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HERD BEHAVIOR AND MOOD

An experimental study on the forecasting of share prices

Ibrahim Filiz, Thomas Nahmer and Markus Spiwoks, February 2019

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Abstract:
This experimental study examines the influence of emotions on the tendency towards herd behavior. The subjects forecast share prices, and while doing so they are offered the chance to orientate themselves towards other subjects and to possibly exhibit herding behavior. In a between-subjects design, three treatments are used (neutral, positive and negative mood). Mood is influenced by means of film excerpts which are shown to the subjects. It is shown that mood really does have an influence on the tendency towards herding behavior. A neutral mood in particular favors a tendency towards herd behavior.

Keywords: share price forecasts, herding behavior, emotions, behavioral finance, experiments.

JEL codes: D83, D91, G12, G17, G41

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1 Introduction

Herding usually refers to convergent social behavior. A common orientation of thoughts or behavior occurs not as a result of centralized coordination, but via the interaction of individuals. For centuries now there have been reports of events which correspond to this understanding of herd behavior. As early as 1374, for example, there were reports of people entering a trance-like state while dancing, which led to mass hysteria and even deaths (Waller, 2009). Other forms of social contagion can occur, for example, during social unrest, due to political opinions or in modern hooliganism (Le Bon, 1896; Russel, 2004). Raafat, Chater and Frith (2009) illustrated a wide range of historical examples for the occurrence of herd behavior.

In economics, herding takes place when subjects imitate the behavior of other subjects, or make economic decisions on the basis of the views, assessments or actions of others. A subject may have good reasons to exhibit herd behavior. For example, financial market analysts might align themselves with the majority opinion because in this way they can best avoid the danger of damage to their reputations. Institutional investors might imitate the investment behavior of others because they think that in this way they can increase their earnings. However, many investors copy the behavior of other investors in an ill-advised and completely irrational way - for example when they get carried along by what is generally thought to be a favorable stock-market mood, or when they panic in the face of falling share prices. Sometimes, social conventions or customs also play a role in the occurrence of herd behavior (Spyrou, 2013).

Adam Smith (1759) and Charles Mackay (1841) were among the first to highlight the significance of herding for the explanation of economic trends. Keynes (1936) also pointed out herding behavior among financial market participants and presented two explanations for it - reputational herding and investigative herding. Scharfstein and Stein (1990) took up these thoughts and thus initiated an intensive discourse which has continued over the past three decades.

Keynes (1936) assumed that financial market analysts tended towards herding because they had little to gain by having a highly individual opinion, and at the same time would be risking a considerable loss of reputation if it went wrong. However, if they aligned themselves with the majority opinion, they might be able to enhance their reputations slightly without taking the risk of endangering them. Financial market analysts who want to keep their well-paid jobs are thus behaving rationally when they always follow the opinion of the majority. In addition, Keynes (1936) assumed that financial market participants with a short-term orientation also tended towards investigative herding. Those who bet on short-term movements in the financial markets should not rely on information which will only be noticed months later by other capital market actors. They would be wiser to orientate themselves towards that which others consider to be relevant in the short term.

The reputational herding and investigative herding approaches have been examined in a large number of studies. Cote and Sanders (1997) came to the conclusion that concerns about reputations and the particular credibility of consensus forecasts favor herd behavior, which in turn leads to a worsening of the quality of forecasts. Bedke, Bizer and Spiwoks (2009) as well as Meub

et al. (2015) confirmed via experiments that concerns about reputations are a decisive factor in the formation of rational herding behavior.

Some studies found a negative correlation between professional experience in years and the tendency towards herding behavior (Hong, Kubik and Solomon, 2000; Lamont, 2002; Clement and Tse, 2005; Krishnan, Lim and Zhou, 2005). Inexperienced analysts who diverge considerably from the majority opinion with their forecasts are at greater risk of being made redundant than experienced analysts. Ashiya and Doi (2001) on the other hand found no indications that the experience of analysts had any significance on the occurrence of herding behavior. Some studies show that analysts who were particularly successful in the past are less likely to exhibit herding behavior (Stickel, 1990; Cote and Sanders, 1997; Graham, 1999). Bhalla (2012) on the other hand, found no indications that analysts make independent forecasts. Spiwoks, Bizer and Hein (2008b) considered how coordinated behavior among financial market analysts can come about. They found that an orientation towards the naive forecast ensures that analysts lastingly remain within the protective environment of the herd. Others have also shown that the more difficult the relevant tasks the earlier herding behavior occurs (Olsen, 1996; Kim and Pantzalis, 2003).

Banerjee (2010) as well as Bikhchandani, Hirshleifer and Welch (1992) showed that herding behavior can even occur when subjects act rationally and make a genuine effort to take meaningful decisions (informational cascades). In this case the subjects try - on the basis of observable decisions made by others - to deduce the latter's private signals. All information (a priori probability, one's own private signal and the private signals of others) is then used to maximize the probability of success of one's own decision. This can lead to herding behavior. Numerous experimental studies have found indications for the fact that informational cascades can really occur (Anderson and Holt, 1997; Hung and Plott, 2001; Celen and Kariv, 2004). A large number of variations of experiments have essentially confirmed these results. In laboratory experiments, informational cascades have also occurred in the case of delayed decision-making so that subjects could benefit from observing others' actions (Sgroi, 2003), or when there was the opportunity to purchase additional information (Kübler and Weizsäcker, 2004; Kraemer, Nöth and Weber, 2006); in the case of decisions which were not strictly sequential (Orlean, 1995), and in the case of different signal qualities (Sasaki, 2005; Sumpter et al. 2012). Other experimental studies have expressed major doubts about how realistic informational cascades are (Spiwoks, Bizer and Hein, 2008a; Çelen and Kariv, 2004; Nöth and Weber, 2003; Huck and Oechssler, 2000). Some subjects assign an inappropriately high level of significance to their own private signal, while others falsely interpret the behavior of those who have made previous decisions. Some subjects orientate themselves solely towards a priori probability, while others orientate themselves exclusively towards the majority of previous decision-makers. Only a small number of subjects are able to apply the Bayesian rule, and many subjects simply follow their gut feeling. Only very few grasp all the relevant information and make rational deductions about the probability of success of the different alternatives. This frequently leads to overlaps in behavior which look like informational cascades but have nothing in common with the thoughts at the core of the concept.

