when hunting or defending the herd. Same kind of behavioural patterns still exists in us people even though the purpose of bringing different skills together is nowadays more civilised. We are working in teams, we practice team sports, many times we apply to same school with friends and for example tends to choose restaurants that another people have recommended. In all the examples above, one is influenced by others. The influence can affect one so strongly that one rejects one's own personal thoughts and preferences and instead follow the decision of others. Behaviour like this is called "herding behaviour".

In this century, we have experienced several market crises. The effects of some of these can still be seen on markets. After a crise, there has usually been a heated debate about what has happened, why it happened, how it was possible and what can be learned of it. Many times, the herding behaviour of investors is highlighted as one reason behind the fast movements on markets. It has for example been claimed that the irrational behaviour of investors can be blamed for rapid price changes. The argument behind this claim is that if investors for some reason starts to act as a "herd", they leave their own thoughts aside and just mimics the common market consensus. This kind of behaviour can strengthen the movements to both directions which can lead to very strong and rapid changes in market prices.

Psychology is part of the herding behaviour and it is the psychological part that makes the studying of herding behaviour extremely challenging (Shiller 2003). Herding behaviour can be seen to be a one form of irrational behaviour. When behavioural of the investors on the stock markets have been studied, have quite often irrational actions and more precisely herding behaviour pointed out as phenomena. (Devenow & Welch 1996).

## 1.1 Purpose and motivation of the study

The purpose of this study is to research herding in the US and German stock markets over a period of 2000-2020. The chosen study objects from these markets are two stock indices**:** Dow Jones Industrial and DAX. More precisely the goal is to research if herding can be observed in general and if herding behaviour more easily raises its head during the times of crises in comparison to more normal market conditions. It is also studied that if herding exists on these markets, how strong impact it has? This study paper takes a close look on theory of herding behaviour, examines the collected data as one entity, splits the years to separate study objects, processes up and down dates separately and as stated before, highlights market crises that have strongly affected the stock market.

It will be interesting to see whether herding behaviour can be recognised and if yes, is it limited to specific years and is it evenly distributed on both markets. According to past studies, herding has been observed in both developed and emerging markets. Herding has been found to be particularly strong during the rising and declining market days. Rational actions are often based on concrete reasons while irrational actions often are a result of emotional factors. Herding is equated with irrational behaviour, and it can be said that often in herding, emotions guide an investor’s actions rather than reason. (Chiang & Zheng 2010.)

## 1.2 Structure of the study

This thesis consists of four main sections. The first two sections covers the theory and literature review. The theoretical part presents the efficient market hypothesis and asset pricing models. Literature review goes through the written literature about herding behaviour very extensively. The third section focuses on the data, descriptive statistics, and on methodological framework used in the study. In the final section the chapters 7 and 8 are presented. The results of the study are reviewed in chapter 7, and lastly the entire study is summarized in chapter 8.

## 1.3 Research hypotheses

The aim of the study is to produce results that can add value to previous published studies in the same study area. The amount of used data in this study is extensive and provides up-to-date information. This helps us to better understand the events of the last 20 years in the US and German stock markets. If herding occurs during certain years, we can analyze the reasons for this: why herding has occurred in year X but not in year Y?

The efficient market hypothesis assumes that the dispersions of stock return are normally distributed. Since anomalies have occurred on the markets it indicates that the markets are not always efficient. Herding and irrational behaviour in general is often used as reasons when trying to explain what causes anomalies on markets. This gives the null hypothesis of the study which is as follows:

H0: During the study period of 2000-2020, stock return dispersions are normally distributed in the US and German stock markets.

The first hypothesis focuses on the main topic of the study: whether herding occurs in the market under study. The first hypothesis tells whether market-wide herding occurs throughout the sample period. The first hypothesis of the study is written as follows:

H1: Herding behaviour occurs in the US and German stock markets during the entire sample period.

Christie and Huang (1995) also researched herding by dividing their sample period into subsamples such as periods of high volatility. Partly motivated by this, the following hypothesis examines whether herding occurs during individual years. The second hypothesis written as follows:

H2: The existence of herding behaviour varies from year to year.

Prechter and Park (2007) observed that herding occurs both on days when markets go up and when markets go down. Naturally on bull markets investors tends to buy stocks and on bear markets investors tends to sell stocks. The reason behind this phenomenon is that investors feels that they can reduce the risk of their portfolios with this kind of activity. By doing so investors actually increase their risk because they buy stocks when price level is high and sell stocks at lower price levels. Motivated by this, the third hypothesis is formulated as follows:

H3: The scale of herding behaviour is asymmetric and thereby the extent of herding is not evenly distributed between up- and down days.

Fenzl and Pelzmann (2013) states that emotions tend to take over during the extreme market conditions. Similar behaviour among investors during large market movements is also observed by Prechter (2001). Gleason, Lee and Mathur (2013) used industry ETF's as their data source and in their research they wondered if herding occurs specially during extreme market conditions. The question is important and therefore the fourth hypothesis is following:

H4: Herding behaviour appears more often during extreme market conditions.

# 2 Overview of herding

*”There are innumerable social and economic situations in which we are influenced in our decision making by what others around us are doing.”* (Banerjee 1992)

We communicate regularly with friends, family, and colleagues, and mutual communication influences our decisions and reinforces similar thinking. Similar thinking exposes us to making decisions based on the thoughts of others and thus we may reject our own original decision. We decide to imitate others and this is called herding. The word herding is a very interesting term and is used in many different disciplines.

Bikhchandandi and Sharma (2001) describes herding as a movement of a group of investors based on previous decisions of other investors. An individual investor rejects his or her own initial decision and decides to make a decision similar to that of other investors, thus overturning the investor’s original plan. Every experienced investor surely knows the concept of herding and may themselves have been exposed to herding on several occasions during their investment journey. Sometimes it can also be extremely challenging to distinguish whether the decision itself is a personal decision or whether the decision is based on a group's actions, i.e. previous decisions made by other investors. Herding is a natural activity with very long roots in history. For example, many animals work in the herd hunting and defending themselves against other animals. There are many good aspects to herding and it is natural that we use other people as models, mimic others and develop ourselves through it. (Bikhchandandi & Sharma 2001.)

An individual investor may have made an investment decision that he or she will purchase security X. Before placing an investment order, the investor goes through the investment forums and finds that many investors are on the opposite side of the discussion compared to the investor. The discussions reveal that many investors are in favour of selling security X and that the future of security X looks uncertain and risky to other investors. This causes the individual investor to rethink his or her original plan to buy the

security and the investor eventually ends up changing the original plan. The end result is that the final decision of the investor is based on the opinions of other investors so a number of other opinions change the original decision into another decision. This has certainly happened to many investors and it is often very challenging to reject the opinions of others completely. It is natural that we want to know the opinions and decisions of others and in many cases they inevitably affect us.

Every single financial crisis has highlighted herding again and again. The 2001 Recession, the IT bubble, the 2008 Financial crisis and the European sovereign debt crisis have shaken global financial markets and the effects of the crises have been felt to this day. In every financial crisis, stock prices have plummeted, with a large proportion of investors selling securities at the same time and thus a large proportion of investors have lost huge sums as a result of these price drops. Herding may decrease stocks prices very quickly and detach the stock price from the actual fundamental value of the company, in which case the price will not match the real value of the stock. For years, several researchers have been trying to figure out why herding happens, because this kind of action can cause huge market disruption in both global and national markets. (Bikhchandandi & Sharkma 2001.)

Numerous researchers have studied herding from a number of different perspectives. For example, how groups with a particular set of values operate in a market, how small retail investors work in a group, how large institutional investors work in a group, and how all investors work as one entity without considering individual groups. Not all results have been consistent as it is challenging to measure the incidence of herding, and efforts have been made to develop different research methods over the years. What makes herding extremely challenging to measure and study is that it is related to psychology, to the functioning of the human mind, and cannot be measured directly.

# 3 Theoretical background

As noted earlier, herding can cause serious market disruption and in many cases irrationality is associated with herding. Herding is often seen as the opposite of the efficient market, and the theory of herding challenges the validity of numerous theories. This section covers extensively and from many different perspectives with the efficient market hypothesis, the capital asset pricing model, the three-factor model, the four-factor model, and the five-factor model.

## 3.1 Efficient Market Hypothesis

The efficient market hypothesis (EMH) is one of the most well-known theories in the financial world, but the complete validity of the theory is repeatedly challenged. The theory has its roots in the 1950s, when Maurice Kendall (1953) studied time series in the market and Kendall (1953) eventually concluded that future price movements in the market can't be predicted and prices seemed to develop randomly. Kendall's (1953) paper "The analysis of economic time series" in 1953 led to numerous other studies on the same subject and eventually became established as the term "random walk". According to Kendall (1953), security prices could rise on one day and fall on another, regardless of historical developments. Predicting prices developments seemed impossible and the study concluded that the market is well functioning, efficient and rational. According to the efficient market hypothesis, the stock market cannot be beaten because all the information related to the stocks is included in the stock prices and thus the stocks are traded at their true value. All information is available to everyone and all information is immediately passed on to stocks prices without any delay. Therefore, the market is efficient, rational and it is not possible to predict changes in market prices because as mentioned before, all available information is already included in the stock prices. Eugene Fama (1965) defines an efficient market as follows: an efficient market is a market with a high level of rationality, active competition, profit maximization, forecasting the future price of stocks, and the use of up-to-date information.

According to EMH, it is not possible to buy undervalued or overvalued stocks as stocks can only be purchased at their actual value. When the stock prices are based on the actual value of a company, all public information is available and the stock price can only be changed by new public information. (Bodie, Kane & Marcus 2009: 345.)

Consider company X. The value of company X's stock is based on the actual value of the stock and no news has been published regarding company X. The next day, company X releases information that will be interpreted as positive in the market and the company's price will rise as positive news. What if company X's price hadn't moved at all with this positive news? The market would then not be efficient because, according to the efficient market hypothesis, all available information is immediately reflected in the stock price. If the price remained stationary in the market, there would be a disruption because the available information is not conveyed to the stock price for some reason and the market could be called an inefficient market. The efficient market hypothesis does not show any disruptions in the market and the flow of information is smooth and accessible to all. (Bodie et al. 2009: 344-345.)

Fama (1965) states that the prices of individual securities reflect past events, current events, and future events that are expected to occur. In other words, in an efficient market, the trading price of a security at any given time corresponds to the intrinsic and real value of the security.

### 3.1.1 Different versions of the efficient market hypothesis

EMH is divided into three different parts, which are the weak, semi-strong and strong. The concepts are divided on the basis of the scope and strength of information available to all in an efficient market. (Bodie et al. 2009: 348.)

The weak form hypothesis allege that stock prices reflect all historical information regarding market data, trading volume and bid and ask levels. All historical information is shown at the current stock price, i.e. past events have not been ignored. As stock purchase levels are stronger than sales levels, naturally the stock price will rise and the efficient market hypothesis will continue to be valid. The semi-strong-form hypothesis assumes that all available public information about companies, both with their future forecasts and financial statements, is immediately reflected in the current stock price. In this model, information includes historical prices, fundamental data, management quality assessment, balance sheet, forecasts of future cash flows, and patents. When investors have access to such information, all of this information is reflected in the stock price. The third and final model is the strong-form hypothesis. This model claims that stock prices represent all available information, even information that is only available to corporate insiders. This model sounds rather fierce because today insider trading is restricted under strict conditions and according to this model, the information available to insiders should be reflected in stock prices. The use of inside information leads to a violation of the law and therefore the strong-form model must be viewed with critical eyes. (Bodie et al. 2009: 348-349.)

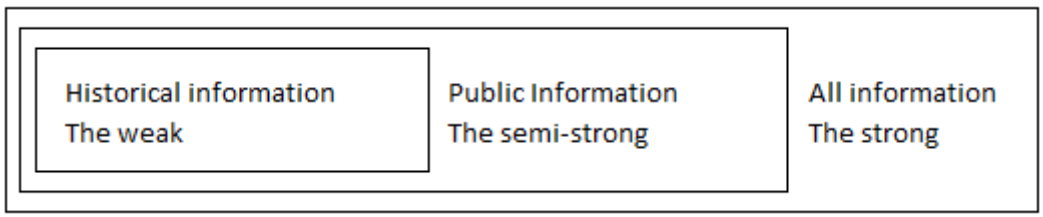


**Figure 1**: Relationship between three EMH models including information levels.

## 3.2 Asset pricing models

### 3.2.1 Capital Asset Pricing Model

The capital asset pricing model (CAPM) is one of the best-known models of financial theory that has established itself permanently in the world of finance. In 1952, Harry Markowitz introduced in his article modern financial theory, and that theory gained enormous prominence. Twelve years later, the CAPM was introduced, presented by researchers William Sharpe (1964), John Lintner (1965) and Jan Mossin (1966). The CAPM describes the relationship between a stock's expected return and risk. It is a very simple and efficient model where the main factor is a company-specific beta factor.

