

Rau, Holger A.

**Working Paper**

## The disposition effect in team investment decisions: Experimental evidence

cege Discussion Papers, No. 256

**Provided in Cooperation with:**

Georg August University of Göttingen, Department of Economics

*Suggested Citation:* Rau, Holger A. (2015) : The disposition effect in team investment decisions: Experimental evidence, cege Discussion Papers, No. 256, University of Göttingen, Center for European, Governance and Economic Development Research (cege), Göttingen

This Version is available at:

<https://hdl.handle.net/10419/117334>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

**THE DISPOSITION EFFECT IN TEAM  
INVESTMENT DECISIONS:  
EXPERIMENTAL EVIDENCE**

---

Holger A. Rau

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

# The Disposition Effect in Team Investment Decisions: Experimental Evidence\*

Holger A. Rau<sup>†</sup>

University of Göttingen, Germany

August 2015

## Abstract

This paper experimentally studies the disposition effects of teams and individuals. The disposition effect describes the phenomenon that investors are reluctant to realize losses, whereas winners are sold too early. Our experiments compare the investments of two-person teams to a setting where investors trade alone. We find that subjects investing jointly exhibit more pronounced disposition effects than individuals. A closer look reveals that investor teams hardly realize losses and predominately sell winners. The data suggest that decision-dependent emotions may explain the differences. That is, teams reporting high levels of regret exhibit significantly higher disposition effects than individuals.

JEL Classification numbers: C92, D70, G12.

Keywords: Decision-dependent emotions, Disposition Effect, Experiment, Team Decision Making.

---

\*I am grateful to Volker Benndorf, Peter Bossaerts, Sascha Füllbrunn, Tommy Gärner, Hans-Theo Normann, Stefan Palan, Charles Plott, David Rojo-Arjona, and Utz Weitzel for helpful comments. I am also indebted to conference participants of the 2011 International ESA Conference in Chicago, the Experimental Finance conference 2011 in Innsbruck, the SABE meeting in Granada 2012, the SEA meeting in New Orleans 2012, The IIOC Annual Meeting in Boston 2013, and seminar participants at the University of Duesseldorf. I would also like to thank the Duesseldorf Institute of Competition Economics (DICE), Heinrich-Heine University of Duesseldorf for financial support and Volker Benndorf for programming the z-Tree code.

<sup>†</sup>Platz der Göttinger Sieben 3, 37073 Göttingen, Phone: +49 551/3922281, E-Mail: holger.rau@uni-goettingen.de

# 1 Introduction

Investors on financial markets are commonly prone to biases and systematic errors<sup>1</sup> which harm their profits (Coval and Shumway, 2005). That is why, they have developed ways which attempt to overcome these biases. There is evidence that a growing number of professional traders have started to trade jointly. Bär et al. (2011) point out that from 1994 until 2003 the fraction of team-managed US equity funds increased from 12% to 57%. Similarly, more and more investors in the private sector have started to discuss the investments in stock market clubs. The “National Association of Investors Corporation” reports on its web page (2015)<sup>2</sup> that it encompasses 13,000 investment clubs with 120,000 members.

One of these biases is the disposition effect which can significantly harm the profit of investors (Odean, 1998). As a consequence, it is frequently studied in behavioral finance. The bias describes a behavior where investors are reluctant to realize capital losses, whereas they sell capital gains quickly (Shefrin and Statman, 1985). Explanations are provided by prospect theory (Kahneman and Tversky, 1979), mental accounting (Thaler, 1985), and emotions (Shefrin and Statman, 1985). Summers and Duxbury (2012) demonstrate that emotional responses such as regret are a necessary cause of disposition effects. The effect is confirmed for private investors (Odean, 1998; Dhar and Zhu, 2006), professional traders (Ferris et al., 1988, Garvey and Murphy, 2004), house owners (Genesove and Mayer, 2001), and students (Weber and Camerer, 1998). Recent experiments have demonstrated that nudging approaches help to debias the disposition effect of individuals. Frydman and Rangel (2014) show that disposition effects are weaker when stocks’ purchase prices are prominently displayed. Fischbacher et al. (2014) report similar findings in a setup with an automatic selling option. Although there is extensive evidence for individuals, less is known about the ability of teams to attenuate disposition effects. Interestingly, the scarce results on the disposition effect in teams point in the opposite direction.

Cici (2012) empirically shows in a data set of US equity mutual funds that team managers exhibit higher disposition effects than individuals. Although these empirical findings are intriguing, it remains unclear why teams are more susceptible to the effect. In particular, it is unknown to which extent behavioral forces such as emotions and group dynamics may have caused the differences. Summers and Duxbury (2012) highlight the role of emotional responses for the emergence of disposition effects. The authors demonstrate that investors keep capital losses to avoid the experience of regret, whereas they realize capital gains to secure the feeling of rejoice. Interestingly, psychological concepts such as groupthink (Janis, 1972) and group polarization (Isenberg, 1986) find that subjects in groups are often prone to group dynamics which may affect their perceptions. Cici (2012) refers to this and suggests that his findings may be explained by *groupthink*.<sup>3</sup> The groupthink theory describes a phenomenon where group members are motivated by conformity. Hence, they tend to reach their agreements without critically evaluating them (Janis, 1972). A related concept is *group polarization* (Isenberg, 1986), which

---

<sup>1</sup>See Barberis and Thaler (2003) for a survey on behavioral finance.

<sup>2</sup>see <http://www.betterinvesting.org>

<sup>3</sup>Bénabou (2013) highlights in a theoretical framework that groupthink might have been an impulsive factor for the failures of companies like “Enron” and “Worldcom” or the financial crisis (see also Janis, 1972).

refers to the phenomenon that group decisions may become more extreme following discussions. In that case, subjects may start to socially compare their preferences with other group members. This may result in an average shift of group preferences, when all members try to adjust their preferences above the average group tendency (Isenberg, 1986). Following Summers and Duxbury (2012) and the idea that preferences may become more extreme in teams, it is possible that teams exhibit higher disposition effects because their perception of regret is enhanced after group discussions.

Laboratory experiments offer controlled environments to study subjects' emotions and preferences which can help to better understand the emergence of decision biases. Motivated by the empirical findings of Cici (2012), we apply laboratory methods to shed more light on the more pronounced disposition effects of teams. The experiments control for the impact of emotional responses and preferences on the emergence of disposition effects. We measure the *individual-level* disposition effects of teams and individuals and relate them to subjects' levels of reported regret and rejoice. We also control for the impact of loss aversion. Our research is inspired by Summers and Duxbury (2012) who argue that emotional responses are a major cause of disposition effects. Following the idea that group polarization (Isenberg, 1986) may enhance emotional responses, we hypothesize that disposition effects are higher in social contexts. To test this, we conduct experiments which build on the experiment of Weber and Camerer (1998). The authors show in a setting with six artificial stocks and pre-determined prices that individuals are prone to disposition effects. Our paper extends their framework to a setup where teams of *two* investors can discuss their trades and decide jointly.