Devenow and Welch (1996) were the first to make a clear differentiation between rational herding (reputational herding, investigative herding and informational cascades) on the one hand and irrational herding behavior on the other. Irrational herding behavior often has a cultural

background (social conventions) or is due to a lack of control over one's impulses and can only be explained psychologically (Baddeley, Curtis and Wood, 2004; Baddeley, 2010). Shleifer and Summers (1990) emphasized the irrational herding behavior of noise traders, for example. Their actions are frequently characterized by pseudo-signals such as recommendations by financial gurus (Black, 1986). Misinterpretations of the actions of third parties can also trigger irrational herding. For example, the purchase of a share can have the purpose of merely restoring the original weighting of a portfolio (rebalancing). Other investors might, however, interpret this purchase as an indication of the particular attractiveness of the share in question and therefore buy it too. Presumptions about the motives of other investors can form a distraction from more important information and lead to sub-optimal decisions (Simonsohn and Ariely, 2008). Roider and Voskort (2016) interpret occurrences of herding behavior as unreflected mutual imitation.

Bikhchandani and Sharma (2000) pointed out that similar behavior should not be equated with herding. If many subjects do the same thing without taking note of each other or reacting to each other in any way, this is referred to as spurious herding. Galariotis, Rong and Spyrou (2015) presented empirical indications of spurious herding. A tendency towards non-conformism can, however, lead to individual subjects consciously leaving a herd. For this phenomenon, known as anti-herding, several findings have been presented (Zitzewitz, 2001; Laux and Probst, 2004; Bernhardt, Campello and Kutsoati, 2006; Naujoks et al., 2009; Pierdzioch and Rülke, 2012; Pierdzioch, Rülke and Stadtmann, 2013).

Table 1: Overview of herding behavior

<table>
<tr><td colspan="3">intentional herding</td><td rowspan="3">irrational herding</td><td rowspan="3">spurious herding</td></tr>
<tr><td colspan="3">rational herding</td></tr>
<tr><td>reputational herding</td><td>investigative herding</td><td>informational cascades</td></tr>
</table>

It is now considered certain that mood has an influence on economic decision-making (for an overview see, for example, George and Dane, 2016; Lerner et al., 2015; Vohs, Baumeister and Loewenstein, 2007; Baker and Wurgler, 2007; Baumeister et al., 2007; Pham, 2007; Shiv et al., 2005; Nofsinger, 2005; Lucey and Dowling, 2005; Watson and Vaidya, 2003; Daniel, Hirshleifer and Teoh, 2002; Hirshleifer, 2001; Loewenstein et al., 2001; Isen, 2000; Loewenstein, 2000; Schwarz, 2000; Elster, 1998; Bless, Schwarz and Kemmelmeier, 1996; Elster, 1996; Johnson and Tversky, 1983).

For example, the effects of sunshine, rain, cloud cover, wind strength, storms and other meteorological factors on market returns at stock exchanges worldwide have been thoroughly investigated (Kim, 2017; Kaustia and Rantapuska, 2016; Apergis, Gabrielsen and Smales, 2016; Bassi, Colacito and Fulghieri, 2013; Lu and Chou, 2012; Mirza et al., 2012; Floros, 2011; Symeonidis, Daskalakis and Markellos, 2010; Kang et al., 2010; Shu and Hung, 2009; Chang et al., 2008; Keef and Roush, 2007; Chang et al., 2006; Dowling and Lucey, 2005; Cao and Wei, 2005; Tufan and Hamarat, 2004; Krivelyova and Robotti, 2003; Hirshleifer and Shumway, 2003; Kamstra,

Kramer and Levi, 2003; Pardo and Enric, 2002; Krämer and Runde, 1997; Saunders, 1993). While doing so, attempts were also made to create a connection between the weather and the mood of capital market protagonists: Hirshleifer and Shumway (2003) showed that stock market returns on days when the sun shines in the morning were higher on average than on days with bad weather. This result was explained by sunshine favoring a positive atmosphere among investors. Kamstra, Kramer and Levi (2003) established that stock market returns varied according to the length of the day, which has been interpreted in a similar way to the results of Hirshleifer and Shumway (2003). Kaustia and Rantapuska (2016) carried out a similar study - however, they only observed a weak correlation between the effect of the length of a respective day, the weather and investment decisions.

Experimental economic research is increasingly interested in the question of which influence positive and negative emotions have on investment decisions. Grable and Roszkowski (2008), for example, showed in an experimental study that subjects whose positive emotions predominate were willing to take greater financial risks, while Kuhnen and Knutson (2011) carried out experiments to establish how different moods affected investment decisions. This showed that subjects tended to avoid risks when their mood is negative, while subjects whose mood was positive were willing to take more risks. According to this, subjects whose emotions are positive are more optimistic in relation to their investment decisions. Colasante, Marini and Russo (2017), however, came to the opposite conclusion. Their subjects were more risk-averse when under the influence of positive and negative emotions than those in a neutral mood. Kaplanski et al. (2015) showed that the mood of investors had an influence on their expectations in terms of returns, and also on their perception of risk. The happier the subjects were, the greater were their expectations in terms of their returns, and the lower the presumed risk of stock market investments. Experiments carried out by Lee and Andrade (2014) showed that negative affects increase risk aversion in investment decisions. An overview of the studies dealing with the effects of mood on risk tolerance can be viewed in Lane (2017) and Duxbury (2015). Lahav and Meer (2012) as well as Andrade, Odean and Lin (2016) used experiments to examine the effect of emotions on speculative bubbles. They established that speculative bubbles were larger in the case of positive affects than with negative affects. Breaban and Noussair (2018) followed a similar approach, though their findings were not as clear-cut. Gavriilidis, Kallinterakis and Tsalavoutas (2016) established that the positive atmosphere during Ramadan leads to an increase in herding behavior on the capital markets.