Figure 2 depicts the capital market line (CML) and efficient front. CML reflects a portfolio that combines risk and return, while an efficient front reflects a portfolio that represents the best possible investment portfolio in terms of return and risk. In figure 2, the Y-axis shows the expected return on the security and the X-axis shows the beta of the security. It can only be concluded that the higher the beta of a security, the higher the expected return on the security. The beta of the market portfolio is exactly one and a company with greater than one beta is a riskier investment than the market portfolio, in which case the return expectation must also be higher than the market portfolio. A company with less than one beta is again a risk-free investment than the market portfolio, which means that the return expectation is naturally lower than the market portfolio. The company-specific beta factor is thus the main driver of the CAPM model. (Bodie et al. 2009: 279-285.)

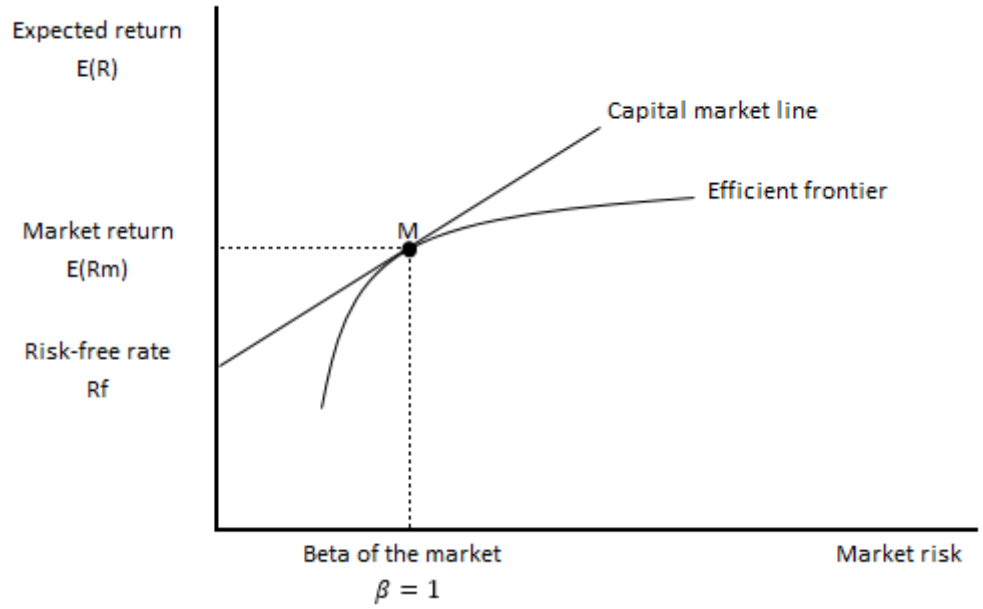


**Figure 2.** The capital market line (CML).

The CAPM equation is presented as follows:

$$E(r_i) = r_f + \beta_i[r_m - r_f]\,, \tag{1}$$

where:

$E(r_i) =$ expected return of the security

$r_f =$ the risk-free rate (for example Germany 30y government bond)

$\beta_i =$ beta of the security

$r_m =$ expected return of the market. (Fama & French 2004.)

Bodie et al. (2009) set six assumptions when examining the effectiveness and functionality of the CAPM. The assumptions are intended to simplify investor operations, making it easier to analyze certain assumptions for all investors. The CAPM assumptions are as follows:

- All investors are price-takers
- All investors have just one similar holding period

- Investors may lend or borrow money at the risk-free rate and all securities are public
- No taxes and no transaction costs
- All investors are using Markowitz's portfolio model, meaning investors are rational
- All investors have homogeneous expectations or beliefs, meaning investors think about the economy and analysing securities in the same way. (Bodie et al. 2009: 280.)

CAPM has been criticized especially for its underlying assumptions. The fact is that not all investors have the same investment period. Secondly, trading is usually subject to costs, i.e. it is not possible for everyone to trade without any costs. The CAPM describes the long-term expected return, in which case short-term returns may differ much from the return expectations of the CAP model. In the short term, volatility in particular has a significant effect on the return on a security. However, the CAPM is a well-used theoretical model because it is in the long run that the return under the CAPM roughly corresponds to the actual return on securities.

### 3.2.2 Fama and French Three-Factor Model

In the 1990s, Eugene Fama and Kenneth French developed a three-factor model which explain, as the name implies, the average returns of the securities by using three different factors. The factors are predefined and they are market (Rm-Rf), size (SMB), value (HML) and each factor has its own beta (B) factor. The market factor (Rm-Rf) is the return on the market portfolio over the risk-free return, the size factor (SMB) means the difference between the returns of a portfolio of small market and large market value firms and the most recent factor, the value factor (HML), is the return on the portfolio of value firms minus the return on the portfolio of growth firms. (Fama & French 1993.)

First, Fama and French (1993) utilized only two factors, the size factor (SMB) and the value factor (HML). However, they found that the two factors together did not nearly fully explain the results of the study, they added a third factor, the market factor (Rm-Rf). The third factor increased clarity regarding difference between the average return of the security and risk-free investment. (Fama & French 1993; 1996.)

According Fama and French (1993), the equation of the three-factor model is formed as follows:

$$R_i - R_f = \alpha_i + \beta_1\left(R_m - R_f\right) + \beta_2 SMB + \beta_3 HML + e_i\ , \tag{2}$$

where:

$R_i$ = expected return of the security

$R_f$ = the risk-free rate (for example Germany 30y government bond)

$a_i$ = estimated alpha

$R_m - R_f$ = excess return of the market portfolio

$SMB$ = the size factor (small minus big)

$HML$ = the value factor (high minus low)

$\beta_{1,2,3}$ = beta coefficients

$e_i$ = the random error variable.

### 3.2.3 Carhart Four-Factor Model

Mark Carhart (1997) continued the Fama and French three-factor model by including a fourth factor to the model, the momentum factor (UMD). In his fourth factor, Carhart utilizes the findings of Jegadeesh's and Titman's (1993). The factor is calculated by reducing the monthly momentum losers from the monthly momentum winners. The phenomenon of the momentum is based on a purely technical analysis and refers to the tendency of up trending securities to continue to rise and correspondingly, the tendency of declining securities to continue to decline. The phenomenon of momentum has been

observed in both small and large equities and the phenomenon also affects other asset classes in addition to securities. The period of the phenomenon of the momentum is usually limited to 3-12 months. If the stock has risen in the last 3-12 months, then it is expected to rise in the future as well. Similarly, if a stock has fallen in the last 3-12 months, the stock is expected to fall in the future as well. Winners will continue to win and losers will continue to lose. The four-factor model does not support the efficient market hypothesis because the momentum investor does not believe the market is completely efficient. However, this model is presented in this thesis due to the coherence of the theory. (Carhart 1997.)

The Carhart four-factor model is presented as follows:

$$R_i - R_f = \alpha_i + \beta_1\left(R_m - R_f\right) + \beta_2 SMB + \beta_3 HML + \beta_4 UMD + e_i\ , \qquad (3)$$

where:

$R_i =$ expected return of the security

$R_f =$ the risk-free rate (for example Germany 30y government bond)

$a_i =$ estimated alpha

$R_m - R_f =$ excess return of the market portfolio

$SMB =$ the size factor (small minus big)

$HML =$ the value factor (high minus low)

$UMD =$ the momentum factor (winner minus losers)

$\beta_{1,2,3,4} =$ beta coefficients

$e_i =$ the random error variable.

### 3.2.4 Fama and French Five-Factor Model

The three-factor model faced some criticism because the three factors did not explain the research results well enough. The level of explanatory was too weak and Fama and French (2015) took a booth form the critique and set out the develop and extend beyond

their previous three-factor model. Carhart's (1997) four-factor model was left in the shadows and Fama and French (2015) added two new factors to the previous three-factor model. The factors are based on the firms profitability (RMW) and the level of the investment (CMA). The profitability (RMW) factor is the most profitable firms minus the least profitable firms and the level of the investment (CMA) means firms which are investing conservatively minus firms which are investing aggressively.

The equation of the five-factor model is presented as follows:

$$R_i - R_f = \alpha_i + \beta_1\left(R_m - R_f\right) + \beta_2 SMB + \beta_3 HML + \beta_4 RMW + \beta_5 CMA + e_i\,, \quad (4)$$

where:

$R_i =$ expected return of the security

$R_f =$ the risk-free rate (for example Germany 30y government bond)

$a_i =$ estimated alpha

$R_m - R_f =$ excess return of the market portfolio

$SMB =$ the size factor (small minus big)

$HML =$ the value factor (high minus low)

$RMW =$ the most profitable firms minus the least profitable firms

$CMA =$ firms which are investing conservatively minus firms which investing aggressively

$\beta_{1,2,3,4,5} =$ beta coefficients

$e_i =$ the random error variable. (Fama & French 2015.)

Fama and French (2015) succeeded in their study and these two new factors in addition three old factors explained better the average earnings of the securities. Research results showed higher profitability lead to higher returns but in the case of small firms five-factor model did not explain the average returns. Also Fama and French (2015) were particularly interested in anomalies and the phenomenon of the momentum and actually they tried to add a sixth factor (momentum factor) but it did not bring significant added value. (Fama & French 2004; 2015.)

# 4 Literature review

## 4.1 First assesments

This section focuses on the first observations and studies of herding behaviour in the financial markets. The section presents the researchers who were the firsts to find indications of the prevalence of herding in the financial markets and its different manifestations.

*”It is not a case of choosing those that, to the best of one’s judgement, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees.”* (Keynes 1936)

Herding has been actively studied throughout the millennium 2000 and its roots go back to the 1990s, when the first studies were published on herding behaviour in the financial markets. In fact, it can be said that signs of herding were already seen in the 1930s when John Maynard Keynes studied stock market price fluctuations in 1936. Keynes (1936) used the name “Keynesian beauty contest” which describes a beauty contest where judges are rewarded for choosing the most famous faces of all judges, rather than the most beautiful ones they can personally find.

Keynes (1936) believed that people think this way in the stock market as well, meaning that investors do not price stocks on the basis of their true value, but rather price stocks on the basis of what other investors believe the value of stocks in the market is. According to Keynes (1936), an investor believes that the value of a stocks is therefore based on the projected value of other investors. Keynes’ (1936) observation was important, since the theory contrasts with the efficient market hypothesis.

Referring to the above mentioned, herding was first properly investigated in the 1990s. Froot, Scharitein, and Stein (1992) are among the first researchers of herding behaviour, and their research shows that speculative investors tend to use the same information that other speculative investors use when the investment period is short.

Banerjee (1992) studied herding with different methods in a very practical way. Everyday examples related to the occurrence and intensity of herding were used in the study. Consider a situation like this: suppose there is a restaurant A and a restaurant B. You are going to eat and you are thinking between the restaurants A and B. Both restaurants are next to each other and the restaurants are the same size. Restaurant A has 30 people while Restaurant B has only five people. So you decide to go eat at Restaurant A because there are more people there, so you think it's a better place than Restaurant B. Is Restaurant A actually a better place? Or do the people in the restaurant mislead other people and can restaurant B still be a better place than restaurant A? At some point in each restaurant there have been the same number of people, someone has decided to go to restaurant A, when there have been more people there, and this creates a chain when others also start going to restaurant A, making the gap grow even greater. Thus, human behaviour is either rational or irrational and it leads to efficiency or inefficiency. (Banerjee 1992.)

Other notable researchers of herding in the 1990s were Bikhchandani, Hirshleifer and Welch (1992) and Lakonishok, Shleifer and Vishny (1994).

There is no single specific definition for herding, herding includes numerous different definitions with their different manifestations. However, it can be generally accepted and stated that herding is related to social behaviour where personal intuition is rejected and it is decided, perhaps even unwillingly, to follow other information and thus join another larger group (Bikhchandani et al. 1992).

Lakonishok et al. (1992) examines US pension funds from two different perspectives: whether fund managers buy (sell) shares at the same time as other fund managers buy (sell) and the effect of positive feedback, which means buying winners and selling losers. Studies show that strong herding does not occur among pension fund managers and trading based on positive feedback cannot be generalized based on results. Only among the small stocks was strong evidence of feedback-based trading found. Finally, based on the data and the results, it can be stated that large institutions do not herding among institutional investors. (Lakonishok et al. 1992.)

Herding is one of numerous manifestations of irrationality and has been argued to be one of the forms of investor behaviour in the stock market. Thus, herding can be thought to lead to a deterioration in market efficiency and securities prices deviating from their actual fundamental value. (Devenow & Welch 1996.) From this it can be concluded that this type of activity leads to great buying and selling opportunities for securities, which some investors are able to take advantage of.