We find strong support for our hypothesis, i.e., the disposition effect is especially pronounced for teams. In more detail, they are reluctant to realize capital losses and predominantly sell capital gains. Thus, our findings confirm Cici's (2012) results in the lab. Subjects investing jointly report a significantly higher degree of perceived regret, indicating that the social context may have amplified teams' emotional responses. The data reveal a strong positive correlation between the perceived regret of teams and the disposition effect. Hence, we find support for the findings of Summers and Duxbury (2012) in a setting where investors decide jointly. Our results therefore suggest that the disposition effects of teams are higher because emotional responses seem to be more pronounced in social environments.

The paper is organized as follows: Section 2 discusses the related literature. Section 3 introduces the conceptual background. Section 4 derives hypotheses and presents the experimental design. Section 5 reports the results and section 6 discusses the findings.

## 2 Related Literature

Our paper is related to experiments on the disposition effect and studies analyzing team decision making. Hence, we review the relevant literature of these areas. We start with experiments on the disposition effect and continue with papers dealing with team decision making.<sup>4</sup>

---

<sup>4</sup>See Kugler et al. (2012) for a survey on group decision making.

## 2.1 Experiments on the Disposition Effect

The emergence of disposition effects is well-documented in laboratory experiments. Weber and Camerer (1998) analyze an investment setting consisting of six assets with pre-determined prices. The assets differ in their characteristics, i.e., their likelihood of stock price increases. The authors find that more than 70% of their participants exhibit disposition effects. Importantly, subjects' disposition effects are stable even between different tasks. This is shown by Weber and Welfens (2007) who study a within-subjects design. The experiment analyzes disposition effects in an investment task similar to Weber and Camerer (1998) and in a framed housing task. In the housing task, the decision makers own houses of different values which change over time. In that case, the disposition effects are calculated based on subjects' willingness to realize houses which have increased/decreased in value. The paper finds a high correlation of individual-level disposition effects in both tasks. Moreover, studies analyzing gender differences find that disposition effects may differ between men and women. However, the results are inconclusive: Da Costa Jr et al. (2008) report that the effect is more pronounced for men, whereas Rau (2014) finds the opposite.

Other papers establish that psychological forces play an important role for the emergence of disposition effects. Chui (2001) applies the setting of Weber and Camerer (1998) and investigates whether disposition effects occur as a result of a psychological concept called "locus of control." The concept argues that persons with an *internal* locus of control believe that their failures are directly related to their decisions, whereas persons with an *external* locus of control do not feel responsible for their outcomes. Chui finds that investors with an internal locus of control have more pronounced disposition effects. Other studies point out that emotions may significantly contribute to the emergence of disposition effects (e.g., Shefrin and Statman, 1985). A recent study of Summers and Duxbury (2012) builds on this idea. The authors demonstrate that decision-dependent emotions such as regret and rejoice are a necessary cause of disposition effects. The paper compares a setting where investors purchase their stocks to an environment where they are automatically endowed with stocks. The authors conclude that disposition effects only occur when investors purchased the stock themselves. Interestingly, subjects report significantly higher levels of regret when they are responsible for their trades. The importance of emotions is also confirmed by neuroeconomic approaches. Goulart et al. (2013) emphasize in a skin-conductor study that subjects with higher disposition effects sweat more.

Recently, some papers have highlighted that experience and nudging may help to attenuate the bias. Da Costa Jr et al. (2013) argue that experienced traders exhibit smaller disposition effects than students. Moreover, disposition effects become smaller when the purchase prices of stocks are prominently displayed (Frydman and Rangel, 2014) or when automatic-selling options are used (Fischbacher et al., 2014).

## 2.2 Studies on Team Decision Making

A number of team experiments focus on tasks which are against nature or analyze strategic games. These studies commonly conclude that deciding jointly leads to more rational decisions.

For instance, there is evidence that teams are better at statistical assessments (Blinder and Morgan, 2000), Bayesian updating (Charness et al., 2007) and learn faster in beauty-contest games (Kocher and Sutter, 2005). Similarly, Cooper and Kagel (2005) show in a market-entry game that teams are better in learning.

By contrast, papers on risk-taking behavior find mixed evidence. Focusing on lottery-choice experiments, a series of studies find that teams are more risk averse than individuals (Baker et al., 2008; Shupp and Williams, 2008; Masclet et al., 2009).<sup>5</sup> Empirical papers analyzing the data of mutual funds report these insights (Bliss et al., 2008; Bär et al., 2011). At the same time, no significant differences can be found in an experiment by Harrison et al. (2012) and an empirical study of Prather and Middleton (2002).

Studies analyzing performance in investment settings also report inconclusive results. There is a pattern that teams apparently make better portfolio decisions than individuals. This is documented by a laboratory experiment of Rockenbach et al. (2007).<sup>6</sup> Empirical evidence supports this view. Bär et al. (2011) find that team-managed funds experience higher inflows.<sup>7</sup> Cheung and Palan (2009) demonstrate that teams of two investors debias the occurrence of price bubbles in experimental asset markets. However, teams may be more prone to heuristic-based biases such as sunk cost effects. This is found by Whyte (1993) who shows that teams who have invested in a failing stock feel significantly more committed to it than individuals. Instead of selling the stock, teams invest additional money in the failing investment.

Our paper is most related to the empirical study of Cici (2012). The author analyzes whether the disposition effects of individuals and teams differ. The study analyzes data on US equity mutual funds from January 1980 to December 2009. The disposition effects are calculated based on the proportion of realized gains and losses (Odean, 1998). The measures are derived on the aggregate level for each fund and each quarter where at least one stock sale took place. Hence, a fund is prone to a disposition effect when it disproportionately realizes more capital gains than losses. The study postulates two possible views regarding the efficiency of teams. First, it may be that the objectivity of other team members might help to break possible attachments to portfolio stocks. Second, team members may gravitate toward “groupthink.” The latter describes the behavior of teams that sometimes tend to reach agreements without critically evaluating their ideas (Janis, 1972). Cici finds that disposition effects are more pronounced for teams and concludes that groupthink may be the driver.

We analyze in a controlled setting whether these findings also emerge in the laboratory. In addition to Cici (2012), this study tries to find explanations based on the channels which may trigger this result. We therefore concentrate on individual investors’ characteristics such as their perception of emotions and their level of loss aversion. In contrast to Cici (2012), we calculate the disposition effects of teams and single investors, based on an individual level. Inspired by Cici’s suggestion that psychological effects may play a role, we analyze subjects’ reported level of perceived regret/rejoice after stock prices decrease/increase. We incorporate these individual

---

<sup>5</sup>Sutter (2007) studies myopic loss aversion and demonstrates that the effect is less pronounced in teams.

<sup>6</sup>The authors also argue that teams and individuals do not differ in terms of expected utility theory.

<sup>7</sup>At the same time, Prather and Middleton (2002) and Bliss et al. (2008) empirically find no performance differences between individuals and teams.

characteristics in our analyses and test their impact for the emergence of disposition effects.