By now there are thus a range of findings showing that the mood of subjects can influence their economic decisions. However, until now no-one has conducted experiments on whether different moods also have an effect on the likelihood of herding behavior. Precisely this research topic has now been addressed by this study. The task facing the subjects here was to forecast future share prices.

2 Design of the experiment and hypotheses

Forecasting future share prices is a challenge which active portfolio managers have to face on a daily basis. However, the percentage of successful share price forecasts is modest. The neo-

classical theory of economics assumes strong or at least semi-strong informational efficiency. In an environment of this kind, forecasting future capital market trends is impossible. However, the conditions for informationally efficient capital markets - namely rational and fully informed subjects with a uniform formation of expectations - are now clearly considered to be non-existent. Successful share price forecasts thus appear to be possible but are seldom achieved in practice. The task of behavioral finance is to determine the cause of this apparent contradiction. Herding behavior can lead to stock market analysts using the available information in a sub-optimal way.

We orientated ourselves towards the approach used by Cote and Sanders (1997) to measure herding. The subjects have to make an initial estimate of a future share price. Subsequently they are informed about the average of the forecasts of all subjects (consensus forecast). Then they are allowed to change their original forecast once. If the subjects change their forecast in the direction of the consensus forecast, this is considered to be herding. If they change their forecast in the opposite direction, this has to be viewed as anti-herding. If the subjects do not change their forecast at all, neither herding nor anti-herding are present.

With regard to the making of forecasts, we roughly orientated ourselves towards the studies by Meub et al. (2015) and that of Becker, Leitner and Leopold-Wildburger (2009). This approach enables subjects to determine future share price levels via four fundamental influencing factors which have a constant effect on the share price. An error-free forecast is made more difficult by a random influence which leads to a situation where even subjects who act rationally only manage to successfully forecast an average of 40% of share prices. The more the subjects deviate from a rational strategy, the lower the success rate of their forecasts. As a reward is given for every successful forecast, subjects have a financial incentive to make rational forecasts. The issue of a consensus forecast makes it possible for subjects to change their own forecast, and it can then be seen to what extent herding behavior leads to subjects diverging from a rational strategy.

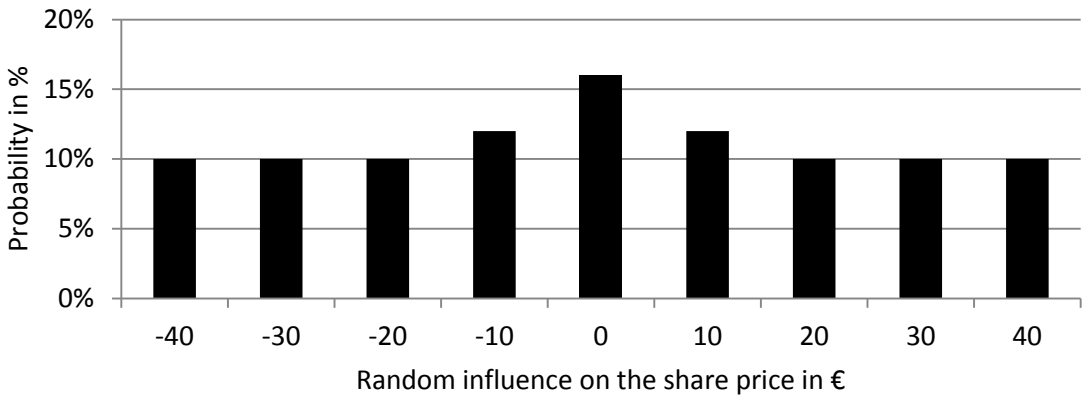
In order to examine the influence of mood on the occurrence of herding, we formed three treatments (positive, negative and neutral). The influencing of moods in the experiment was carried out by showing film excerpts, which is considered to be a tried and tested technique (Westermann et al., 1996; Allwood, Granhag and Jonsson, 2002; Kirchsteiger, Rigottii and Rustichini, 2006; Rottenberg, Ray and Gross, 2007; Ifcher and Zarghamee, 2014; Oswald, Proto and Sgroi, 2015). Whether the subjects' mood has been successfully influenced is assessed with manipulation checks.

Subjects make their forecasts as follows: The share price in € at the point in time t (K_t) is determined by four influencing factors (the fundamental data A_t, B_t, C_t and D_t) and a random influence (ε_t). The fundamental data is provided before each forecast is made. The subjects are also aware of the specific influence the fundamental data has on the share price.

(1) $$K_t = 2 \cdot A_t + 3 \cdot B_t - 1 \cdot C_t + 4 \cdot D_t + \varepsilon_t$$

The random influence (ε_t) moves within a range of €-40 and €+40. The probability of the events €-40, €-30, €-20, €+20, €+30 and €+40 is 10% each. The probability of the events €-10 and €+10 is 12%. The event €±0 has a probability of occurrence of 16% (Figure 1).