Herding behaviour has been studied a lot but a few studies (Christie and Huang 1995; Chang, Cheng & Khorana 2000) have risen to particular value. Christie and Huang (1995) examines herding in extreme market conditions. Chang, Cheng and Khorana (2000) studied herding activity internationally, with market areas including the US, Japan, and South Korea, and the results are very interesting. First, macroeconomic information is more important to investors than company-specific information. Second, no herding occurred in the US and Hong Kong, while partial herding was observed in Japan. Third, strong herding was observed in emerging markets in Taiwan and South Korea. Research shows that the less information investors have, or the less information-conscious investors are, the more herding occurs. Rationally speaking, this makes sense because when information is scarce, investors may find it easier to buy (sell) securities than any other larger group of investors buys (sells). (Chang et al. 2000.)

Economou, Kostakis and Philippas (2011) were inspired for their study from the Financial crisis of 2008, when the market collapsed dramatically. Economou et al. (2011) studied four southern European stock markets over a ten-year period, with a particular focus on the 2008 Financial crisis. Significant results were found in the Greek and Italian stock markets and herding was found to be stronger during the high volatility market days (Economou et al. 2011.) Zheng, Li and Zhu (2015) the study showed the intensity of irrationality. They observed herding in emerging markets and found irrational herding to lead to anomalies in the stock market in the short term.

Economou, Hassapis and Philippas (2018) results show herding in the UK market during the 2008 Financial crisis and found that herding in one market may also be affected by the functioning of other markets, making herding global. Lodha and Soral (2020) study covered 14 years of data targeting the US and India. The researchers used daily data and no signs of herding were found, despite the fact that herding was studied in extreme market conditions, both in the rising and falling markets.

## 4.2 Different forms of herding

Herding is typically divided into two different categories: rational and non-rational herding. Both categories have certain features that stand out above the others. However, it is also good to remember that both rational and non-rational herding have similar characteristics and sometimes it is very difficult to distinguish between the two categories. An action may seem rational to others even though those who perform the action think it is non-rational.

### 4.2.1 The rationality of herding

In the banking world, market liquidity management, information acquisition and maintaining one's reputation are the situations where rational herding occurs (Devenow & Welch 1996). Investors are constantly thinking about their own reputation and success

and comparing themselves to other investors. Some investors may value other investors specifically on the basis of return, risk appetite, or avoiding large losses through smart allocation changes in the investor's own portfolio. Herding can be seen as a form in which investors want to join as part of a large group because when a group fails, failure doesn't feel so bad compared to failure alone (Yahyazadehfar, Ghaykhloo & Sadeghi 1985). Action like this may be rational or irrational. Is it rational action to reduce possible self-repentance if a person makes a wrong choice. Or is this kind of action irrational, where you play on the so-called safe and not listen to your own feelings and decide to join as part of a larger group.

We often think that rational herding refers to situations where the investor has little information about the security and is better to follow the market. Imagine a situation where you are thinking of buying a certain security. You have researched the security to some extent but you think your knowledge is not sufficient. However, you want to invest your money somewhere because you want a return on your investment. Due to a lack of know-how, you decide to invest in a global well-diversified fund that is a safe target and a very common investment target among investors. This kind of activity is a rational activity because of the lack of information, it makes more sense to follow the market than to take a big risk and invest in a security for which you don't have much information.

In the banking literature, herding is often seen as a purely negative phenomenon that leads to undesirable situations. Banking crises, credit crises, currency crises and various regulatory changes are discussed for a long time afterwards, and if no sensible and solid explanations for the crises can be found, usually herding is seen as the cause of the crisis. (Reisen 1999.)

Peter Haiss (2010) examined in his study rational herding in the banking sector and the reasons that led to herding among bankers. Haiss (2010) notes that there are numerous reasons for rational herding, especially when looking at the banking sector and related issues. The main reasons are the preservation of the banker's personal reputation, the

structures of the bonus systems and the information cascade. These three main reasons are next going through one at a time.

The banking world is known as a challenging industry where the pressures of success are constantly present. There may be uncertainty among investment managers regarding the selection of the right security, and the uncertainty will ultimately result in the investment manager deciding to play it safe and following other investment managers in selecting the security. Own personal and original decision may be ignored and it is decided to make a similar investment decision as other investment managers do. An unprofitable decision is not so bad for reputation when others make the same mistake. So whether the decision was good or bad, one's own reputation is secured by joining among others to make the same investment decision. Keynes (1936) states: ”it is better for reputation to fail conventionally than to succeed unconventionally”. (Haiss 2010.)

Investment managers are usually paid bonuses for their performance, which is measured, among other things, by the portfolio's return percentage. Performance is compared to other competing investment managers who follow broadly and generally similar investment strategies (Rajan 2006). This type of activity can distort the herding of investment managers and lead to herding because the investment manager has an incentive to follow other investment managers so that the performance of their portfolio is as close as possible to the benchmark and thus the personal bonus is secured. Kirkpatrick (2009) notes that remuneration schemes for commercial bank managers are increasingly based on performance and that bank managers are therefore increasingly vulnerable to herding. (Haiss 2010.)

An information cascade is a process broadly similar as herding has had significant implications for the financial world. This type of activity may occur when uncertainty emerges in the market (Bikhchandandi et al. 1998). Uncertainty refers to the accuracy of the information available, which results in the decisions of other actors being monitored and ultimately, one's own personal information being ignored. It is good to avoid activities

like this, and by identifying and avoiding activities like this, you can make better financial decisions in your own life. (Haiss 2010.)

Over the years, people have identified various financial crises with rapid and major stock market drops that have caused a dramatic thousand in the financial sector for a longer period of time. As the crisis strikes, panic spreads rapidly, investors panic and uncertainty escalates globally. When stock prices declines begin, it is extremely difficult for an investor to know how large a price drop is. When the drop starts, it's worth selling your shares or is the drop just stopping and it's good not to do anything at all. Rational herding can be defined as an activity in which an investor sells securities at the start of a fall in the price if the fall continues for a long time. Something has caused the market to change rapidly as stock prices start to collapse, the investor jumps along with the rest of the market as they start selling their own securities and possibly avoids larger losses by selling their securities as soon as the fall begins. This type of behaviour is very common in many crises, and such behaviour can therefore be considered rational. The form of rational and irrational herding is sometimes extremely difficult to determine because in certain cases the activity may reflect both rational and irrational activity.

### 4.2.2 The irrationality of herding

Herding is one of many forms of irrational behaviour, and irrational herding is often brought up when talking about investor behaviour in the stock market (Devenow & Welch 1996).

Fama (1965) considers the market to be efficient and highlights a market where the availability and flow of the information is perfect. Fama's (1965) theory has been challenged throughout history because according to his theory, the collection of information is of no use and all available information is transmitted to stock prices. However, Fama (1965) notes that not all investors should be rational based on the efficient market hypothesis. A small number of investors can act irrationally if it is assumed to be random. The

activities of other irrational investors are overturned by the irrational activities of other investors, so after all, such activities have no effect on the prices of the securities (Fama 1965). Whether effective market or not, irrational action occurs. The different thing is how strongly irrational activity occurs and in what kind of market, the activity can have extremely serious consequences in the stock market.

Fama's (1965) description is based on an ideal world and in reality, investors are guided by their feelings and emotions, which occasionally makes them behave in very unexpected irrational ways (Shiller 2003). According to Shiller (2003), behavioural finance tries to answer why people do not always act rationally and thus the market is sometimes inefficient. Psychological factors play a huge role in people's actions and through that they also affect the financial markets. Human is unique and diverse and it is almost impossible to predict the behaviour of an individual in the financial markets. Shiller (2003) notes that taking into account psychological factors could help to better identify herd behaviour in financial markets and then help predict or possibly even prevent future financial crises that have originated from herd behaviour in investors.

The hypothesis of rational economic thinking assumes that investors have clear preferences and views. In reality, the number of rational investors is limited in the market and there are noise traders in the market. In the worst case scenario, noise traders 'investment behaviour could lead to large asset price fluctuations in the stock market and cause a series of price deviations. Activities like this cannot be explained by traditional financial theory.

Prast (2000) found cognitive psychology to have a significant effect on irrational herding. Shiller (2015: 165-166) says that irrational herding is based on investor psychology, where the investor makes an unconscious and unintentional decision. These types of investors can cause sudden changes in stock market prices and according to Shiller (2015), irrational investors are prone to make bad, quick, momentary decisions that are largely based on a purely lack of information. Irrational investors are guided by the

direction of the market, meaning that when the market falls, an irrational investor sells his securities for fear of the fall continuing. For an irrational investor, a lack of information can in some cases lead to the sale of the entire portfolio, panic affects the investor so strongly that the investor no longer thinks rationally. It may be a moment's stronger-than-normal decline, and when an irrational investor has no more information, he believes the decline will continue, realize his securities, and then realize that the decision was made very quickly without its heavier know-how. An irrational investor is so strongly guided by the investor's own feelings and emotions that the feeling goes beyond reason and investment decisions are made on a whim (Shiller 2015: 165).

The combined effect of the behaviour of irrational investors can be extremely strong in the market, and the behaviour occasionally provokes debate. Over the years, the stock market has seen various abnormal situations in which the share price either rises or falls very sharply. The changes have been extremely rapid, while sparking a debate about the power and influence of herd behaviour in the stock market. The action has been irrational and often based on so-called dumb money. Dumb money refers to money that a group of people use in the market to buy or sell securities at the wrong time. Dumb money group does not have access to securities analysis, in-depth market information or other relevant information about the market and thus this group makes stock trades based on instinct. Dumb money group buys securities at high prices and sells at low prices, so they act contrary to what financial theory teaches. The dumb money group is in a hurry to put money on the market without a more in-depth analysis of it.

February 2021 saw a chain of events in the stock market that has not been experienced before in history. The share price of the US company Gamestop had been trading between $ 10-40 for a long time. Then something happened that no one could explain immediately. Gamestop's share price was $ 39.12 on January 20, 2021 and exactly one week later the price was $ 347.51 per share. The share price had thus increased almost ninefold in just a week and the company had not provided any new significant

information about its business or information that should affect the value of the company. (Financial Times 2021; New York Times 2021.)

The market was very confused by what happened in the market and the reasons began to be sought. A group on the forum called Reddit's wallstreetbets proved to be the cause of the rise, and small investors had bought a number of the company's shares with the intention of flicking on hedge funds. A hedge fund is an investment fund that seeks to increase its value regardless of the market situation, even when the prices fall. The large hedge funds had shorted the Gamestop stock for big money because they were confident of a decline in the share price, as the outlook for the loss-making company was really weak. A short selling refers to a situation where an investor lends a share, sells it on the market hoping for a fall in price and later buys the share back to himself at a price lower than the investor's original selling price and returns the borrowed share to the lender. The difference between the sale and purchase price is the investor's profit. As a result of the rise, the hedge funds had to close their positions according to the rules, buy the shares back for themselves at an extremely high price, and thus the hedge funds realized huge losses. About a week ahead of the stock's peak, Gamestop's stock price was $ 53.5 per share on February 4, 2021. In a week, the share price had almost increased ninefold and from this week onwards the share price had plummeted to almost pre-rise levels. During the two weeks, huge volatility in the share price was experienced. (Financial Times 2021; New York Times 2021.)

One can assess the previous situation in more detail from a herding perspective by dividing the situation into two parts: the rise and fall of the stock. Behind the stock rise was a huge group of small investors who had gathered together on a discussion forum and joined forces. The rise in the stock was not based on any fundamentals factors of the company, it was based on the idea of driving institutional hedge funds into trouble and maximizing their losses. Thus, it can be said that the operation of small investors in the herding was partly based on rational activity and dumb money shifted to the hedge funds. As the rise progresses, there is growing speculation that investors will see new

opportunities to raise the share price even higher. As the Gamestop's stock price rose, many investors who were not familiar with the market woke up to the rise in the stock and more and more investors began to buy Gamestop shares at a very high price. At this point, many private investors thought that the stock has risen so much that you also have to earn something yourself and get in to the rise. Eventually, Gamestop's share price plummeted almost as fast as it rose and numerous investors suffered large losses. Indeed, irrational activity was strongly present at the peak of the stock's rise as small investors diligently bought the stock without knowing the true fundamental value of the company and thought the purchases would enrich as quickly as those who previously become shareholders. The power of herding is well observed in this situation, and herding may be both rational and irrational at the same time. (Financial Times 2021; New York Times 2021.)

## 4.3 Overconfidence of herding

Psychologists have found that overconfidence causes people to overestimate their skills and knowledge, to exaggerate their ability to manage change, to underestimate potential risks, and to behave emotionally (Baker & Wurgler 2002).

In Sweden, a one famous study was conducted in which drivers assessed their own driving skills compared to other drivers. As a result of the survey, 90% of drivers considered themselves as better than average drivers. Such overconfidence is also often the reason for overactive investing, where one's own ability is overestimated and risks are underestimated. It is thought that active trading wins the market and, as a result, makes a profit. (Bodie et al. 2009: 386.)