### 3 Conceptual Background

This section demonstrates how the interplay of prospect theory (Kahneman and Tversky, 1979), mental accounting (Thaler, 1985), and decision-dependent emotions (Summers and Duxbury, 2012) may cause disposition effects. Furthermore, we show how the concept of group polarization (Isenberg, 1986) may relate to the disposition effect in team decisions. Afterwards, we introduce the experimental framework of Weber and Camerer (1998) and present the disposition-effect measures which are used in this paper.

#### 3.1 The Causes of Disposition Effects

There is evidence that disposition effects are induced by the combination of wealth changes and investors' responsibility for these events. The wealth-change argument was put forward by Shefrin and Statman (1985) who apply prospect theory (Kahneman and Tversky, 1979) and mental accounting (Thaler, 1985) to explain disposition effects. The main idea is that subjects' utility follows an S-shaped value function which is defined by changes in wealth. The function is concave in the gain domain, whereas it is convex and steeper in the loss domain. The S shape implies that subjects show a reference-dependent behavior. That is, investors become risk averse in the gain domain, whereas they increase their risk tolerance in the loss domain. Prospect theory predicts that investors will tend to realize capital gains in order to avoid facing the risk that the stock price will further decline in the future. By contrast, investors will be predisposed to keep their assets when the stocks have decreased in value. Moreover, the concept of mental accounting (Thaler, 1985) assumes that investors evaluate different stocks separately. That is, they use each stock's purchase price as its individual reference point. Shefrin and Statman (1985) suggest that psychological factors such as the avoidance of regret and the experience of pride may additionally matter for the cause of disposition effects.

Motivated by this, Summers and Duxbury (2012) demonstrate that specific emotional responses are necessary to cause the disposition effect. Their argument builds on the idea that the change in risk preferences as described in prospect theory, is not sufficient to cause disposition effects. The authors argue that investors' responsibility for wealth changes leads to positive/negative emotions which ultimately cause the effect. In the next paragraph we demonstrate Summers and Duxbury's (2012) idea, describing how decision-dependent emotions cause disposition effects.

An investor who bought a stock feels disappointment when she realizes that it has decreased in value. In the current period the investor has to decide whether to keep or realize the stock. If the investor keeps the stock there is a possibility that it will change in value. By contrast, the wealth change becomes fixed when the stock is realized. In this case, the investor would experience disappointment because of the wealth change. However, she would additionally feel regret about having bought the stock. Hence, it is likely that investors do not realize losing stocks, as they want to avoid the negative emotion of regret. Conversely, an investor experiences



elation when stocks have increased in value. If the investor decides to realize the stock, she would additionally experience rejoice because it would thus be confirmed that the investment was smart. Selling the stock ensures that subjects can preserve the positive emotions induced by making the right investments. Therefore, it might be optimal to realize capital gains quickly.

Summers and Duxbury (2012) find that disposition effects only occur when investors are responsible for their portfolio. The authors point out that regret is the main driver of the disposition effect leading to subjects' reluctance to realize capital losses. At the same time, they demonstrate that elation is sufficient for the realization of capital gains. In this paper we build on the evidence that disposition effects are caused by a combination of prospect theory and decision-dependent emotions. We especially focus on the impact of decision-dependent emotions on the disposition effect when investors make decisions as a team.

## 3.2 Group Polarization

Focusing on social contexts such as team investments, it is likely that group dynamics such as groupthink (Janis, 1972) and group polarization (Isenberg, 1986) may play a role. In contrast to groupthink, group polarization is more likely to occur in groups without leaders (Kocher and Sutter, 2012). As our experimental framework analyzes a group setting without designated leaders, we refer in the following to the concept of group polarization.

The concept of group polarization describes the phenomenon that decisions in groups often become more extreme than individual decisions. In this case an initial tendency of one or more group members toward a certain direction is emphasized after group discussion (Isenberg, 1986). The group-polarization theory argues that "social comparison" may be responsible for the more extreme outcomes of groups. More precisely, team members are motivated to present themselves in a socially desirable light. In this regard, they constantly process information in the group discussion about how other group members present themselves. It follows that people adjust their own self-expression accordingly (Isenberg, 1986). Some people often tend to be perceived more favorably than others. When most group members behave like this, the consequence will be an average shift towards a more extreme direction.

We now apply this concept to the emergence of disposition effects in teams. According to Summers and Duxbury (2012), investors experience disappointment when facing losses, whereas they feel elation when facing gains. When investors sell stocks they additionally feel regret in the first case and rejoice in the second case. If groups polarize after group discussions this may lead to a reinforcement of these emotions. Put differently, when a team owns shares which have lost in value, both members should feel disappointment. At the same time, both members should fear the feeling of regret when capital losses are realized. Thus, teams may discuss the consequences of realizing capital losses. In this case, it is possible that a team member may adjust her own self-representation when she realizes that the other member is regret averse. According to the concept of group polarization this may lead to an average shift of the perceived regret of team members. Hence, it is possible that teams perceive a higher level of regret when facing of capital losses than individuals. The same idea applies to the case of capital gains. Here, we expect that teams may report a higher level of perceived rejoice due to polarization after group discussions.

### 3.3 The Framework of Weber and Camerer

In the experimental framework of Weber and Camerer (1998) six different assets labeled A, B, C, D, E, and F are traded in 14 periods. The asset prices are predetermined for all periods and follow a distinct random process. Thus, prices cannot be influenced by subjects' trading actions. The price sequences of all 14 periods are computed by a random table before the experiment starts. The stocks are classified in different types which determine their chances of a price increase. More precisely, exactly one stock follows a *good/very good* quality (labeled: +, ++), exactly one stock follows a *poor/very poor* quality (labeled: -, --), and two stocks follow a *neutral* quality (labeled: 0). Subjects were told about the existence of the types and their characteristics, but received no information on the allocation of the labels. Our experiment uses exactly the same stocks (A to F), the same allocation of the stock types and the same price sequences as in Weber and Camerer (1998). In each period, prices are set in two stages: 1. Determination of the price movements; 2. Determination of the price changes' magnitudes. The two stages are explained in detail in the following sections.

#### Stage 1: Determination of the Price Movement

It is determined in the first stage whether an asset increases/decreases in value. The probability of a price increase/decrease depends on the assets' stock types. Weber and Camerer's (1998) random process allocates fixed probabilities of stock increases/decreases for each stock type of each quality. This design feature allows the predetermination of the sequence of the price changes. The idea is to create a controlled setting with stocks which clearly represent good, bad or neutral types. First, a random process determines whether a stock increases or decreases in value. This depends on the underlying probabilities for price increases of the stock types (see Table 1, third column). Table 1 presents the underlying allocation of the stocks (A to F) to the types. Our experiment follows Weber and Camerer (1998) and adopts their design.

Table 1: Stock characteristics

stock		probability of price change	
name	type	increase	decrease
A	+	55%	45%
B	-	45%	55%
C	--	35%	65%
D, E	0	50%	50%
F	++	65%	35%

Notes: Overview of the stock types and their probabilities of price increases and decreases.