Fig. 1: The probability distribution of the random influence ε_t on the formation of the share price in €



The random influence for each period is determined by means of a lottery. As an example, here is how the share price was determined for Period 1. The subjects were informed that $A_1 = 32$, $B_1 = 26$, $C_1 = 22$ and $D_1 = 25$. Hence:

$$K_1 = 2 \cdot 32 + 3 \cdot 26 - 1 \cdot 22 + 4 \cdot 25 + \varepsilon_1 = 220 + \varepsilon_1$$

The expected value for ε_t is zero. In addition, €±0 is also the most frequently occurring random event (16%). A forecast is considered successful and is rewarded accordingly when it does not diverge more than €10 from the actual share price. Rational subjects will therefore, in accordance with the expected value of the price, make a forecast of €220 (in the example of Period 1). In 40% of all cases their forecasts will be correct, because the probability that the price is not more than €10 above or below the expected value is 12% + 16% + 12% = 40%. If one made a forecast of €230, the probability of success would only be 38% (16% + 12% + 10%). And if one made a forecast of €240, the probability of success would fall even further to 32% (12% + 10% + 10%). A forecast of €280 would have a probability of success of 0%, because ε_t moves between €-40 and €+40 and the tolerance between the actual share price and a successful forecast is only €10.

The subjects play five rounds - in other words, they are supposed to make five preliminary and five final forecasts. Each successful forecast is rewarded with €10. The show-up fee is €5.

The experiment is carried out as follows: before the beginning of the experiment an initial mood test is carried out in order to recognize any possible distortions of the research results due to an unusual mood beforehand. Then the subjects receive an instruction sheet in which the rules and requirements of the game are explained (see Appendix). Subsequently they have to answer test questions to ensure that they have understood how the game works (see Appendix). Then the subjects receive a history of the share price during the past ten periods as a line chart as well as an overview of the random events of the past ten periods as a bar chart (see Appendix).

This is followed by the first film excerpt and a subsequent manipulation check. Then the fundamental data for the current period is announced. The subjects are allowed to use a pocket

calculator to determine the expected value. After this they have to make their preliminary forecast. In the next step another film excerpt is shown and a second manipulation test is carried out. Then the consensus forecast is made available and the subjects are asked whether they want to change their forecasts. Finally, the actual share price is announced and the share price history chart is completed. This procedure is repeated a total of five times. At the end the subjects' forecasting performance is determined and their performance-based payment and the show-up fee are paid.

The three treatments differ with regard to the film excerpts shown: in the treatment "positive", film excerpts are shown which usually create a positive mood. In the treatment "negative", film excerpts are shown which usually create a negative mood. And in the treatment "neutral", film excerpts are shown which normally create a neutral mood.

Numerous findings from behavioral economics show that subjects by no means always make rational decisions. We therefore expect our subjects to also make forecasts which do not correspond to the expected value of the share price. The first hypothesis is therefore as follows:

Hypothesis 1: The subjects will make forecasts which do not correspond to the expected value of the share price.

The null hypothesis to be examined is therefore:

Null hypothesis 1: The forecasts always correspond to the expected value of the share price.

On the basis of numerous findings on the occurrence of herding among capital market participants, we expect herding behavior to also appear in our experiment.

The second hypothesis is therefore as follows:

Hypothesis 2: After the announcement of the consensus forecast, adjustments will be made to the forecasts which align them closer to this consensus forecast (herding behavior).

The second null hypothesis to be examined is therefore:

Null hypothesis 2: After the announcement of the consensus forecast, no adjustments will be made to the forecasts which align them closer to this consensus forecast.

In addition, we expect that herding behavior will also be evident in the standard deviation of the forecasts before and after the announcement of the consensus forecast.

Our third hypothesis is therefore as follows:

Hypothesis 3: the standard deviation of the forecasts before the announcement of the consensus forecast (preliminary forecasts) will be higher than the standard deviation of the forecasts after the announcement of the consensus forecast (final forecasts).

The third null hypothesis to be examined is therefore:

Null hypothesis 3: the standard deviation of the forecasts before the announcement of the consensus forecast (preliminary forecasts) will not be higher than the standard deviation of the forecasts after the announcement of the consensus forecast (final forecasts).

Against the background of previous research findings on the effect of emotions, we expect that a positive or negative mood will lead to a greater deviation from the rational forecast (forecast = expected value of the share price) than a neutral mood.

The fourth hypothesis is therefore:

Hypothesis 4: In the treatment "neutral", more forecasts are made which correspond to the expected value of the share price than in the treatments "positive" and "negative".

The fourth null hypothesis to be examined is therefore:

Null hypothesis 4: In the treatment "neutral", the same number or fewer forecasts are made which correspond to the expected value of the share price than in the treatments "positive" and "negative".

In addition, we expect that subjects in a positive or negative mood will exhibit a different tendency towards herding than subjects in a neutral mood.

The fifth hypothesis is therefore:

Hypothesis 5: In the treatments "positive" and "negative", the frequency with which forecasts are corrected in the direction of the consensus forecast is different than in the treatment "neutral".

The fifth null hypothesis to be examined is therefore:

Null hypothesis 5: In the treatments "positive" and "negative", the frequency with which forecasts are corrected in the direction of the consensus forecast is the same as in the treatment "neutral".

3 Results

The experiment was carried out between 14 December and 20 December 2018 in the Ostfalia Laboratory for Experimental Economic Research (OLEW) at the Ostfalia University of Applied Sciences in Wolfsburg, Germany. A total of 181 subjects took part in the experiment. Of these, 60 played the treatment "neutral" (neutral mood), 63 played the treatment "positive" (positive mood) and 58 the treatment "negative" (negative mood).