Theoretical models predict that overconfident investors will trade more actively than usual and previous psychological studies show that men are more confident in the financial markets than women. As a result, men are also more active in trade than women. Barber and Odean (2001) investigated this claim by dividing investors into men and

women. Barber and Odean (2001) used trade data from more than 35,000 households from the period 1991-1997. They found that men traded 45% more than women and as a result of higher activity, men's income lagged behind women's income. Too much trading thus led to lower returns and weak portfolio performance. 20% of the most active investors performed with 7% lower returns compared to 20% of the least traded investors. As a survey result: the higher the activity, the lower the return. In conclusion, the researchers state: "trading is hazardous to your wealth". (Barber & Odean 2001.)

Investors with overconfidence think they have a better understanding of how the financial market works. In 1982, Alpert and Raiffa found persistent overconfidence among investors and found that investors actively take more risk as opposed to rational thinking. As a result of overconfidence, investors often ignore the truth and believe stock prices follow a certain formula.

According to the efficient market hypothesis, stocks follow a random walk, meaning that historical market events cannot be used to predict future price movements. In 1982 study, the results contradict the efficient market hypothesis and, according to the study, excessive self-confidence leads to a delusion in which investors misunderstand and misread the market. (Alpert & Raiffa 1982).

## 4.4 Regret avoidance

Psychologists have found that individuals who make bad investment decisions regret their decisions more than others when it has been a more unconventional investment decision. It is important for the investor to understand the regret avoidance theory and how it affects an individual's investment decisions. Regret theory can have either a positive or negative effect on an investor's performance. According to the theory, the investor becomes either a risk averse or a risk lover.

For example, investing in a blue-chip portfolio that ends up performing negatively is not as bad an investment decision as investing in a start-up company that also ends up performing negatively. Investing in a well-known and researched stock is safer than investing in a riskier and less well-known stock. Even investing in a blue-chip stock fails, the investor does not experience so much regret because many others have invested in the same stock and numerous other investors in addition to the investor have failed in their investment decision. Failure doesn't bother you so much when you've failed along with others. However, regret avoidance theory may also have a negative impact on the investor in some cases. Imagine a situation where an investor has researched a small growth company and has considered investing in that company. The investor is aware that the investment is risky because it is a fairly new company, there is not much information about that company, the future outlook is based very well on the long term of the future and the company's stock turnover is very small on the stock exchange. According to regret avoidance theory, an investor may abandon his original plan, the investor will not invest in a risky growth company but will end up investing in a safe globally diversified index that is well known and common among a larger group of investors. Even if a risky growth company has risen more than the index, the investor loses returns and, according to regret avoidance theory, ends up with a negative outcome because the investor has abandoned his intuition and initial investment plan. (Bodie et al. 2009: 385-387.)

## 4.5 Reputational herding

Scharfstein and Stein (1990) were the first to introduce reputational herding. The basic idea of the theory is that when an investor is uncertain about his or her own investment decision, the investor chooses a safe path and follows the investment decisions and strategy of investment professionals. According to the theory, the investor reduces the potential negative impact on his personal reputation. (Scharfstein & Stein 1990.)

Reputational herding occurs in analysts' forecasts. Young newly started analysts in particular are under enormous pressure to succeed in their work, and Trueman's (1994)

study shows that analysts tend to write forecasts that are broadly similar to those previously published by other analysts. Trueman (1994) notes that reputational herding occurs especially among young junior analysts. Senior analysts notice imitation of junior analysts and also active and highly knowledgeable investors are aware of reputational herding in analyst forecasts (Trueman 1994).

Imagine you have just started as an analyst and your job is to follow the company X. You do an analysis of the company, see the company's future outlook as positive and give company X a buy recommendation at target price Y. Just before publishing your forecast, you read other analysts 'forecasts for the same company X and find that their predictions differ greatly from your own view. Other analysts predict a decline in the price, set the new target price below the current market price of company X, and issue a recommendation to the stock to sell. What are you doing in this situation? Whether you publish your original forecast as is or decide to discard it by following other analysts and rewriting your forecast based on other analysts' forecasts.

Referring to the previous one, Haiss (2010) studied herding in the banking sector and one of the three main reasons for herding was the preservation of the banker's personal Reputation. Haiss's (2010) study shows that investment managers working in the banking sector resort to on reputational herding securing their own position in the labour market. In that study, the actions of investment managers are rational because, by maintaining and maintaining their own personal reputation as best as possible, investment managers are allowed to continue in their work and livelihoods are also secured in the future. From the point of view of investment managers, the action is rational, from another perspective it can be irrational, and in the bigger picture the action can be both rational and irrational.

## 4.6 Herding of the retail and institutional investors

A very large proportion of behavioural finance research focuses on the study of institutional fund managers. After all, institutional fund managers have huge investment portfolios under their control, and the influence on market movements among fund managers is significant. The first of the major studies on this topic is a study published by Shiller and Pound in 1986, which examined the intensity of herding of institutional investors.

The models needed to study herding in the financial market had not yet been developed at that time, as the first relevant models were not invented until the 1990s. Shiller and Pound (1986) composed a kind of questionnaire that included various questions with the aim of trying to observe herding and the intensity of its occurrence among institutional investors. The questions sought to answer how many of the institutional investors acted systematically, how communication affected investors' actions, and how different stimuli were reflected in investors' decisions. Researchers used the term "word of mouth investing," which refers to the impact of other speeches on one's own investment decisions. This is a very common thing you hear every day in the world: directions talk to each other every day about different investments, and when we listen to others, the speeches affect at least some of us in at least some way. The results of the study show that herding occurs among institutional investors and it is therefore extremely challenging to believe that institutional investors would be immune to the speeches of others. (Shiller & Pound 1986.)

Lakonishok et al. (1994) found that retail investors want to think and believe for themselves that past returns are also a good indication of future returns. If prices have risen, they will continue to rise in the future. This kind of thinking reinforces momentum phenomena, and herding has been found to have a significant effect on various market phenomena, such as momentum phenomena. (Lakonishok et al. 1994.) Sirri and Tufano (1998) found that retail investors lean on positive feedback trading, meaning that the behaviour of private investors is biased. Retail investors buy securities when stock prices rise and sell securities when stock prices fall.

One of the best known and most cited papers has been written by Nofsinger and Sias (1999) where they study the herding of institutional and retail investors. The two main points of the study are herding and trading feedback. Trading feedback is divided into two parts: positive and negative feedback trading. Positive feedback trading refers to a trading strategy in which investors buy securities when prices rise and sell securities when prices fall. Negative feedback trading is the opposite of positive, meaning that in negative feedback trading, investors sell their securities when prices rise and buy securities when prices fall. Feedback trading has been a researched topic, it has been observed globally in both developed and emerging markets, and most studies have found more positive than negative feedback trading. (Nofsinger & Sias 1999.)

“Herding and feedback trading have the potential to explain a number of financial phenomena, such as excess volatility, momentum, and reversals in stock price” says Nofsinger and Sias (1999). They see a clear positive association between institutional ownership shifts and returns over the same time span. The findings suggest that institutional investors engage in more positive-feedback trading than individual investors, or that institutional herding has a greater impact on prices than individual herding. Both factors appear to play a role in explaining the relationship, according to the evidence. In addition, institutional herding tends to be linked to stock return momentum and is positively associated with lag returns. (Nofsinger & Sias 1999.)

Choi and Sias (2009) examined industry herding in the US as a target group for institutional investors. They found that institutional investors were following each other in the same industries and in some cases also left a particular industry if other institutional investors also left the same industry. Institutions are more likely to follow similar institutions of the same size class as institutions that are very different from each other. The study shows that the herding of institutions influences market prices and the effect is clear and significant as the study shows strong industry herding among the institutional investors. (Choi & Sias 2009.)

Burghardt (2011) argues that institutional investors are guided by their profession and are dependent on the programs they use to invest. Various market analyzes, information retrieval programs, theoretical models, and rules guide professional institutional investors and thus market sentiment are not so strongly influenced. However, the information available to retail investors is limited, new information is difficult to analyze, one's own abilities are not trusted enough, and in the end one is forced to invest with the market, rejecting one's own original investment ideas. Burghardt (2011) argues that the "free riding"-issue exists among retail investors. His research shows that retail investors show strong herding and Burghardt (2011) states: "More than 10% of all investors than expected by chance are on the same side of the market each day". An interesting finding is also that among retail investors, herding is stronger in a bear market than in a bull market. Institutional investors have the power to control the market and by controlling the market, institutional investors get some of the retail investors to operate in the herd of retail investors following the direction of the market. (Burghardt 2011.)

## 4.7 Asymmetric herding

Christie and Huang (1995) states that herding is asymmetric because it occurs differently in both up and down markets. People are innately greedy and many people want everything as fast as possible. The herding in the stock market is due to the fact that investors want as much profit as possible, as few losses as possible, and this type of activity is further emphasized in the up and down markets. (Prechter 2001.)

### 4.7.1 Herding in rising and falling markets

Herding occurs mostly in rising markets and thus herding plays a significant role in the trend towards price overvaluations, notes Christie and Huang (1995). They study the prevalence of herding in different market situations and find that herding occurs when

there are rapid and large movements in the market prices. Under normal market conditions, the incidence was not significant. (Christie and Huang 1995.)

Prechter and Parker (2007) finds that retail investors buy securities in an upturn market and sell securities in a downturn market. Investors think that their actions reduce their overall risk by following the general direction of the market. In reality, investors' risks increase, investors misinterpret the risk and increase the risk even more through their actions. (Prechter & Parker 2007.) Tan, Chiang, Mason and Nelling (2008) examined Chinese A-share and B-share stocks for the period July 1994 to December 2003. Chinese A-share stocks are mostly owned by domestic investors and Chinese B-share stocks are again mostly owned by foreign investors. Herding was observed in both share series in both the up and down markets. A-share investors engage in herding more during a rising market and high volatility, while no asymmetric herding was observed among B-share investors. The performance of B-share investors in the herd was similar in all market situations. (Tan et al. 2008.)

Goodfellow, Bohl and Gebka (2009) studied the Polish stock market by dividing investors into retail and institutional investors. Retail investors practice herding during bear markets but not as much during bull markets. Herding occurs during both bull and bear markets but it is clearly stronger among retail investors during a declining market. Among institutional investors, the researchers did not observe any herding at all. According to this, institutional investors thus operate rationally in accordance with the efficient market hypothesis. In summary, there are different types of behaviour between two different groups on the same stock exchange and the findings of the study are in line with Burghardt (2011). (Goodfellow et al. 2009.)

### 4.7.2 Herding under extreme market conditions

Bikhchandani and Sharma (2000) argue that consciously following the actions of others will lead to increased volatility, market vulnerabilities, various crises and further strengthening of different momentum phenomena.

Strong ups and downs market movements are momentary, but their consequences will be felt even years later. Various stock bubbles have been observed over the years but even bubbles always explode at some point because the market does not rise forever without a fall. There are even quite long periods in which assets are either undervalued or overvalued but eventually the valuations return to their actual values. The speculative market is experiencing stock bubbles and the collapse of bubbles as a result of the formation of bubbles. The activities of speculative investors are somewhat reflected in herding in extreme market situations, and herding is mainly explained by three reasons. First, investors ignore common sense and act irrationally; second, investors follow other investors and incorporate other investors ’information into their own investment decision; and third, investors fear their reputation will deteriorate, so they will monitor the market and reduce their risk with a loss of personal reputation. (Lux 1995.)

Numerous studies have focused on the stock market and specifically on specific stock indices. Gleason, Lee, and Mathur (2004) deviate from the mass and use industry ETFs as their data, utilizing traditional regression models. Their results show that herding did not occur during extreme market conditions. (Gleason et al. 2004.)

In extreme market situations, high-quality market analysis is overshadowed and emotions, mood and greed take over, notes Fenzl and Pelzmann (2012). Herding takes a very strong position and in extreme market situations, the market is ultimately driven by a group of investors. Findings regarding the capture of investors ’emotional power are in line with Prechter (2001). (Fenzl & Pelzmann 2012.)

Keasey, Mobarek and Mollah (2014) study country-specific herding in the European market. They used the main stock indices from Central Europe, the Nordic countries and the PIIGS countries as their data. The data period is from 2001 to 2012. Portugal, Ireland, Italy, Greece and Spain were the worst victims of the euro crisis and together they form the acronym PIIGS. Measured throughout the period, no herding was observed, but during the euro crisis and asymmetric periods, strong and significant herding was observed. The herding effect varies across countries as in some countries it is stronger than average during the euro crisis. Herding also seems to be influenced by the actions of regulators and the fear of investors in an unstable market situation. (Keasey et al. 2014.)