#### Stage 2: Determination of the Price Magnitude

The magnitude of the price change is randomly determined in the second stage and can either be 1, 3 or 5 Talers. All outcomes occur with a probability of one third. The probability of a stock price increase is not correlated with the magnitude of the price change and the expected

value of a price change for a randomly-chosen stock is zero. The framework easily allows the application of Bayesian Updating in each period. Bayesian subjects would repeatedly update their beliefs on the increase probability of all six shares, based on the actual observed price changes. Hence, investors may apply a simple heuristic of counting the number of times a stock increased to determine its type. The stock whose price has increased most often is most likely to be of the ++ type. The stock which had the second highest number of price increases must be of type +, etc.<sup>8</sup>

Weber and Camerer (1998) determined stocks' price sequences as outlined above. They also computed the asset prices for four prior periods: -3, -2, -1, and 0. This information is presented to subjects prior to the start of the experiment. The purpose is to give participants an initial idea of the stocks' characteristics. In this experiment we also present this information to subjects before the experiment starts. Figure 1 illustrates the resulting stock movements of Weber Camerer (1998) in periods -3 to 14.

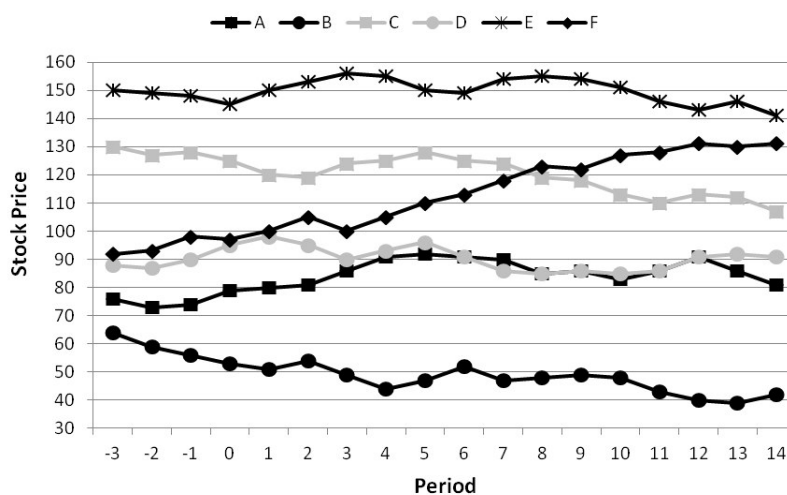


Figure 1: Price movements of stocks A to F over time.

### Elicitation of Guess Scores

Weber and Camerer (1998) examine the possibility that subjects' disposition effects are caused by misjudgments of the stock types. After periods 7 and 14 subjects have to guess the type of each of the six stocks. The estimates are used to derive a measure of fit ( $\delta$ ) between the best fit and a subjects' actual guess of the stock type. The guesses of the six stocks are coded in the following way: ++ = 2, + = 1, 0 = 0, - = -1, -- = -2. The coding corresponds to the rational estimate. Afterwards, the absolute value of the difference between a subject's actual estimate and the rational estimate is calculated for each of the six stocks. The delta corresponds to the sum of the absolute differences of all six stocks. The  $\delta$ -measure ranges from 0 (best estimates) to 12 (worst estimates). For instance, if a subject guesses that the ++-type is stock "F" then the subject's actual estimate equals the rational estimate. Thus, the difference

<sup>8</sup>Investors who apply this method would discover the trends: +, --, -, 0, 0, ++ for shares A to F before period 8 and +, -, --, 0, 0, ++ in periods 9 to 14.

is:  $2 - 2 = 0$ . If the subject guesses that the 0-type is stock “A” then the difference is:  $1 - 0 = 1$ . It follows for the delta of this subject:  $\delta = 0 + 1 + \text{etc.}$

### 3.4 Measures of the Disposition Effect

When investors sell shares, the purchase prices are not always known. Hence, the paper uses three accounting principles to compute results: (i) *Average Price*; (ii) *Last-In-First-Out* (LIFO); (iii) *First-In-First-Out* (FIFO).<sup>9</sup> The Average Price approach (e.g., Odean, 1998) determines stocks’ purchase price as weighted average of all stocks’ purchase prices. By contrast, the LIFO/FIFO measures identify stocks’ purchase prices by assuming that investors sell the stocks in distinct orders. That is, the LIFO (FIFO) accounting principle assumes that investors first sell the stocks which were bought at the end (at the beginning).

In a next step, disposition effects are calculated assuming that investors use the purchase price as a reference point. The analysis follows Odean (1998) to test investors’ tendency of realizing stocks in the gain/loss domain. In contrast to Odean we compute individual-level disposition effects of all investors. We therefore determine the proportion of gains realized (PGR) and the proportion of losses realized (PLR). The PGR (PLR) is the number of realized capital gains (losses) divided by the total number of capital gains (losses) which could be potentially sold. Paper gains/losses are all gain and loss stocks which were not traded. In accordance with Odean (1998) it can be defined as follows:

$$\text{Proportion of Gains Realized (PGR)} = \frac{\text{Realized Gains}}{\text{Realized Gains} + \text{Paper Gains}}$$

$$\text{Proportion of Losses Realized (PLR)} = \frac{\text{Realized Losses}}{\text{Realized Losses} + \text{Paper Losses}}$$

We calculate individual-level disposition effects (DE) for all individual investors and each investor team as the difference between the PGR and PLR:

$$DE = PGR - PLR$$

The DE measure is defined between  $-1$  and  $1$ . Investors with  $DE = 1$  always realize the capital gains immediately, whereas they never realize capital losses. The opposite is true for investors with  $DE = -1$ . They immediately sell capital losses and never realize capital gains. Investors with  $DE = 0$  have a balanced amount of the PGR and PLR. Note, that in the Weber and Camerer framework (1998) it is not always optimal to immediately sell all capital losses. Even the ++ stock type sometimes generates losses. Hence, subjects should try to learn from the stocks’ price movements and sell when realizing that a stock is not likely to be a the ++ type.<sup>10</sup>

Odean (1998) and Da Costa Jr et al. (2013) point out that the DE measure has the disadvantage that it is sensitive to portfolio size and trading frequency.<sup>11</sup> Therefore, we also

<sup>9</sup>Figure 4 in the Appendix highlights that the three measures do not significantly differ.

<sup>10</sup>We want to thank an anonymous referee for this comment.

<sup>11</sup>Da Costa Jr et al. (2013) report that the PGR and PLR are likely to be smaller for investors who hold larger portfolios and trade frequently.

compute disposition effects with the measure of Weber and Camerer (1998). Henceforth we will refer to this measure as the “alpha” measure. It examines whether investors use last period’s stock prices as reference points. In this regard, it is considered whether subjects predominately sell after increases of last period’s stock price. The alpha measure can be defined as:

$$\alpha = \frac{(S_+ - S_-)}{(S_+ + S_-)}$$

Where  $S_+$  ( $S_-$ ) is the sum of trades realized after stock price increases (decreases). Alpha is the difference in sales of winner and loser stocks by one investor normalized by the total number of sales by this investor. An alpha of 1 (-1) indicates that subjects only sell after stock increases (decreases).

## 4 Hypotheses and Experimental Procedures

In this section we derive hypotheses for the emergence of disposition effects in team- and single-investment decisions. We refer to the conceptual background and related literature sections.