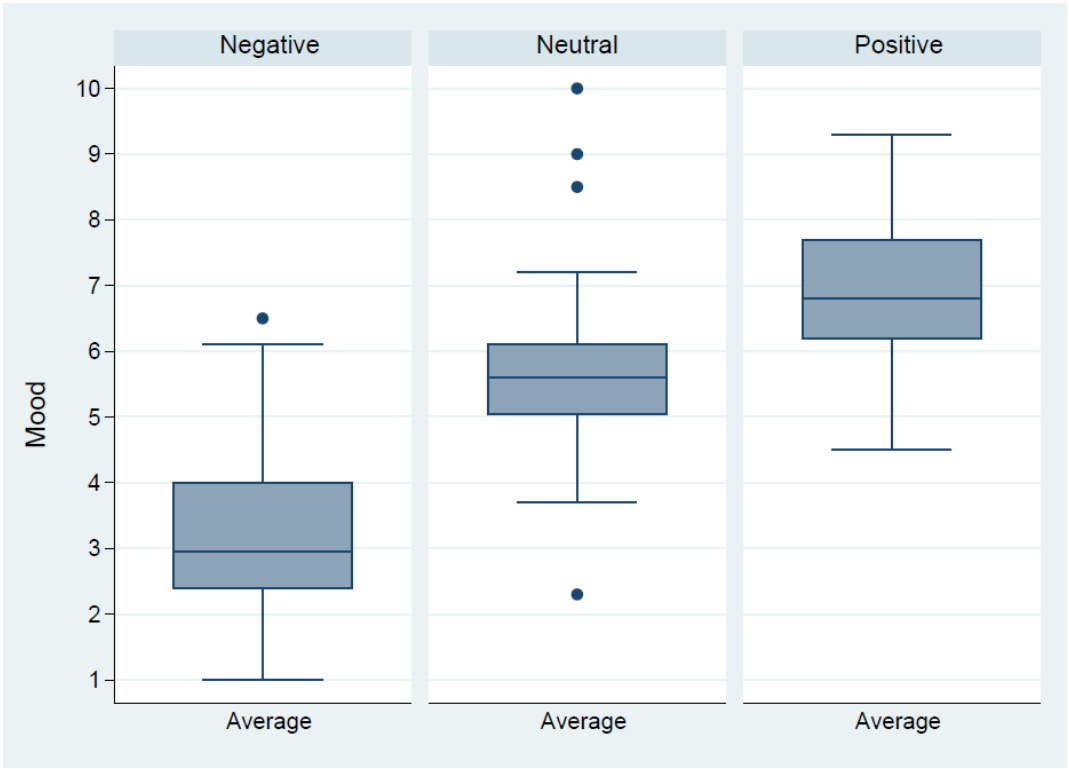
The subjects are students at the Ostfalia University of Applied Sciences in Wolfsburg. 92 subjects (50.8%) study at the Faculty of Business, 14 subjects (7.7%) at the Faculty of Health Care, and 73

(40.3%) at the Faculty of Vehicle Technology. A total of 20 sessions were carried out. The experiment was programmed in z-tree (Fischbacher, 2007). In the Ostfalia Laboratory for Experimental Economic Research (OLEW) there are a total of 12 computer workplaces, which makes it possible to completely separate the subjects from each other. The experiments are constantly monitored by a master of ceremonies so that communication between the subjects and the use of prohibited aids (such as smartphones) can be ruled out.

Overall the subjects received an average payment of €23.20. The highest payment was €45 and the lowest was €5. Taking part in the experiment took an average of 50 minutes, so the payment can be considered to be very attractive. The subjects gave the impression of being highly concentrated and motivated.

The influencing of the subjects' mood via the film excerpts was successful (Figure 2). The average mood in the treatment "negative" exhibited a value of 3.21, while it was 5.64 in the treatment "neutral" and 6.89 in the treatment "positive".

Fig. 2: Successful influencing of mood in the three treatments



In the Mann-Whitney U test the differences in the moods of the subjects were shown to be highly significant. The treatment "negative" differed significantly from the treatment "neutral" (z = -7.838, p = 0.000). The treatment "positive" also differed significantly from the treatment "neutral" (z = -6.263, p = 0.000). Accordingly, the treatment "negative" also differed significantly

from the treatment "positive" (z = -9.152, p = 0.000). In this way we established that the film excerpts achieved the intended influence on the subjects' mood.

For their forecasts, rational utility maximisers always use the expected value, which results from the four fundamental data items and the random influence. However, only just under a third (32.41%) of the preliminary forecasts and also only just below a third of the final forecasts (30.97%) corresponded to this expected value (Tab. 2). Over two thirds of all forecasts were thus not based on rational considerations, and in this way the subjects reduced the expected value of their payment. Not even one in ten subjects (9.94%) followed a rational course of action throughout the experiment (Tab. 2). The average absolute deviation of the forecasts from the expected value was €18.26. In the t-test (one-sample mean comparison), the deviation from the rational strategy (average deviation of the of the forecasts from the expected value = 0) is highly significant (p = 0.000). Thus, null hypothesis 1 clearly has to be rejected. This confirmed our assumption that the subjects do not correspond to the neo-classical concept of homo oeconomicus.

Table 2: Overview of the rational strategy

	Treatment „neutral"	Treatment „positive"	Treatment „negative"	All treatments
Rational strategy (preliminary forecast)	84 out of 298 forecasts 28.19%	108 out of 315 forecasts 34.29%	100 out of 290 forecasts 34.48%	292 out of 903 forecasts 32.41%
Rational strategy (final forecast)	77 out of 298 forecasts 25.84%	98 out of 315 forecasts 30.79%	104 of 290 forecasts 35.86%	279 out of 903 forecasts 30.97%
Subjects with a rational strategy in all rounds	3 out of 60 subjects 5.00%	8 out of 63 subjects 12.70%	7 out of 58 subjects 12.07%	18 out of 181 subjects 9.94%

Just over a third of the preliminary forecasts (35.99%) were revised after the announcement of the average of these forecasts (consensus forecast) (Tab. 3). The majority of these revisions (86.46%) were in the direction of the consensus forecast. For the subjects, it is easy to recognize the forecast with which they can maximize the expected value of their payment. With the aid of the information on the fundamental data, the forecast with the highest probability of success can be worked out very simply. There is therefore no need to react to the announcement of the consensus forecast, and there is no sensible reason for changing one's own preliminary forecast in the direction of the consensus forecast. The revision of forecasts in the direction of the consensus forecast therefore has to be interpreted as a sign of herding behavior. The average absolute adjustment of the forecasts in the direction of the consensus forecast amounted to €28.27. In the t-test (one-sample mean comparison), the adjustment towards the consensus forecast is shown to be highly significant (p = 0.000). Null hypothesis 2 thus also has to be rejected. Our assumption that herding behavior would occur was confirmed.