Clements, Hurn and Shi (2017) published a study called "an empirical investigation of herding in the US stock market ", which examined the prevalence of herding in the Dow Jones Industrial Index over the reference period from January 2003 to September 2016. They extended the traditional herding regression method with the Granger causality test and the results differed from the results of previous studies. Clements et al. (2017) found evidence for the prevalence of herding during different crises. The 2008 Financial crisis, the eurozone debt crisis, and the 2015 Chinese stock market crisis had a strong impact on the global economy, and they observed strong herding in all three of these crises. The results differ mainly from other studies as in the past, little evidence of the prevalence of herding has been observed in the US stock market during the same time period. The most likely reason for this is that other studies have used traditional regression methods and in this study the regression method was extended. (Clements et al. 2017.)

# 5 Data and descriptive statistics

## 5.1 Data

In this thesis, all the data is collected from the Thomson Reuters Datastream. The study uses data from the US and German stock market in order to measure herding on these specific markets. The data includes two major stock indices: Dow Jones Industrial Average index for the US stock market and DAX for the German stock market.

The Dow Jones index consists of 30 major US companies. As the name implies, the index was created with the original purpose of making it easier to track the price of industrial stocks in the US stock market. The main focus is still on industrial companies, but other companies have also been included in the index over the years. The weights of the shares in the Dow Jones Index are determined by their share price. As the index is a price-weighted index, the higher the share price, the higher the weight of the share in the index. The DAX 30 index, which consists of the 30 largest companies in terms of trading and volume on the Frankfurt Stock Exchange, is a market value-weighted index, meaning shares are weighted according to the market values of the companies. With Germany being the largest single economy in Europe, the DAX index is a well-monitored and influential European index. The DAX index is the most followed stock index in Germany and is often compared to the Dow Jones index.

All returns are in the local currencies: Dow Jones-index in US dollars and DAX 30-index in euros. The sample period used is from January 2000 to December 2020. There are 30 stocks per index in both indices, but it is important to understand that there have been changes in the indices over the past 20 years. Some stocks have been removed from an index and new stocks have been added to an index so that the total number of stocks in the index is 30. As a result of the changes, it has been decided to proceed as follows: stocks that have been in the index, but are no longer in the index on the last day of the review period on 31 December 2020, are given the average value of the market portfolio.

The total number of observations is 5284 in the US market and 5330 in the German market. The difference between the two figures is due to a number of different factors: the main reason is national holidays (when the stock market is closed), which vary between the two stock markets.

The daily return on stocks has been calculated using the daily closing prices of the stocks. The daily return is calculated using the following formula:

$$R_t = 100 \cdot (log(P_t) - log(P_{t-1})) , \quad (5)$$

where:

$R_t$ = change in stock/market index daily closing price

$P_t$ = stock/market index price at time t

$P_{t-1}$ = stock/market index price day before

## 5.2 Descriptive statistics

Table 1 describes descriptive statistics for daily CSAD and market returns for US and Germany stock market. The sample period is 1.1.2000 – 31.12.2020 and there are 5284 observations for the US and 5330 observations for the Germany. First, analyzed the CSAD values and then the market return values.

The German maximum value for the CSAD measure is significantly higher than the US but the minimum value is almost the same in both markets. The higher value in Germany is interesting and it will be interesting to see how it affects the results of the study. Mean and medians values are close together. Together, they range from 0.791 to 0.954, and both the highest mean value and the lowest media value belong to the US. The standard deviation ranges from 0.538 to 0.604 and this figure is in line with other studies which studies the same markets. Kurtosis is above 11 in both markets, suggesting that returns

are not normally distributed. Skewness is positive for both CSAD values and also skewness indicate that stock returns are not normally distributed.

Next, we will go through the descriptive statistics for the market returns. Statistics are amazingly quite similar in both markets. Although the target markets turns on the Atlantic side and vice versa, the statistics are still almost identical. The market return is -13.842 (minimum) and 10.764 (maximum) for the US and -13.055 (minimum) and 10.797 (maximum) for Germany. Large daily losses and gains have been experienced during crises. When a crisis breaks out, the market plunges, but in many cases the direction changes quickly, and thus the rise following a decline can be very sharp. This was the case during the 2008 Financial crisis, when market volatility was very high. An interesting finding is the large difference in German kurtosis value compared to US. The US kurtosis value of 13,032 indicates that returns are not normally distributed and the German value of 5,740 tells the same thing, but the effect is stronger for the US.

**Table 1.**

Descriptive statistics.

| Market | US | | Germany | |
|---|---|---|---|---|
| | CSAD | Rm | CSAD | Rm |
| Mean | 0,954 | 0,019 | 1,111 | 0,013 |
| Median | 0,791 | 0,051 | 0,943 | 0,076 |
| Minimum | 0,223 | -13,842 | 0,299 | -13,055 |
| Maximum | 6,497 | 10,764 | 11,120 | 10,797 |
| Standard Deviation | 0,538 | 1,208 | 0,604 | 1,491 |
| Kurtosis | 11,304 | 13,032 | 11,100 | 5,740 |
| Skewness | 2,545 | -0,377 | 3,309 | -0,165 |
| No. of observations | 5284 | 5284 | 5330 | 5330 |

Descriptive statistics of daily cross-sectional absolute deviations (CSAD) and daily index market returns (Rm) for the Dow Jones (US) and DAX (Germany).

The sample period is 1.1.2000-31.12.2020.

Figure 3 describes the historical stock returns for the US and German markets during the study period. The 20-year data is extremely interesting because it contains many crises whose effects on market prices are very clear. The current century includes the IT crisis,

the 2008 Financial crisis and the eurozone debt crisis. Also in the spring of 2020, an extremely large market movement was experienced when stock prices plummeted within a short period of time. Behind all this, we were all surprised by the Covid-19 virus, which was something completely new, many countries went to total lock down and the economy contracted sharply. The future was shrouded in obscurity, no one knew how long the state of emergency would be and when countries would begin to open their borders. The Dow Jones came in from just under 30,000 points to under 25,000 points in just about a couple of weeks. At the same time, in Germany, the DAX index fell from just under 14,000 points to closer to 10,000 points. The market movement was extremely fast and strong and no one could expect such a market movement.

The IT crisis experienced in the early 2000s is still remembered today. Technology stocks rose extremely fast at the turn of the century and valuation figures broke three-digit figures. The rise was followed by a sharp decline: the German DAX index fell more than two-thirds from its 2000s peak in about three years. The decline was huge and although the decline started in the US, the US Dow Jones index fell by only about 10 per cent in the first three years of the 21st century. The main reason for this is that the Dow Jones is an industry-focused index. Germany, which experienced a larger drop during the IT crisis, should be more vulnerable to herding. The Financial crisis of 2008 affected both indices to the same extent: within about a year, 30-40 per cent of the index values disappeared. With the drop so large, both markets are extremely vulnerable to herding at that time. It will be interesting to see from the results of the study whether herding occurs during such large market declines. As the crisis calmed down, both indices started to rise at the same pace and no major differences were seen in terms of recovery. The eurozone debt crisis in the 2010s had very little impact on the US market while the German market experienced a clear drop in stock prices in 2011. This is understandable as the debt crisis started in Europe and as Germany’s largest and most significant economy in Europe, the impact on Germany is naturally significant.

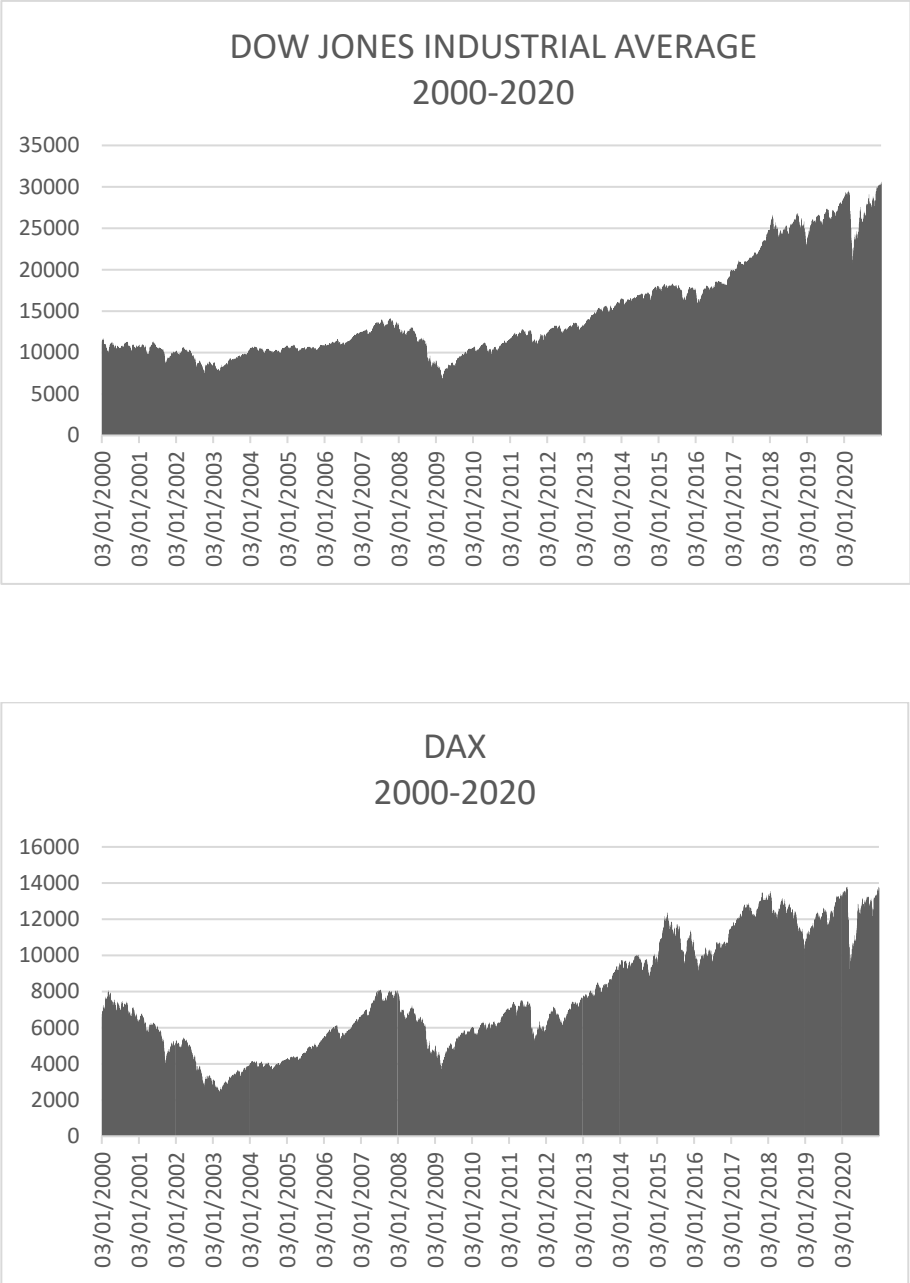


**Figure 3.** Historical stock market returns for the Dow Jones and DAX.

# 6 Methodology

This study examines herding in the US and German stock markets. Bikhchandandi and Sharma (2001) describe herding as a movement of a group of investors based on previous decisions of other investors. An individual investor rejects his or her own initial decision and decides to make a decision similar to that of other investors, thus overturns the investor's original plan (Bikhchandandi & Sharma 2001). The timeline of the study is the first twenty years of the 21st century, and this period accommodates numerous interesting financial crises with different natures and consequences. In both indices, 20-year data are divided into annual periods, and crises are specified from the data. Also, it will be interesting to see whether herding occurs in a particular year.

The purpose of the study is to investigate whether there is a herding in the US and German stock markets and how strong the occurrence is. The study corresponds to the hypotheses presented at the beginning of the study, and based on the results, it can be analyzed which all hypotheses are accepted or rejected. The study examines whether herding occurs throughout the period under study, in certain years, during crises, and whether anomalies in herding are observed in both the up and down markets.

To study herding, the study uses Christie and Huang (1995), Chang et al. (2000) and Chiang and Zheng (2010) developed methods. The method of Christie and Huang (1995) has been continued by adding components to it, and this model has established its position in scientific papers on herding.

## 6.1 CSSD-model

The first relevant model of herding was presented by Christie and Huang in 1995. The idea behind cross-sectional standard deviation (CSSD) is to compare an individual's return with the average return of the market, and the higher the dispersion, the more the

individual's performance differs from the average market performance. The model looks at the return on an individual stock to the average return on the market. The lower the CSSD value, the stronger the incidence of herding. (Christie and Huang 1995.)