The previous section has shown that disposition effects are caused by the interplay of decision-dependent emotions and wealth changes (Summers and Duxbury, 2012). The emergence of disposition effects is empirically (e.g., Odean, 1998; Dhar and Zhu, 2006) and experimentally (e.g., Weber and Camerer, 1998; Da Costa Jr et al., 2013) well-confirmed for single investors. Hence, we expect that single investors in our experiment will exhibit disposition effects. Turning to joint investments, group polarization (Isenberg, 1986) suggests that team members may polarize after group discussions. As a consequence, team members’ perception of regret and rejoice should be reinforced after discussing their trades. Following the evidence that regret aversion and rejoice cause disposition effects (Summers and Duxbury, 2012), we anticipate that the disposition effects of teams will be higher as compared to single investors. Furthermore, Cici (2012) empirically shows that teams exhibit higher disposition effects. Thus, we formulate our main hypothesis:

### **Hypothesis 1**

*Team investors will exhibit higher disposition effects than single investors.*

The alpha measure of Weber and Camerer (1998) is another indicator to test whether subjects are prone to disposition effects. It investigates whether investors use last period’s stock price as reference point. According to that, investors are prone to disposition effects when they predominately sell after stock price increases. Weber and Camerer (1998) and Chui (2001) have shown that this behavior holds for single investors. Following the idea that group polarization enhances decision-dependent emotions, we anticipate that teams will have a higher alpha measure. Put differently, when teams perceive higher levels of regret, they are more reluctant to sell after price decreases than individuals. For the case of capital gains, teams’ enhanced perception of rejoice should induce more selling after stock price increases. Thus, we formulate our second hypothesis:

## Hypothesis 2

*Teams will be more inclined to predominantly sell after stock price increases.*

### 4.1 Experimental Procedures

The experiment involves two treatments named “single” and “team.” The *single* treatment is an exact replication of the Weber and Camerer (1998) setup with single investors. It follows the framework described in section 3.3.

A crucial difference applies to the *team* treatment, i.e., *two* investors discuss their trades in a joint portfolio. The experiment intends to take the next smallest step (i.e., extending the number of investors by one) to infer the effects of team-decision making. This is justified by the imprecise empirical evidence on the exact number of deciding team members. Instead, the experiment analyzes whether group polarization impacts the extent of the disposition effect as early as when *two* persons discuss their trades. The teams are randomly matched to rule out that team members know each other, which could increase coordination. The environment is also motivated by the approach of Cheung and Palan (2009) where teams of two investors sit at one computer. Similar to their experiment, teams can discuss their investments without a decision rule. The experiment does not apply a decision rule because it is not clear which rules are used in the field. Another reason is that the study aims to allow space for group polarization. Apart from the number of decision makers in *team*, everything is identical to *single*.

### 4.2 Treatment: Single

In *single* all participants received a show-up fee of 4€ and an endowment of 10,000 Talers. Subjects were informed in detail of the different stock types. All participants were told that exactly four stocks followed the types: +, ++, -, -- and two stocks followed 0. However, they did not receive information about the real types of stocks A to F. The two-stage pricing process was also explained to subjects. Before the experiment started, a computerized loss-aversion elicitation task was conducted (Gächter et al., 2010).<sup>12</sup> Participants received information on the stock prices (see Figure 1) of four prior periods (periods -3, -2, -1, 0) before period 1 started. In periods 1 to 13<sup>13</sup> subjects were given the possibility to buy or sell assets which were labeled with the neutral German word *Anteile* (“shares”). Subjects did not necessarily have to invest their endowment and could not borrow money. There were no transaction costs for trading and subjects were not allowed to make short sales, i.e., they could only sell stocks which they owned. In period 14 subjects’ portfolios were automatically liquidated. Their final payoff corresponds to the value of the liquidated portfolio plus the money they owned in period 14. To evaluate whether subjects had a good understanding of the stock types, they had to guess the stock types after periods 7 and 14. Here, they received 200 Talers (20 cents) for

<sup>12</sup>See section 5.3 for detailed information.

<sup>13</sup>The purpose of period 14 was to determine the final prices when all stocks were automatically liquidated.

each correct guess. Finally, subjects' levels of perceived regret and rejoice were elicited in a post-experimental questionnaire after the experiment was completed.

### 4.3 Treatment: Team

In *team* almost everything was identical as in *single*.<sup>14</sup> However, one crucial difference was that *two* investors decided on a joint portfolio. The teams were randomly composed, i.e., when entering the laboratory, everybody had to pick a ticket with a number indicating her matching partner. This reduced the probability of companioned participants forming teams. In most sessions five teams of two investors participated.<sup>15</sup> Team members were always allowed to discuss their strategies in a low voice with their partners before trading took place (Cheung and Palan, 2009). Subjects were asked to sit down at predetermined desks to avoid that teams being able to listen to the conversations of other teams. There were large gaps between the desks and great care was taken that subjects only talked quietly. In the *team* treatment each investor received a show-up fee of 4€. All teams were endowed with a joint endowment of 10,000 Talers. Each of the two team members received the final joint payoff at the end of the experiment.

Before the experiment started subjects in *single* and *team* had to complete a couple of control questions to ensure that every participant understood all the procedures. The experiment was programmed in z-Tree (Fischbacher, 2007). The data encompasses nine sessions of *team* with a total of 84 subjects (42 independent observations) and three sessions of the control treatment (*single*) with a total of 55 subjects (55 independent observations).<sup>16</sup> In total, 139 participants took part in the experiment and were recruited with ORSEE (Greiner, 2004). The subject pool consisted of students from the University of Düsseldorf from various fields who earned on average 15.89€. The sessions lasted 90 minutes on average.

## 5 Results

The results section starts with an overview of subjects' trading activities. The analysis then focuses on the occurrence of disposition effects. Afterwards, we study subjects' reported levels of perceived regret and rejoice. The section closes with regression analyses. All reported tests are based on two-sided  $p$ -values if not otherwise specified.

### 5.1 Trading Activities

Table 2 is an overview of subjects' trading activities in the two treatments. It counts each action where subjects either purchase or sell stocks as one "trade."

---

<sup>14</sup>The team treatment used exactly the same stock price movements. Subjects in the *team* treatment individually completed a "pen-and-paper" variant of the loss-aversion test.

<sup>15</sup>There also were three sessions where only four teams took part. This was due to the fact that only four teams showed up.

<sup>16</sup>The data of the control treatment was also used to study gender effects in Rau (2014).

Table 2: Summary statistic of subjects' trading activities

	single investors	team investors	total sample
sample size	55	42	97
total # of trades	1468	1106	2574
avg. cash held	4005.8	3566.4	3811.9
avg. # of stocks in portfolio	62.8	67.5	64.8
avg. freq. of trades	27.6	27.5	27.6
avg. freq. of stock purchases	16.9	17.9	17.3

Notes: The table reports the aggregate number of subjects' trades (*total # of trades*), the average amount of money which was not invested (*avg. cash held*), the average number of stocks held (*avg. # of stocks in portfolio*), and the average frequency of trades (*avg. freq. of trades*). It also presents the average frequency of stock purchases (*avg. freq. of stock purchases*).