Table 3: Overview of herding behavior

	Treatment „neutral“	Treatment „positive“	Treatment „negative“	All treatments
Revised forecasts	125 out of 298 forecasts 41.95%	106 out of 315 forecasts 33.65%	94 out of 290 forecasts 32.41%	325 out of 903 forecasts 35.99%
Revision per consensus (herding)	117 out of 298 forecasts 39.26%	85 out of 315 forecasts 26.98%	79 out of 290 forecasts 27.24%	281 out of 903 forecasts 31.12%
Revision against the consensus (anti-herding)	5 out of 298 forecasts 1.68%	14 out of 315 forecasts 4.44%	12 out of 290 forecasts 4.14%	31 out of 903 forecasts 3.43%
Other revisions	3 out of 298 forecasts 1.01%	7 out of 315 forecasts 2.22%	3 out of 290 forecasts 1.03%	13 out of 903 forecasts 1.44%
Subjects not exhibiting herding behavior in all rounds	16 out of 60 subjects 26.67%	20 out of 63 subjects 31.75%	20 out of 58 subjects 34.48%	56 out of 181 subjects 30.94%

“Other revisions" are ones which are in the direction of the consensus forecast, but go so far beyond it that they are further from the consensus forecast than they were before the revision.[1]

Table 4: Overview of the variance of the forecasts

	Treatment „neutral“	Treatment „positive“	Treatment „negative“	All treatments
Average standard deviation preliminary forecast	45.08	34.74	46.63	41.25
Average standard deviation final forecast	34.92	23.34	21.00	27.14

This result is further substantiated when the standard deviations of the preliminary and the final forecasts are compared (Tab. 4). The preliminary forecasts have an average standard deviation of 41.25, while the average standard deviation of the final forecast is only 27.14. The Wilcoxon signed rank test shows that the standard deviation is reduced significantly by the revision of the

[1] Here is an example of an “other revision”: the subject’s preliminary forecast is €200. The consensus forecast is €220. The subject’s final forecast is then €250. This is not anti-herding, because the forecast was changed in the direction of the consensus forecast. However, the subject cannot be accused of herding behavior either, because the final forecast is further from the consensus forecast than the preliminary forecast was.

forecasts (z = 2.023; p = 0.0431). Null hypothesis 3 thus has to be rejected too. This is a further clear indication of the occurrence of herding behavior.

In addition, it can be seen that mood really does exercise an influence on the tendency towards rational behavior. However, this influence turns out to be quite different to what was initially expected. The results of previous research showed that a neutral mood is best suited to promoting the pursuit of rational action. Positive and negative moods tend to reduce the ability and/or willingness to act rationally, it was thought. This experiment, however, reveals a completely different picture (Tab. 2). In the treatment "neutral", only 84 of the 298 preliminary forecasts (28.19%) are based on the rational approach. In the treatment "positive", the figure is slightly higher at 108 out of 315 preliminary forecasts (34.29%). In the treatment "negative", it is 100 out of 290 preliminary forecasts (34.48%). The picture is very similar for the final forecasts (Tab.2). In the treatment "neutral", only 77 of the 298 preliminary forecasts (25.84%) are based on a rational approach. In the treatment "positive", the figure is somewhat higher at 98 out of 315 preliminary forecasts (30.79%). In the treatment "negative", it is 104 out of 290 preliminary forecasts (35.86%). The Wilcoxon rank sum test shows that the difference between the treatment "neutral" and the treatment "positive" (p = 0.1669) is not significant, and neither is the difference between the treatments "positive" and "negative" (p = 0.6707). Only the treatment "neutral" differs significantly from the treatment "negative" (p = 0.0694). Null hypothesis 4 therefore cannot be rejected. The presumption that a neutral mood is more conducive to a rational strategy than a positive or negative mood was therefore not confirmed. The opposite was closer to the truth.

It can be seen here that mood really does have an influence on the tendency towards herd behavior (Tab. 3). In the treatment "neutral", 117 out of 298 forecasts (39.26%) were corrected in the direction of the consensus forecast, while in the treatment "positive", only 85 out of 315 forecasts (26.98%) were revised in the direction of the consensus forecast. In the treatment "negative", 79 out of 290 forecasts (27.24%) were adjusted in the direction of the consensus forecast. The Wilcoxon rank sum test shows that the difference in terms of herding behavior between the treatment "neutral" and the treatment "positive" (p = 0.0333) is significant, as is the difference between the treatments "neutral" and "negative" (p = 0.0438). There is no significant difference between the treatments "negative" and the treatment "positive" (p = 0.9143). Null hypothesis 5 thus has to be rejected. The presumption that mood does have an influence on the tendency towards herding behavior was thus confirmed. It can be seen that subjects in a neutral mood are particularly susceptible to herding behavior.

4 Summary

In this experiment, the influence of the subjects' mood on their tendency towards herding behavior in the context of share price forecasts was analyzed. The future share price is composed - in a deterministic way - of four fundamental influencing factors which the subjects are informed of before every round of the game. A random influence with an expected value of zero and with the greatest probability for the event of ±0 makes forecasting more difficult. Subjects who act rationally forecast the future share price in accordance with the four fundamental influencing

factors and presume a random event of Ɛ = ±0. In this way they can maximize their expected payment. First of all the subjects make a preliminary forecast. Then they are informed of the average of all of the preliminary forecasts (consensus forecast), after which they have the opportunity to revise their preliminary forecast.
The experiment is carried out using three treatments (neutral, positive and negative) The three treatments differ in terms of the mood which is created among the subjects. The subjects' mood is influenced by film excerpts which are shown before every preliminary and every final forecast is made. Manipulation checks confirm whether the film excerpts have achieved the desired mood change.