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N}(R_{it}-R_{mt})^2}{(N-1)}}, \quad (6)$$

where:

$N =$ the number of the companies

$R_{it} =$ observed return of the stock at time t

$R_{mt} =$ cross-sectional return for market portfolio at time t

Christie and Huang (1995) assumes herding to be stronger during large market movements. It can be concluded that the CSSD value is lower during large market movements compared to the normal market situation. The assumption is in line with a rational pricing model that assumes dispersion increases as volatility increases. (Christie and Huang 1995.)

## 6.2 CSAD-model

Chang et al. (2000) continued to study herding by developing a more complex model. Chang et al. (2000) model has established itself in academic research, the model is robust and widely known, and is easy to understand. For these reasons, this study uses a cross-sectional absolute deviation (CSAD) by developed Chang et al. (2000). CSAD represents the return dispersion and this model observes the nonlinear relationship between the return of an individual stock in relation to the return of the market portfolio.

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}|R_{it} - R_{mt}|\,, \tag{7}$$

where:

$N =$ the number of the companies

$R_{it} =$ observed return of the stock at time t

$R_{mt} =$ observed return of the market portfolio at time t

The CSAD model describes better the possible prevalence of herding in a normal market condition than the CSSD model. The CSAD model has been continued by adding components, making the model even more robust. The coefficient $y_3 R_{mt}^2$ is negative and statistically significant if herding occurs. (Chang et al 2000; Tan et al. 2008.)

$$CSAD_t = \alpha + y_1 R_{mt} + y_2|R_{mt}| + y_3 R_{mt}^2 + \varepsilon_t\,, \tag{8}$$

where:

| | |
|---|---|
| $\alpha =$ | the constant term |
| $y_1 R_{mt} =$ | the normal term; return of the market portfolio at time t |
| $y_2\|R_{mt}\| =$ | the absolute term; return of the absolute term of the cross-sectional return of the market portfolio at time t |
| $y_3 R_{mt}^2 =$ | the squared term; the non-linear term |
| $\varepsilon_t =$ | the error term |

Some studies have observed asymmetry herding occurring during the up- and down market and the extreme market conditions. (Tan et al. 2008; Chiang & Cheng 2010; Batmunkh, McAleer, Moslehpour & Wong 2018). To study herding under different market conditions, equation 9 is presented in this study.

$$CSAD_t = \alpha + y_1(1 - D)R_{mt} + y_2(D)|R_{mt}| + y_3(1 - D)R_{mt}^2 + y_4(D)R_{m_t}^2 + \varepsilon_t, \quad (9)$$

The equation is remarkable to the study because as mentioned before, some studies have observed herding precisely under the extreme market conditions and one of the hypotheses in this study focuses on studying herding under crises. Equation 9 contains dummy variables to distinguish between the rising and the falling markets. If the return on the index is negative, the dummy variable is exactly one, and if the return on the index is positive, the dummy variable is zero. Referring to the previous, the negative and statistically significant coefficient $y_3$ constitutes the occurrence of herding and in this equation the coefficient $y_3$ describes the rising market. Correspondingly, the negative and statistically significant coefficient $y_4$ constitutes the occurrence of herding during a falling market.

# 7 Results

This section covers all the empirical results of the study. The results are displayed in tables, presenting the results as clearly and simply as possible. All of the hypotheses are reviewed one at a time and at the end of the section we conclude which hypotheses are accepted and which are rejected, summarizing the main findings.

The first subchapter reviews the entire sample period of both markets and thus provides an answer to the first hypothesis: whether there is herd behaviour during the entire sample period. The second subchapter focuses on the individual years of the sample period. In this chapter, the whole sample period is divided into years, and thus we can examine whether herding occurs in a particular year and whether herding is completely random between the years studied. The second subchapter therefore answers to hypothesis two. The third subchapter examines both the bull and bear markets separately and responds to the third hypothesis. It will be interesting to see whether stronger herding is observed and whether discrepancies are found between a strong rise and fall in the markets. The last subchapter is also very interesting as it examines extreme market conditions in various occasions, such as in the 2008 Financial crisis and the European sovereign debt crisis. The last subchapter therefore responds to the last hypothesis, which is the fourth hypothesis.

## 7.1 Herding in the US and Germany during the whole sample period

**Table 2.**

Estimates of market-wide herding in the US and German stock markets.

The sample period is 1.1.2000 - 31.12.2020.

| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | Adj. R2 |
|---|---|---|---|---|---|---|---|---|---|
| Market | | | | | | | | | |
| US | 0,724 | *** | 0,011 | | 0,290 | *** | 0,001 | | 0,254 |
| | (73,991) | | (2,141) | | (23,765) | | (0,616) | | |
| Germany | 0,830 | *** | 0,013 | *** | 0,245 | *** | 0,012 | *** | 0,299 |
| | (72,517) | | (2,897) | | (19,585) | | (5,710) | | |

*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

Table 2 above shows the regression results of formulas 7 and 8 for the whole sample period for the US and German stock markets. As mentioned before, the negative and statistically significant $y_3$ reflects market-wide herding.

According to the results, the coefficient $y_3$ is statistically significant at 1% only in Germany but the coefficient is not negative in either in the US or Germany. Based on the results, herding does not occur in the US and Germany when looking at the whole sample period as a single entity. Therefore we can conclude that investors do not operate in a herd and the results in Table 3 are not at all surprising, although the results of previous studies have been slightly inconsistent. Most previous studies have found similar results, but some studies have also found herding to occur in specific countries.

Christie and Huang (1995) and Chiang and Zheng (2010) studied the US stock market and based on their results, no herding occurred in the market. Chang et al. (2000) and Henker J., Henker T. and Mitsios (2006) examined numerous developed markets and similarly found no evidence of herding. The results are in line with the results of this study.

However, Hwang and Salmon (2004) observed market-wide herding in the US stock market in particular using a slightly different methodology, and Keasey et al. (2014) studied herding in the European market in the European market using Germany as one of their target countries, and also found market-wide herding during a period of 2001–2012. Thus, the results of Hwang and Salmon (2004) and Keasey et al. (2014) are inconsistent with the results of this study.

## 7.2 Herding in the US and Germany divided into individual years

Tables 3-6 below describe the regression results of herding by dividing the whole data into individual years and formulas 7 and 8 are used for these results. Looking at the whole data period as one entity, we did not observe herding but there is a possibility of occurrence during the individual years. As for Table 3, the negative and statistically significant $y_3$ reflects market-wide herding.

The years 2008, 2010, 2014, 2016, 2017 and 2018 are negative for the US and only 2018 is statistically significant at level 5 %. The negative coefficient for 2008 is explained by the beginning of the Financial crisis that started in the US. This is encouraged by Christie and Huang (1995), who state that herding is more pronounced when the market is in crisis. The years 2002, 2005, 2006, 2018 and 2020 are negative for Germany and none of the coefficients are statistically significant.

An interesting finding for Germany is the negative value of 2002, as the 2001 Recession and IT crisis wiped two-thirds of the value of the German DAX index in just a few years. A large number of investors realized their investments at a rapid pace and although the value is not statistically significant, basically some degree of herding can be observed in Germany during the 2001 Recession.

**Table 3**.

Estimates of market-wide herding in the US, divided into yearly periods.

The sample period is 1.1.2000 - 31.12.2010.

| Market | US | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | Adj. R2 |
| 2000 | 1,841 | *** | 0,048 | * | 0,222 | ** | 0,007 | | 0,120 |
| | (26,460) | | (1,783) | | (2,342) | | (0,301) | | |
| 2001 | 1,386 | *** | 0,049 | * | 0,033 | | 0,082 | *** | 0,302 |
| | (20,346) | | (1,732) | | (0,392) | | (4,644) | | |
| 2002 | 1,192 | *** | 0,015 | | 0,160 | ** | 0,001 | | 0,133 |
| | (21,278) | | (0,854) | | (2,328) | | (0,076) | | |
| 2003 | 0,885 | *** | 0,009 | | 0,006 | | 0,028 | | 0,045 |
| | (27,669) | | (0,586) | | (0,105) | | (1,314 | | |
| 2004 | 0,78 | *** | -0,012 | | -0,025 | | 0,059 | | 0,004 |
| | (26,387) | | (-0,601) | | (-0,238) | | (0,806) | | |
| 2005 | 0,74 | *** | -0,005 | | -0,033 | | 0,097 | * | 0,042 |
| | (27,213) | | (-0,239) | | (-0,377) | | (1,685) | | |
| 2006 | 0,748 | *** | 0,028 | | 0,067 | | 0,015 | | 0,031 |
| | (29,931) | | (1,375) | | (0,808) | | (0,295) | | |
| 2007 | 0,715 | *** | 0,001 | | 0,033 | | 0,052 | ** | 0,171 |
| | (27,923) | | (0,081) | | (0,532) | | (2,027) | | |
| 2008 | 1,013 | *** | 0,026 | * | 0,255 | *** | -0,003 | | 0,379 |
| | (17,892) | | (1,875) | | (5,494) | | (-0,522) | | |
| 2009 | 0,900 | *** | 0,019 | | 0,279 | *** | 0,004 | | 0,350 |
| | (18,331) | | (1,089) | | (4,490) | | (0,305) | | |
| 2010 | 0,650 | *** | -0,005 | | 0,140 | ** | -0,006 | | 0,142 |
| | (27,638) | | (-0,370) | | (2,811) | | (-0,368) | | |

*** Significant at the 0.01 level.

** Significant at the 0.05 level.

* Significant at the 0.10 level.

**Table 4.**

Estimates of market-wide herding in the US, divided into yearly periods.

The sample period is 1.1.2011 - 31.12.2020.

| Market | US | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | Adj. R2 |
| 2011 | 0,667 | *** | 0,021 | ** | 0,081 | ** | 0,022 | *** | 0,375 |
| | (29,796) | | (2,231) | | (2,423) | | (2,629) | | |
| 2012 | 0,643 | *** | 0,022 | | 0,036 | | 0,052 | | 0,117 |
| | (28,591) | | (1,444) | | (0,552) | | (1,504) | | |
| 2013 | 0,657 | *** | 0,006 | | 0,014 | | 0,004 | | -0,009 |
| | (28,419) | | (0,359) | | (0,201) | | (0,094) | | |
| 2014 | 0,574 | *** | -0,009 | | 0,109 | | -0,011 | | 0,039 |
| | (24,977) | | (-0,494) | | (1,498) | | (-0,260) | | |
| 2015 | 0,622 | *** | 0,016 | | 0,060 | | 0,008 | | 0,042 |
| | (23,590) | | (1,072) | | (1,170) | | (0,408) | | |
| 2016 | 0,566 | *** | -0,028 | | 0,238 | *** | -0,004 | | 0,190 |
| | (18,670) | | (-1,250) | | (3,003) | | (-0,103) | | |
| 2017 | 0,525 | *** | 0,028 | | 0,268 | ** | -0,051 | | 0,106 |
| | (23,838) | | (0,983) | | (2,582) | | (-0,620) | | |
| 2018 | 0,688 | *** | -0,018 | | 0,197 | | -0,025 | ** | 0,161 |
| | (26,365) | | (-1,340) | | (4,548) | | (-2,040) | | |
| 2019 | 0,708 | *** | 0,001 | | 0,075 | | 0,018 | | 0,061 |
| | (26,496) | | (0,045) | | (1,128) | | (0,660) | | |
| 2020 | 0,876 | *** | 0,019 | | 0,282 | *** | 0,001 | | 0,463 |
| | (15,640) | | (1,214) | | (6,163) | | (0,195) | | |

*** Significant at the 0.01 level.

** Significant at the 0.05 level.

* Significant at the 0.10 level.

**Table 5.**

Estimates of market-wide herding in the Germany, divided into yearly periods.

The sample period is 1.1.2000 - 31.12.2010.

| Market | Germany | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | Adj. R2 |
| 2000 | 1,658 | *** | 0,044 | ** | 0,042 | | 0,087 | | 0,279 |
| | (23,014) | | (2,100) | | (0,392) | | (2,792) | | |
| 2001 | 1,257 | *** | -0,004 | | 0,237 | *** | 0,007 | | 0,332 |
| | (21,908) | | (-0,241) | | (4,454) | | (0,761) | | |
| 2002 | 1,061 | *** | 0,019 | | 0,379 | *** | -0,016 | | 0,417 |
| | (13,794) | | (1,388) | | (5,633) | | (-1,421) | | |
| 2003 | 1,088 | *** | 0,009 | | 0,144 | *** | 0,018 | * | 0,350 |
| | (21,011) | | (0,650) | | (2,749) | | (1,783) | | |
| 2004 | 0,784 | *** | 0,010 | | 0,062 | | 0,024 | | 0,090 |
| | (27,322) | | (0,645) | | (1,015) | | (0,965) | | |
| 2005 | 0,686 | *** | 0,010 | | 0,122 | * | -0,015 | | 0,052 |
| | (27,719) | | (0,634) | | (1,757) | | (-0,431) | | |
| 2006 | 0,717 | *** | 0,022 | | 0,136 | ** | -0,004 | | 0,108 |
| | (26,250) | | (1,445) | | (2,219) | | (-0,144) | | |
| 2007 | 0,899 | *** | -0,005 | | -0,062 | | 0,101 | *** | 0,135 |
| | (24,616) | | (-0,303) | | (-0,739) | | (2,759) | | |
| 2008 | 1,335 | *** | 0,032 | | 0,103 | | 0,031 | ** | 0,283 |
| | (11,848) | | (1,,113) | | (1,046) | | (2,553) | | |
| 2009 | 1,324 | *** | 0,028 | | 0,059 | | 0,052 | *** | 0,250 |
| | (17,442) | | (1,368) | | (0,670) | | (2,712) | | |
| 2010 | 0,860 | *** | 0,010 | | 0,022 | | 0,043 | *** | 0,193 |
| | (29,431) | | (0,750) | | (0,448) | | (2,932) | | |

*** Significant at the 0.01 level.

** Significant at the 0.05 level.

* Significant at the 0.10 level.