Focusing on investors' portfolios, we find that individuals on average hold more cash (4005) than teams (3566). This may explain why individuals hold insignificantly less stock (62.8) than teams (67.5). The average frequency of trades is similar for individuals (27.6) and teams (27.5). However, single investors buy slightly less stock (16.9) than individuals (17.9).<sup>17</sup>

Table 3 presents subjects' selling actions. It overviews the average frequency of capital gain and capital loss sales.

Table 3: Subjects' selling actions

	avg. Price	LIFO	FIFO
<b>single investors</b>			
avg. frequency of capital gain sales	5.7	6.2	6.4
avg. frequency of capital loss sales	4.2	4.6	4.4
<b>team investors</b>			
avg. frequency of capital gain sales	5.5	6.3	6.1
avg. frequency of capital loss sales	3.0	3.2	3.4

Notes: The table focuses on the avg. frequency of capital gain and loss sales. The value of the sales is calculated by applying the avg. price, the LIFO, and the FIFO accounting principles.

We apply three accounting principles to determine whether stocks are sold as capital gains or losses (see section 3.4): avg. Price, Last-in-First-Out (LIFO), First-in-First-Out (FIFO).<sup>18</sup>

The results do not differ for any of the three determination methods. Hence, we discuss the data derived by the average-price method. A conspicuous finding is that single investors more frequently sell capital gains (5.7) than losses (4.2) (Wilcoxon matched-Pairs test,  $p = 0.019$ ). This confirms the findings of Weber and Camerer (1998) and Chui (2001). It is noteworthy that investing jointly leads to similar results, i.e., teams more frequently sell capital gains (5.5)

<sup>17</sup>All differences (average stocks in portfolios, cash held, and frequency of trades) are insignificant for Kolmogorov-Smirnov tests, with  $p$ -values of at least  $p > 0.2$ .

<sup>18</sup>All stocks whose selling prices were at least as high (below) their purchase prices are counted as capital gains (losses) (see Weber and Camerer, 1998).



than capital losses (3.0) (Wilcoxon matched-Pairs test,  $p = 0.002$ ).<sup>19</sup> The results are a first indication that both investor groups tend to exhibit disposition effects. Remarkably, teams sell capital loss sales (3.0) significantly less frequently than individuals (4.2) (Kolmogorov-Smirnov test,  $p = 0.040$ ). Thus, investing jointly seems to complicate the realization of capital losses.

## 5.2 Analysis of Disposition Effects

Table 4 presents subjects' disposition effects (DE) determined by the method of Odean (1998). The table also reports the proportion of gains realized (PGR) and the proportion of losses realized (PLR). The emergence of disposition effects is statistically tested by applying  $t$ -tests.

Table 4: Disposition effects of single and team investors

	single investors			team investors		
	avg. Price	LIFO	FIFO	avg. Price	LIFO	FIFO
<b>Disposition Effect (DE)</b>	0.00	-0.02	0.02	0.10	0.08	0.08
	(0.26)	(0.29)	(0.24)	(0.27)	(0.28)	(0.25)
$t$ -statistic (mean DE = 0)	-0.011	-0.563	0.572	2.315	1.961	2.062
standard error	0.035	0.039	0.033	0.042	0.043	0.038
$p$ -value	0.992	0.576	0.570	0.026	0.056	0.046
<b>PGR</b>	0.17	0.16	0.17	0.22	0.21	0.21
	(0.17)	(0.17)	(0.17)	(0.24)	(0.22)	(0.20)
$t$ -statistic (mean PGR = 0)	7.467	6.900	7.664	6.150	6.202	6.720
standard error	0.023	0.023	0.023	0.036	0.034	0.031
$p$ -value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
<b>PLR</b>	0.17	0.18	0.15	0.13	0.13	0.13
	(0.20)	(0.22)	(0.18)	(0.11)	(0.13)	(0.13)
$t$ -statistic (mean PLR = 0)	6.408	6.130	5.927	7.326	6.710	6.262
standard error	0.027	0.030	0.025	0.018	0.020	0.020
$p$ -value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Notes: The table summarizes subjects' disposition effects (DE) determined by the method of Odean (1998). It also reports the proportion of capital gains/losses realized. The standard deviations are reported in parentheses. The table also includes the  $t$ -statistics controlling whether the means are significantly different from 0.

The data shows that all accounting methods yield similar results. This holds for both investor groups and is confirmed by Kolmogorov-Smirnov tests.<sup>20</sup> Thus, we focus on the data derived by average prices. The DE measure of individuals (0.00) is not significantly different from zero ( $t$ -test,  $t(53) = -0.011$ ,  $p = 0.992$ ). Single investors realize a balanced proportion of

<sup>19</sup>All results hold for the LIFO and FIFO methods (all Wilcoxon matched-Pairs tests,  $p < 0.01$ ).

<sup>20</sup>All pairwise comparisons of the methods are insignificant (individuals:  $p > 0.688$ ; teams:  $p > 0.715$ ). See Figure 4 in the Appendix for CDFs, demonstrating no significant differences between the measures.

capital gains (0.17) and losses (0.17). A conspicuous finding is that teams have a DE (0.10) which is significantly different from zero ( $t$ -test,  $t(41) = 2.32$ ,  $p = 0.026$ ). Compared to individuals, teams not only realize a higher proportion of capital gains (0.22 vs. 0.17), in fact they also sell a smaller proportion of capital losses (0.13 vs. 0.17). Focusing on the PGR and PLR of teams, we find that they sell a significantly higher proportion of capital gains (0.22) than losses (0.13) ( $t$ -test,  $t(41) = 2.303$ ,  $p = 0.027$ ). By contrast, no difference can be found for individuals.<sup>21</sup> Hence, we find that the disposition effect is more pronounced for teams. This supports Hypothesis 1.

To test the robustness of the findings, we focus on the alpha measure of Weber and Camerer (1998). This method uses last period's stock price as a reference point. Table 5 reports the average alpha of single and team investors which correspond to disposition effects determined by last period's stock prices.

Table 5: Disposition effects determined by last period's stock price

	single investors	team investors
alpha measure (Weber and Camerer)	0.22 (0.64)	0.47 (0.63)
$t$ -statistic (mean $\alpha = 0$ )	2.553	4.927
standard error	0.086	0.096
$p$ -value	0.014	<0.001

Notes: The table depicts subjects' disposition effects derived by the alpha measure. Standard deviations are reported in parentheses.

The alpha measures of individuals (0.22) and teams (0.47) are positive and significantly different from zero.<sup>22</sup> Teams particularly sell after increases of last period's stock prices. We find that the teams' alpha is twice as high compared to single investors. The difference is significant (Kolmogorov-Smirnov test,  $p < 0.001$ ) and confirms Hypothesis 2. Thus, we find additional support that the disposition effect is more pronounced in joint investment decisions.