The experiment produced the following results:

1. The subjects did not act in accordance with *homo oeconomicus*, a figurative human characterized by the ability to make rational decisions, because they did not always choose the rational strategy. Less than a third of all forecasting decisions (31.62%) followed the rational strategy, and less than a tenth of all subjects (9.94%) always made rational decisions.
2. After the consensus forecast had been announced, the subjects frequently adjusted their forecasts (in 35.99% of all cases). These adjustments were almost exclusively in the direction of the consensus forecast. A clear tendency towards herding behavior was thus observed.
3. The average standard deviation of the preliminary forecasts was significantly higher than the average standard deviation of the final forecasts. This is also a sign of herding.
4. There was hardly any sign of anti-herding. Only 3.43% of the revisions of forecasts were not in the direction of the consensus forecast, and were thus in the opposite direction.
5. The rational strategy was followed significantly more often in the treatments "positive" (34.29%) and negative (34.48%) than in the treatment "neutral" at 28.19%.
6. Adjustments of the forecasts in the direction of the consensus forecast (herding behavior) occurred in the treatments "positive" (26.98%) and "negative" (27.24%) significantly less often than in the treatment "neutral" (39.26%).

In summary, it can be stated that herding can be observed very frequently. The mood of the subjects has an influence on the occurrence of herding. The tendency towards herding behavior is stronger in a neutral mood than in a positive or negative mood. In addition, less attention is paid to the rational strategy in a neutral mood than in a positive or negative mood.

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Appendix (instructions and test questions)

Instructions

Player number _____ Computer number _____

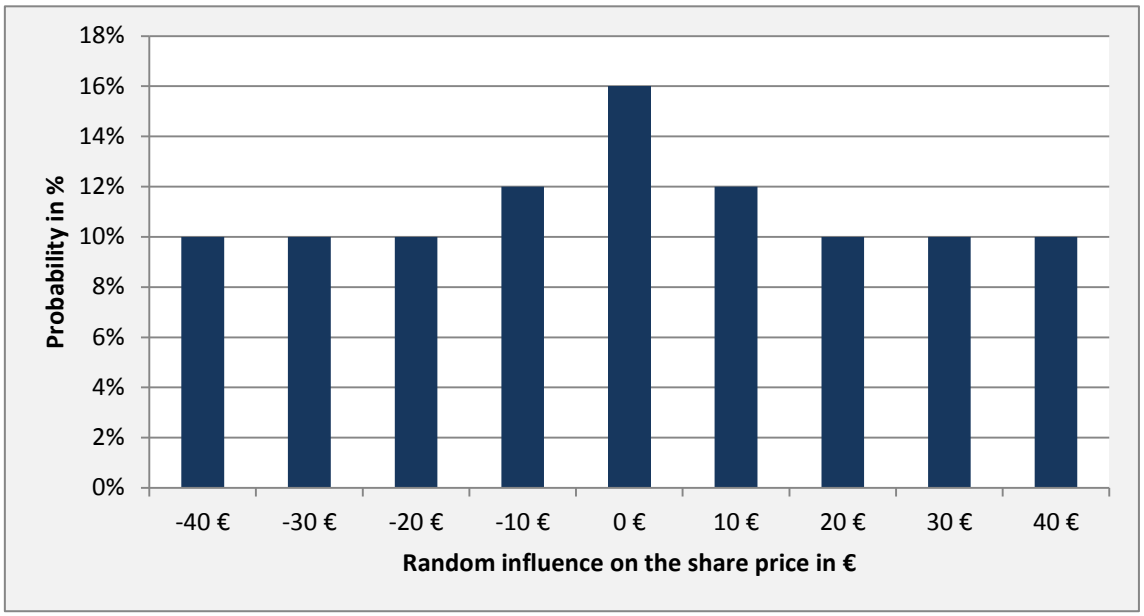
The Game

In this game you are requested to make forecasts for the future trend of a share price. This share price in euros at the point in time t (K_t) is always determined by four influencing factors (the fundamental data A_t, B_t, C_t and D_t) and a random influence (ε_t). The fundamental data is provided before each forecast is made. The subjects are also aware of the specific influence the fundamental data has on the share price.