**Table 6.**

Estimates of market-wide herding in the Germany, divided into yearly periods.

The sample period is 1.1.2011 - 31.12.2020.

| Market | Germany | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | Adj. R2 |
| 2011 | 0,907 | *** | 0,001 | | 0,098 | * | 0,022 | ** | 0,318 |
| | (21,188) | | (0,066) | | (0,062) | | (0,046) | | |
| 2012 | 0,782 | *** | 0,018 | | 0,0123 | ** | 0,005 | | 0,156 |
| | (24,637) | | (1,325) | | (2,234) | | (0,287) | | |
| 2013 | 0,771 | *** | -0,011 | | 0,081 | | 0,01 | | 0,061 |
| | (25,308) | | (-0,706) | | (1,125) | | (0,326) | | |
| 2014 | 0,687 | *** | -0,014 | | 0,086 | | 0,000 | | 0,065 |
| | (24,559) | | (-1,022) | | (1,445) | | (0,013) | | |
| 2015 | 0,954 | *** | 0,00 | | -0,265 | *** | 0,115 | *** | 0,242 |
| | (22,906) | | (0,025) | | (-4,429) | | (6,957) | | |
| 2016 | 0,783 | *** | -0,015 | | 0,138 | *** | 0,010 | | 0,199 |
| | (21,463) | | (-0,907) | | (2,942) | | (0,906) | | |
| 2017 | 0,683 | *** | 0,013 | | 0,026 | | 0,034 | | 0,036 |
| | (29,816) | | (0,605) | | (0,407) | | (1,064) | | |
| 2018 | 0,831 | *** | -0,034 | * | 0,094 | | -0,007 | | 0,039 |
| | (22,402) | | (-1,747) | | (1,222) | | (-0,218) | | |
| 2019 | 0,807 | *** | 0,00 | | 0,063 | | 0,052 | * | 0,149 |
| | (23,535) | | (0,001) | | (0,816) | | (1,751) | | |
| 2020 | 0,908 | *** | 0,027 | | 0,0277 | *** | -0,004 | | 0,325 |
| | (16,807) | | (1,599) | | (6,316) | | (-0,870) | | |

*** Significant at the 0.01 level.

** Significant at the 0.05 level.

* Significant at the 0.10 level.

## 7.3 Herding in rising and falling markets

**Table 7.**

Estimates of market-wide herding in the US and German in rising and falling markets.

Sample period: 1.1.2000 - 31.12.2020.

| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | $\gamma 4$ | Adj. R2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Market | | | | | | | | | | |
| US | 0,747 | ** | 0,020 | *** | 0,297 | *** | -0,042 | | -0,010 | 0,158 |
| | (58,67) | | (22,144) | | (21,355) | | (-0,155) | | (-0,037 | |
| Germany | 1,024 | *** | 0,001 | | 0,004 | *** | 0,046 | *** | 0,240 | 0,184 |
| | (68,515) | | (4,765) | | (14,785) | | (6,707) | | (-0,155) | |

*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

Table 7 describes the herding during the up and down days and formula 9 has been used to calculate the regression results. If herding occurs, the coefficients $y_3$ and $y_4$ are statistically significant. The negative and statistically significant coefficient $y_3$ reflects herding during rising markets and negative and statistically significant coefficient $y_4$ reflects the herding during falling markets.

From Table 7 we can conclude that coefficients $y_3$ and $y_4$ are negative for the US but the results are not statistically significant. For Germany, the coefficients $y_3$ and $y_4$ are neither negative nor statistically significant. Thus, none of the results are both negative and statistically significant at the same time, i.e. herding does not occur during the rising and declining days when looking at the sample period as a single entity. Chiang and Zheng (2010) did not find asymmetric herding in their study of developed markets, meaning the results are consistent with the results of Chiang and Zheng (2010). Ohlson (2010) and Saastamoinen (2008) found herding to occur during rising days, and Keasey et al. (2014) found evidence of herding during declining days. The results in Table 8 are thus inconsistent with the results of Saastamoinen (2008), Ohlson (2010) and Keasey et al. (2014). One of the explanatory factors is the timeline of the data. In this study, the years 2000-2020 are used as data, and the data in the study is very current and, for example, the entire last year has been included in the data. Many of the studies referred to in the

past generally use some years from 2000 to 2015 as their data, so the last five years in particular are not included in the studies. In addition, other studies mainly use other stock indices as their data.

## 7.4 Herding under the extreme market conditions

**Table 8.**

Panel A: Estimates of market-wide herding during the 2001 Recession.

The sample period is 1.3.2001 - 31.11.2001.

| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | $\gamma 4$ | | Adj. R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Market | | | | | | | | | | | |
| US | 1,317 | *** | 0,037 | | 0,017 | | 0,082 | *** | 0,052 | *** | 0,452 |
| | (21,075) | | (1,532) | | (0,234) | | (5,510) | | (3,267) | | |
| Germany | 1,163 | *** | -0,011 | | 0,293 | *** | -0,001 | | -0,003 | | 0,417 |
| | (18,620) | | (-0,646) | | (5,316) | | (-0,108) | | (-0,098) | | |

Panel B: Estimates of market-wide herding during the global Financial crisis.

Sample period: 1.1.2008 - 31.6.2009.

| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | $\gamma 4$ | | Adj. R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Market | | | | | | | | | | | |
| US | 1,087 | *** | 0,030 | ** | 0,252 | *** | -0,004 | | -0,002 | | 0,359 |
| | (24,124) | | (2,592) | | (6,719) | | (-0,712) | | (-0,188) | | |
| Germany | 1,418 | *** | 0,044 | ** | 0,144 | ** | 0,025 | *** | 0,047 | *** | 0,277 |
| | (17,184) | | (2,096) | | (2,079) | | (2,750) | | (2,897) | | |

*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

**Table 9.**

Panel A: Estimates of market-wide herding during the European sovereign debt crisis.

Sample period: 1.4.2011 - 28.2.2013.

| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | $\gamma 4$ | | Adj. R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Market | | | | | | | | | | | |
| US | 0,636 | *** | 0,018 | ** | 0,102 | *** | 0,019 | *** | 0,080 | ** | 0,321 |
| | (43,020) | | (2,258) | | (4,014) | | (2,659) | | (1,644) | | |
| Germany | 0,830 | *** | 0,003 | | 0,099 | *** | 0,025 | *** | 0,019 | ** | 0,315 |
| | (30,340) | | (0,302) | | (2,706) | | (2,960) | | (5,233) | | |

Panel B: Estimates of market-wide herding during the Covid-19 pandemic.

Sample period: 1.3.2020 - 31.12.2020.

| | $\alpha$ | | $\gamma 1$ | | $\gamma 2$ | | $\gamma 3$ | | $\gamma 4$ | | Adj. R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Market | | | | | | | | | | | |
| US | 0,928 | *** | 0,012 | | 0,283 | *** | 0,000 | | 0,005 | | 0,459 |
| | (14,180) | | (0,679) | | (5,482) | | (0,056) | | (0,777) | | |
| Germany | 0,955 | *** | 0,018 | | 0,287 | *** | -0,006 | | 0,002 | ** | 0,321 |
| | (15,195) | | (0,977) | | (5,792) | | (-1,074) | | (-0,201) | | |

*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

Tables 8 and 9 describes herding under extreme market conditions and the equation 9 is used for the results. Over the last twenty years, the biggest and most significant global crises from a stock market perspective have been the IT crisis in the turn of the century, the Financial crisis of 2008, the European sovereign debt crisis of 2011 and the Covid-19 crisis that surprised us all in 2020. As mentioned before, the negative and statistically significant coefficient $y_3$ reflects herding during rising markets and the negative and statistically significant coefficient $y_4$ reflects herding during falling markets.

The negative and statistically significants $y_3$ and $y_4$ does not occur during any of the above crises, which is a little surprising. During periods of rapid and strong ups and downs, a large number of investors are on the same side, suggesting herding occurs at least at some level. Based on the results of this study, investors do not imitate other investors and the investor acts independently and rationally following his or her own intuition.

As mentioned before, Table 5 shows that on the German stock market, the coefficient $y_3$ is negative for 2002, and Table 8 shows that $y_3$ and $y_4$ are also negative for the 2001 Recession but not statistically significant. At the time, the US experienced a burst of the technology stock bubble, the 2001 WTC terrorist attack, and numerous accounting scandals at large US companies. The 2008 Financial crisis in the US shows a negative $y_3$ coefficient but the coefficient is not significant. This is in line with the previous results of the study as the year 2008 was also negative and insignificant for the US. The Financial crisis originated in North America, so it is understandable that one of the coefficients are at least negative. The Euro Sovereign debt crisis does not show negative or statistically significant results for the coefficients, so no herding occurred in any way during this crisis. In early 2020, all of us were surprised as Covid-19 collapsed the stock market in March 2020, but the recovery happened quickly. In the case of Germany, a negative result is observed during rising market and it can be concluded from this that Germany may have experienced some degree of herding, although the result is not statistically significant.

Christie and Huang (1995) and Caparrelli, Arcangelis and Cassuto (2004) observed stronger herding than normally during large market movements. Christie and Huangs (1995) one of the target countries was the US and Caparrelli et al. (2004) studied the Italian stock market. Chang et al. (2000) and Fenzl and Pelzmann (2012) found herding to be stronger during market crises. On the other hand, Tan et al. (2008) and Yao et al. (2014) did not observe any herding during large market movements. The results in tables 9 and 10 are thus partly in line with some studies but on the other hand inconsistent with some of the studies.

## 7.5 Summary of the results

The results of this study are in line with each other, but in a larger picture compared to previous studies, the results are partially inconsistent. The differences are partly explained by the data itself: the timeline of the data and the target indices under observation. This study uses the general and well-established CSAD-model, which is a globally known model in scientific research to study herding. Next, one can assess which hypotheses are accepted and which hypotheses are rejected.

According to the null hypothesis stock return dispersions are normally distributed among the US and German stock markets during the sample period. Based on the descriptive statistics, the US kurtosis value of 13,302 and the German kurtosis value of 5,740 tells that returns are not normally distributed. Thus, it can be said that the null hypothesis is rejected for the US and Germany. Herding does not occur in either market when looking at the entire sample period as a single period, and thus the first hypothesis is rejected for both stock indices. Next, the entire sample period is divided into individual years and it can be analyzed whether there is a herding in a particular year. Of the studied markets, only the US shows herding in 2018 and thus, herding was observed in only one year at a time, and this was specifically in the US. In this way, we can accept the second hypothesis for the US and reject it for the Germany.

According to the third hypothesis, the scale of herding behaviour is asymmetric and thereby the extent of herding is not evenly distributed between up- and down days. However, Table 8 shows that this is not the case. Although the market is divided into up and down days, no herding is observed. The third hypothesis is rejected for both the US and Germany. According to the latest or fourth hypothesis, herding behaviour appears more often during extreme market conditions. Four crises with different natures have been brought to the fore, and no herding was observed during any of the crises. Some of the explanatory coefficients were negative but not statistically significant, so the fourth hypothesis is rejected for both the US and German markets.

# 8 Conclusion

In recent years has behavioural finance become an increasingly important topic. Even financial markets are highly influenced by human behaviour, since in the end its we humans who makes the investment decisions. The better knowledge of human behaviour makes it possible to estimate how and in which way behavioural aspects affects the financial markets. This increased knowledge has increased the popularity of behavioural finance as a study object. The concept of behavioural finance is also starting to challenge the traditional financial theories more and more.