Figure 2 depicts the CDFs of single and team investors' alphas. The diagram documents that the largest fraction of subjects' alphas is greater than zero. This is more pronounced for teams (79%) than for individuals (64%). The diagram shows that teams face the problem of reaching agreements on their selling decisions. When deciding jointly, reference points like last period's stock prices play an important role. That is, price increases may serve as focal points facilitating the selling decisions of teams. By contrast, stock price decreases seem to hinder the realization of stocks for teams.

<sup>21</sup> $t$ -test,  $t(53) = -0.021$ ,  $p = 0.983$ .

<sup>22</sup> $t$ -tests reveal that alpha is significantly different from zero for individuals ( $t$ -test,  $t(54) = 2.553$ ,  $p = 0.014$ ) and teams ( $t$ -test,  $t(41) = 4.927$ ,  $p < 0.001$ ).

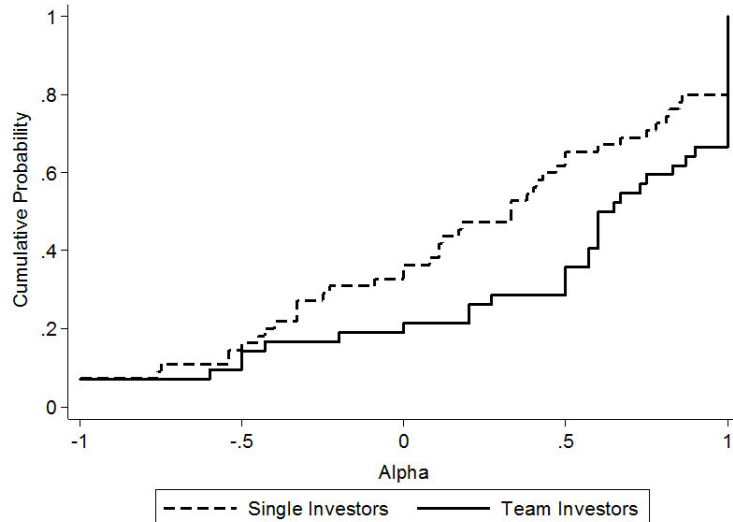


Figure 2: CDFs of single and teams investors' alphas.

### 5.3 The Role of Regret and Rejoice

This section aims to shed more light on the drivers of the disposition effects, analyzing the impact of subjects' decision-dependent emotions. We present the data on subjects' perception of regret and rejoice when stock prices decreased or increased respectively. The data was collected in a post-experimental questionnaire where single investors and team members were individually asked. Subjects answered the following question: "Please state on a scale between 1 (no regret) and 10 (strong regret) how much regret you felt when you owned shares which had decreased in value compared to the previous period."<sup>23</sup>

The perceived regret and rejoice of teams is determined by using the mean value of both members. We find that teams on average report a higher perceived regret (6.30) than individuals (5.89). A contingency test rejects the hypothesis that the distribution of perceived regret is the same for teams and individuals ( $\chi^2(17) = 48.816$ ,  $p < 0.001$ ). The same pattern occurs for subjects' perceived rejoice i.e., teams report a higher average level (7.40) than individuals (6.22) ( $\chi^2(14) = 51.218$ ,  $p < 0.001$ ). Figure 3 presents scatter plots illustrating the correlation of perceived regret/rejoice and the alpha measure. The diagrams are conditioned on single and team investors.

Generally, it can be seen that subjects' alphas increase in their level of perceived regret and rejoice. The pattern in Figure 3 shows that this is true for both single investors and team investors as well. Thus, the finding on single investors supports the results of Summers and Duxbury (2012). Interestingly, it turns out that the correlations of regret and rejoice are more pronounced for the case of team investors. Focusing on regret, we find that Pearson's correlation coefficient is positive and highly significant for teams ( $\rho = 0.498$ ,  $p < 0.001$ ). By

<sup>23</sup>For the case of rejoice we asked: "Please state on a scale between 1 (no rejoice) and 10 (strong rejoice) how much rejoice you felt when you owned shares which had increased in value compared to the previous period."

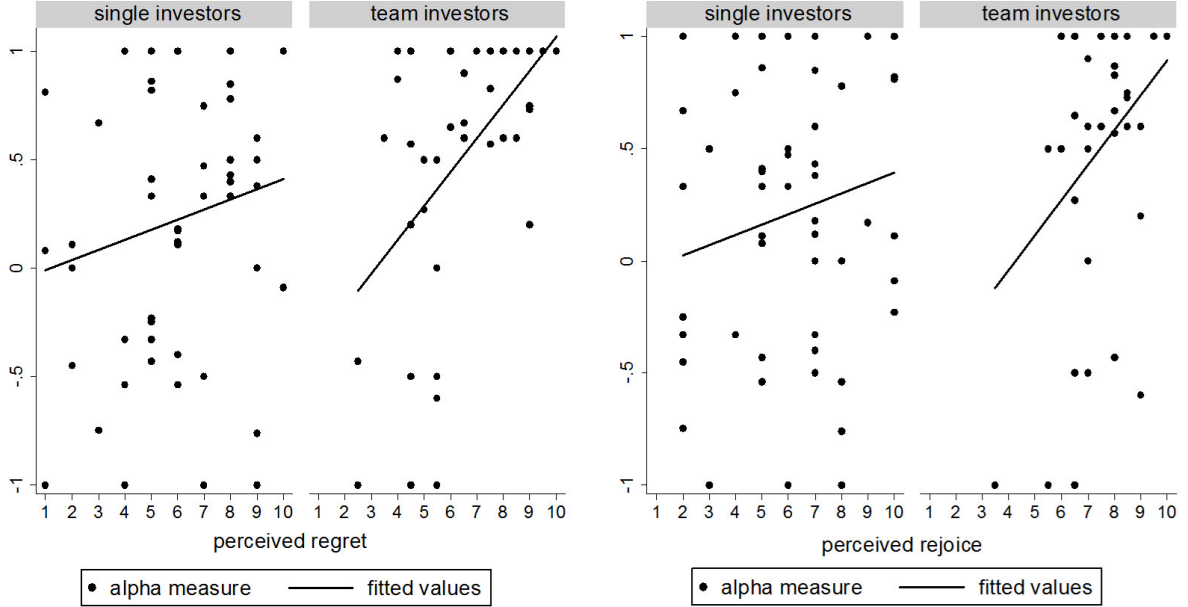


Figure 3: Correlation of regret/rejoice and single and teams investors' alphas.

contrast, the coefficient is smaller and insignificant for individuals ( $\rho = 0.177$ ,  $p = 0.195$ ). Turning to rejoice, we find that teams' reported levels are significantly correlated with their alphas ( $\rho = 0.323$ ,  $p = 0.040$ ). Again, the data shows no significant correlation for individuals ( $\rho = 0.180$ ,  $p = 0.189$ ).