$$K_t = 2 \cdot A_t + 3 \cdot B_t - 1 \cdot C_t + 4 \cdot D_t + \varepsilon_t$$

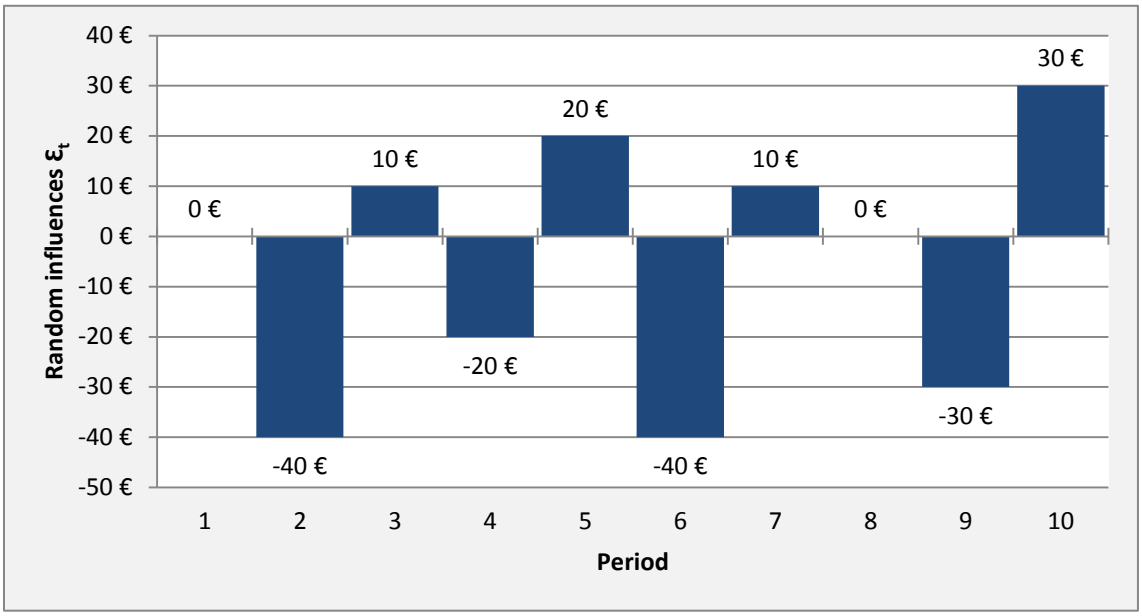
The value of the random influence (ε_t) moves within a range of €-40 and €+40. The probability of the events €-40, €-30, €-20, €+20, €+30 and €+40 is 10% each. The probability of the events €-10 and €+10 is 12%. The event €±0 has a probability of occurrence of 16% (Figure 1).

Fig. 1: Distribution of the probability of the random influence ε_t on the formation of the share price in euros



The random influence ε_t for each period is determined by a lottery. On the next page you can see the random influences of the last 10 periods (Fig. 2).

Fig. 2: Random influences ε_t of the last 10 periods



As an example, here is how the share prices were determined for Period 6.

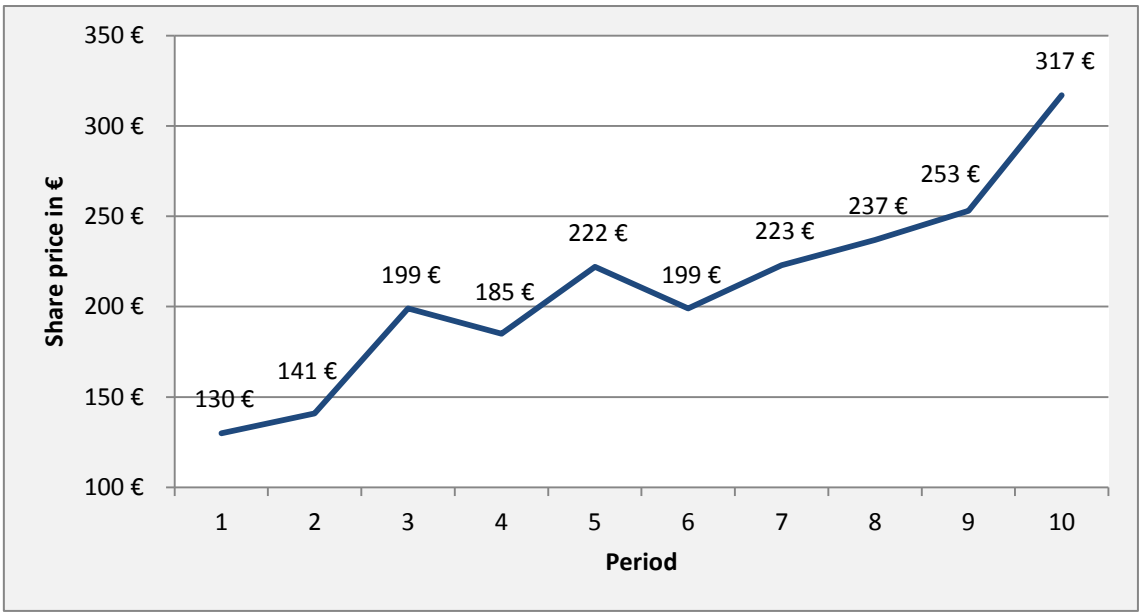
The fundamental data and the random influence are as follows:

A_6 = €31; B_6 = €26; C_6 = €25; D_6 = €31; ε_6 = €-40

Hence:
$K_6 = 2 \cdot €31 + 3 \cdot €26 - 1 \cdot €25 + 4 \cdot €31 + €-40 = €199$

In Figure 3 you can see the price movements of the share over the last ten periods.

Fig. 3: Price movements of the share over the last ten periods.



Share price in euros / period

Procedure:

After reading the instructions and answering the test questions you will see a film excerpt. Following this you will receive the figures of the fundamental data for the current period. You will be asked to make a forecast for the share price. Then you will see another film excerpt. Then you will receive the information about the consensus forecast. The consensus forecast is the arithmetical average of all preliminary forecasts made by the participants. Now you have the opportunity to revise your forecast. A total of five rounds are played. Before each round you see the trajectory of the share price and the random influences of the last rounds of the game.

Payment:

You will receive a show-up fee of €5 for taking part in the experiment. For every successful share price forecast you receive €10. A forecast is considered successful and is rewarded accordingly when it does not diverge by more than €10 from the actual share price. In total you can earn up to €55. Payment is made at the end of the experiment.

Information:

- Please remain quiet during the experiment
- Do not look at your neighbors' screen
- Apart from a pocket calculator, no aids are permitted (smartphones, smart watches etc.)
- Please note the respective time limits given on the upper right of the screen.

Test questions

Multiple-choice test questions:

1. What is your task in this game?
   - Solving mathematical problems.
   - Making forecasts for the future trend of a share price. (correct)
   - Making diversification decisions.

2. What is the probability of occurrence of the random influences €-10 and €+10?
   - 16%
   - 10%
   - 12% (correct)

3. What does the payment depend on?
   - On the movement of the share price.
   - On the success of the forecast. (correct)
   - On the level of the DAX.

4. The current share price is €232 and you forecast €241. How much is your payout?
   - €5
   - €0
   - €10 (correct)