Herding behaviour is a sub-area within behavioural finance. This concepts it´s strongly linked with human psychology. Psychological factors make it to be a very interesting study object, but also a difficult one since it is well known that psychology is a challenging area to study. On some level exists herding behaviour in our everyday life. This includes both positive and negative things. The history of herding extends to the early meters of evolution. In early phases herding was used for example for defending the tribe. In modernised world the need for defending the close ones has vanished from our daily life, but the herding behaviour still exists in us. Thereby the study field of the term has expanded on new areas, which better matches with the tasks we people have in today's world. In the context of finance, herding refers to the actions where investors reject own thoughts and decides to imitate the market. In previous studies the study objective has been to determine, whether herding occurs during financial crises, in certain countries, in certain industries, and whether the prevalence of herding is asymmetric.

This study examines the prevalence of herding in the US and German stock markets. The data used in this study paper consists of daily price data of past 20 years' time from the US Dow Jones Industrial index and the German DAX index. The paper covers the theory of herding extensively, the literature review is strongly presented, and herding is studied from many different perspectives. Various approaches have been used to study herding over the years, but a few studies have established their place in the academic within the study area of herding. Most of the past research papers are based on the studies

published by Lakonishok et al. (1992), Christie and Huang (1995), Chang et al. (2000) and Hwang and Salmon (2004). In this study, the CSSD and CSAD model are used. These models are developed by Christie and Huang (1995) and Chang et al. (2000).

At the beginning of the study the hypotheses are presented. In addition to noll hypothesis there are all in all four-hypothesis used. The hypotheses are following ones: H0: During the study period of 2000-2020, stock return dispersions are normally distributed in the US and German stock markets, H1: Herding behaviour occurs in the US and German stock markets during the entire sample period, H2: The existence of herding behaviour varies from year to year, H3: The scale of herding behaviour is asymmetric and thereby the extent of herding is not evenly distributed between up- and down days and H4: Herding behaviour appears more often during extreme market conditions.

The answers to the hypotheses are obtained by regression analysis of the results. The results can be founded in the last section where the key findings are closely presented and explained. The regression process offered some unexpected results. It is surprising to note that herding occurs only in 2018 for the US and in all the other years, no evidence of herding is found. What comes to Germany, herding does not exists in the German stock markets during the study period. The results for determined hypothesis were following ones: The null hypothesis is rejected for both study indices in US and Germany. The first hypothesis is rejected for both stock indices. The second hypothesis is accepted only for the US and rejected for the Germany. Hypotheses three and four have been rejected for both markets.

Regression results showed that herding was only observed during some individual years, but the results were not statistically significant. It was also interesting that systematic herding did not occur even during market crises. The results of previous studies are partly inconsistent and gives also contradictory results when comparing with each other. Christie and Huang's (1995) study found no herding in the US stock market. Chang et al. (2000) shared this view. On the other hand, Hwang and Salomon (2004) observed

herding in the US stock market using a slightly different methodology, and Khan et al. (2011) made a similar finding in the German stock market.

In conclusion, the results provide very little support for the prevalence of herding on studied markets. Even though the study object was divided in different sub-areas and tested with different hypothesis, gave none of these smaller sub-areas support for the view of herding behaviour existing on the stock markets. Based on these clear results I question the CSAD methodology which was used as theoretical framework also in this study. CSAD-model is widely used, but the results of many studies have given only little support for the existence of herding in financial markets. The methodology should be developed further. When similar studies are done in the future could the researcher also include analysts' forecasts. It would be interesting to study different industries, compare large and small companies, and compare growth and value companies separately to learn more of possible existence of herding on markets.

## References

Alpert, M. & Raiffa, H. (1982). Judgment under Uncertainty: Heuristics and Biases. Cambridge University Press. 294-305.

Baker, M. & Wurgler, J. (2007). Investor Sentiment in the Stock Market. *Journal of Economic Perspectives*. 21(2), 129-152.

Banerjee, A. V. (1992). A Simple Model of Herd Behaviour. *The Quarterly Journal of Economics.* 107(3), 797-817.

Barber, M.B. & Odean, T. (2001). Boys will be Boys: Gender, Overconfidence and Common stock investment. *The Quarterly Journal of Economics*. 166(1), 262-292.

Batmunkh, M-U., McAleer, M., Moslehpour, M. & Wong, W-K. (2018). Confucius and Herding Behaviour in the Stock Markets in China and Taiwan. *Sustainability.* 10, 1-16.

Bikhchandani, S., Hirshleifer, D. & Welch, I. (1998). Learning from the Behavior of Others: Conformity, Fads, and Informational Cascades. *The Journal of Economic Perspectives*. 12(3), 151-170.

Bikhchandani, S. & Sharma, S. (2001). Herd Behavior in Financial Markets. *IMF Staff Papers.* 47, 279-310.

Bodie, Z., Kane, A. & Marcus, A. J. (2009). *Investments* (8th global ed.). New York: McGraw Hill Education.

Burghardt, M. (2011). *Retail Investor Sentiment and Behavior: An Empirical Analysis*. [Master's thesis, Karlsruhe Institute of Technology].

Caparrelli, F., D'Arcangelis, A. M. & Cassuto, A. (2004). Herding in the Italian Stock Market: A Case of Behavioral Finance. *The Journal of Behavioral Finance*. 5(4), 222-230.

Carhart, M. (1997). On persistence in mutual fund performance. *The Journal of Finance.* 52(1), 57-82.

Chang, E.C., Cheng, J.W. & Khorana, A. (2000). An Examination of Herd Behavior in Equity Markets: An International Perspective*. Journal of Banking and Finance*. 24(10), 1651-1679.

Chiang, T.C. & Zheng, D. (2010). An empirical analysis of herd behavior in global stock markets. *Journal of Banking and Finance*. 34, 1911-1921.

Choi, N. & Sias, R.W. (2009). Institutional Industry Herding. *Journal of Financial Economics*. 94(3), 469-491.

Christie, W.G. & Huang, R.D. (1995). Following the Pied Piper: Do Individual Returns Herd around the Market? *Financial Analysts Journal.* 51(4), 31-37.

Clements, A., Hurn, S. & Shi, S. An empirical investigation of herding in the U.S. stock market. *Economic Modelling.* 67, 184-192.

Devenow, A. & Welch, I. (1996). Rational herding in financial economics. *European Economic Review.* 40(3), 603-615.

Economou, F., Kostakis, A. & Philippas, N. (2011). Cross-Country Effects in Herding Behaviour: Evidence from Four South European Markets. *Journal of International Financial Markets, Institutions and Money*. 21(3), 443-460.

Fama, E. F. (1965). Random Walks in Stock Market Prices. *Financial Analysts Journal.* 21(5), 55-59.

Fama, E. F. & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics.* 33(1), 3–56.

Fama, E. F. & French, K. R. (2004). The Capital Asset Pricing Model: Theory and Evidence. *The Journal of Economic Perspectives*. 18(3), 25-46.

Fama, E. F. & French, K. R. (2004). The Capital Asset Pricing Model: Theory and Evidence. *The Journal of Economic Perspectives.* 18(3), 25-46.

Fama, E. F. & French, K. R. (2015). A Five-Factor Asset Pricing Model. *Journal of Financial Economics.* 116(1), 1–22.

Fenzl, T. & Pelzmann, L. (2012). Psychological and Social Forces Behind Aggregate Financial Market Behavior. *Journal of Behavioral Finance*. 13(1), 56-65.

Froot, K.A., Scharfstein, D.S. & Stein, J.C. (1992). Herd on the Street: Informational Inefficiencies in a Market with Short-Term Speculation. *The Journal of Finance*. 47(4), 1461-1484.

Gleason, K. C., Mathur, I. & Peterson, M. A. (2004). Analysis of Intraday Herding Behavior among the Sector ETFs. *Journal of Empirical Finance*. 11(5), 681-694.

Goldin, I. (10.2.2021). How herd behaviour drives action on r/WallStreetBets. Financial Times. Retrieved 14.2.2021 from https://www.ft.com/content/971df303-726a-4bdf-93eb-9a9e848f7109

Goodfellow, C., Bohl, M.T., & Gebka, B. (2009). Together We Invest? Individual and Institutional Investors' Trading Behaviour in Poland. *International Review of Financial Analysis.* 18(4), 212-221.

Haiss, P. (2010). Bank Herding and Incentive Systems as Catalysts for the Financial Crisis. *Journal of Behavioral Finance*. 7(1/2), 30-58.

Henker, J., Henker, T., & Mitsios, A. (2006). Do investors herd intraday in Australian equities? *International Journal of Managerial Finance.* 2(3), 196-219.

Hwang, S. & Salmon, M. (2004). Market Stress and Herding. *Journal of Empirical Finance*. 11(4), 585-616.

Jegadeesh, N. & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *The Journal of Finance.* 48(1), 65-91.

Keasey, K., Mobarek, A. & Mollah S. (2014). A Cross-Country Analysis of Herd Behavior in Europe. *Journal of International Financial Markets, Institutions & Money.* 32, 107-127.

Kendall M.G. & Bradford Hill A. (1953). The Analysis of Economic Time-Series-Part I: Prices. *Journal of the Royal Statistical Society*. 116, 11-34.

Khan, H., Hassairi, S. A. & Viviani, J. L. (2011). Herd Behavior and Market Stress: The Case of Four European Countries. *International Business Research*. 4(3), 53- 67.

Lakonishok, J., Shleifer, A. and Vishny R. (1992). The impact of institutional trading on stock prices. *Journal of Financial Economics*. 32, 23–43.

Lakonishok, J., Shleifer, A. & Vishny, R. W. (1994). Contrarian Investment, Extrapolation, and Risk. *The Journal of Finance.* 49(5), 1541-78.

Lintner, J. (1965). Security Prices, Risk, and Maximal Gains From Diversification. *The Journal of Finance*. 20(4), 587-615.

Lodha, S. & Soral, G. (2020). Exploring the Herd Behaviour of Investors: A Comparative Study of the Indian and US Stock Markets. *Journal of Applied Finance*. 26(4), 49-60.

Lorenz, T. & Phillipis, M. (25.2.2021). "Dumb Money" Is on GameStop, and It's Beating Wall Street at Its Own Game. The New York Times. Retrieved 28.2.2021 from https://www.nytimes.com/2021/01/27/business/gamestop-wall-street-bets.html

Lux, T. (1995). Herd Behavior, Bubbles and Crashes*. The Economic Journal.* 105(431), 881-896.

Mossin, J. (1966). Equilibrium in a Capital Asset Market. *Econometrica*. 34(4), 768-783.

Nofsinger, J.R. & Sias, R.W. (1999). Herding and Feedback Trading by Institutional and Individual Investors. *The Journal of Finance*. 54(6), 2263-2295.

Pound, J. & Shiller, R.J. (1986). Survey Evidence on Diffusion of Interest Among Institutional Investors. *RePEc Working Paper Series*. 1851.

Prast, H.M. (2000). Herding and financial panics: a role for cognitive psychology? Research Memorandum WO & E. Netherlands Central Bank*.* 611.

Prechter, R.R. (2001). Unconscious Herding Behavior as the Psychological Basis of Financial Market Trends and Patterns. *The Journal of Psychology and Financial Markets*. 2(3), 120-125.

Prechter, R.R. & Parker, W.D. (2007). The Financial/Economic Dichotomy in Social Behavioral Dynamics: the Socionomic Perspective. *The Journal of Behavioral Finance.* 8(2), 84-108.

Rajan, R. (2006). Has Finance Made the World Riskier? *European Financial Management*. 12(4), 499-533.

Reisen, H. (1999). After the Great Asian Slump: Towards a Coherent Approach to Global Capital Flow. *OECD Development Centre Policy*. 16.

Saastamoinen, J. (2008). Quantile Regression Analysis of Dispersion of Stock Returns-Evidence of Herd behavior. *Discussion Paper*. University of Joensuu. Economics.

Scharfstein, D.S. & Stein, J.C. (1990). Herd Behavior and Investment. *The American Economic Review.* 80(3), 465-479.

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance*. 19(3), 425-442.

Shiller, R.J. (2003). From Efficient Markets Theory to Behavioral Finance. *Journal of economic perspectives*. 17(1), 83-104.

Shiller, R. (2015). *Irrational Exuberance* (3rd edition). New Jersey: Princeton University Press.

Sirri, E.R. & Tufano, P. (1998). Costly Search and Mutual Fund Flows. *The Journal of Finance*. 53(5), 1589-1622.

Tan, L., Chiang, T.C., Mason, J.R. & Nelling, E. (2008). Herding behavior in Chinese stock markets: An examination of A and B shares. *Pacific-Basin Finance Journal*. 16(1), 61-77.

Trueman, B. (1994). Analyst forecasts and herding behavior. *Review of Financial Studies*. 7(1), 97-124.

Yahyazadehfar, M., Ghayekhloo, S. & Sadeghi, T. (1985). The Influence of Investor Psychology On Regret Aversion. *Finance*. 1-8.

Zheng, D., Li, H. & Zhu, X. (2015). Herding behavior in institutional investors: Evidence from China's stock market. *Journal of Multinational Financial Management.* 32(33), 59-76.