In what follows, we analyze whether individuals' and teams' decision-dependent emotions impact the choice to sell after increases of last period's stock price. Table 6 presents Tobit regressions on subjects' alphas. The regressions involve 91 observations because some subjects had multiple switching points when eliciting loss aversion. The Tobit models are left censored to -1 and right censored to 1 (alpha is defined between -1 and 1.). Models one and two analyze the role of regret, whereas models three and four concentrate on rejoice. Due to multicollinearity, we incorporate subjects' perceived regret and rejoice in separate models.<sup>24</sup> We apply the following regressors: *team*, which is a dummy variable controlling for team membership (it is positive for teams), *regret* and *rejoice* measure subjects' perception of regret/rejoice (on a likert scale from 1 to 10). *Team*  $\times$  *regret* and *team*  $\times$  *rejoice* are interaction terms controlling for the role of decision-dependent emotions in teams. Finally, we use a set of control variables: *loss aversion* which corresponds to subjects' level of loss aversion ( $\lambda$ ), *guess* is the mean of subjects' guess scores, and *average # of sales* controls for the impact of subjects' average number of sales. Subjects' loss aversion is determined with the elicitation task of Gächter et al. (2010). In the task, 10 different lottery choices exist. The lotteries are framed such a way that a certain amount of money is lost if a coin lands on "heads" whereas subjects win 10€ if the coin lands on "tails." The losses increase with each lottery from 2€ to 11€, whereas the winning payoff is constant.<sup>25</sup>

<sup>24</sup>The data show that *regret* and *rejoice* are significantly correlated (Pearson's correlation coefficient,  $\rho = 0.268$ ,  $p = 0.008$ ).

<sup>25</sup>The choices were hypothetical to avoid distracting subjects' attention from the actual experiment (which

Table 6: Censored Tobit Regressions of single and team investors' alpha measures

	alpha measure			
	(1)	(2)	(3)	(4)
<i>team</i>	0.331*	-0.921	0.262	-1.012
	(0.181)	(0.570)	(0.193)	(0.943)
<i>regret</i>	0.118***	0.073		
	(0.041)	(0.048)		
<i>rejoice</i>			0.090**	0.080
			(0.045)	(0.049)
<b>interaction terms</b>				
<i>team</i> × <i>regret</i>		0.205**		
		(0.090)		
<i>team</i> × <i>rejoice</i>				0.173
				(0.128)
<b>control variables</b>				
<i>loss aversion</i>		0.114		0.116
		(0.083)		(0.088)
<i>guess</i>		-0.040		-0.028
		(0.069)		(0.073)
<i>average # of sales</i>		0.000		-0.001
		(0.016)		(0.017)
<i>constant</i>	-0.410	-0.271	-0.270	-0.347
	(0.264)	(0.398)	(0.300)	(0.414)
observations	91	91	91	91
Pseudo $R^2$	0.053	0.097	0.019	0.057

Robust standard errors in parentheses

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

Notes: The regressions are left censored to -1 and right censored to 1. Standard errors are presented in parentheses.

Subjects state for each of the ten lotteries whether they accept it. The task focuses on the case when subjects stop to accept the lotteries (switching point). Based on that, we calculate the loss-aversion coefficients ( $\lambda$ ). It follows:  $\lambda = V(G)/V(L)$ , where  $V(G)$  and  $V(L)$  represent the potential gain/losses of the lottery which is rejected. Lambda is defined between: 0.91 and 5. We elicit the loss aversion of both team members and derive teams' mean loss aversion.<sup>26</sup>

The results of regression one highlight that *team* is weakly significant with a positive sign, i.e., team membership in general leads to a moderately higher alpha. *Regret* is highly significant

followed afterwards). Another reason was to avoid wealth effects. Yet the results confirm that the data is in line with previous findings. This is shown in the companion study of Rau (2014).

<sup>26</sup>We find that the average loss aversion of individuals (2.14) and teams (1.89) is similar (Mann-Whitney test,  $p = 0.696$ ).

and positive. Put differently, subjects with a higher perception of regret tend to sell most often after increases of stock prices. Thus, we find strong support for the findings of Summers and Duxbury (2012). Turning to regression two, it can be seen that  $team \times regret$  is positive and significant. At the same time,  $regret$  is no longer significant. Thus, subjects' perceived regret only significantly impacts on the alphas of teams. This may explain why the disposition effect is higher for teams: the perceived regret after stock prices decrease hinders team members in their realization of losers. In this case, teams apparently fail in reaching an agreement to realize the losing stock. Focusing on the impact of perceived regret, we find in regression three that  $rejoice$  is positive and significant. Thus, rejoice generally seems to enhance disposition effects. At the same time,  $team$  is not significant anymore when controlling for  $rejoice$ . A closer look at regression four suggests that the higher disposition effect of teams cannot be explained by  $rejoice$ . More precisely, the interaction term of  $team$  and  $rejoice$  is insignificant. Moreover, neither  $team$  nor  $rejoice$  are significant.

## 5.4 Investment Behavior and Profits

This section focuses on investors' portfolio compositions and the corresponding stock returns. If subjects are prone to disposition effects, the realized profits should be higher than the final value of their portfolio. Table 7 presents the average number of stocks held, the average returns of stocks sold/kept, and the ratio of these two measures. The ratio is defined as:  $ratio = sold/kept$ .

Table 7: Average number of stocks held and yielded profits

stock	# held	single investors' profits			# held	team investors' profits		
		sold	kept	ratio		sold	kept	ratio
A	23.8	2912	1579	1.8	24.0	2514	1621	1.6
B	4.4	579	374	2.8	5.4	900	218	4.1
C	2.6	512	374	1.4	3.7	773	627	1.2
D	10.2	1379	400	3.4	9.7	1536	128	12.0
E	3.1	1418	359	3.9	2.8	1306	376	3.5
F	18.8	1976	3766	0.5	21.8	2345	4890	0.5

Notes:  $\# held$  reports the average number of stocks which were held by the investors. All profits are reported in Taler. *Sold* refers to all cases where subjects realized stock returns, whereas *kept* refers to the final value of the stocks kept in period 14. *Ratio* is the ratio of the two measures (sold/kept).

All investors hold nearly the same average number of all stock types. It turns out that both investor groups mostly hold A stocks (single: 23.8; team: 24.0) and F stocks (single: 18.8; team: 21.8). The portfolio compositions of the two investor groups are similar. The table demonstrates that investors always achieve higher profits by stock sales in contrast to the case of keeping them. Turning to the sold/kept ratio, we find support for this, i.e., it is always higher than one. The only exception is stock F where both investor types have a ratio of 0.5. Focusing on stock D, teams achieve a sales profit which is 12 times higher than the profits generated when

keeping stocks. By contrast, the ratio of stock D is only 3.4 for single investors. Hence, the findings on subjects' profits again demonstrate that investors are prone to disposition effects. It can also be seen that the higher disposition effects of teams cannot be explained by differences in their portfolio compositions.

## 6 Conclusion

This paper experimentally analyzes the disposition effects of team and single investors. Our findings highlight that the decision bias occurs in both scenarios. However, the effect is more pronounced for team investors. In more detail, the data shows that teams clearly sell less capital losses than individuals. At the same time, they tend to realize more capital gains than single investors.

Summers and Duxbury (2012) highlighted the importance of decision-dependent emotions for the cause of disposition effects. Our data is in line with their findings. Interestingly, we show that decision-dependent emotions are more pronounced for teams. More precisely, subjects who invested jointly, report a higher perception of regret and rejoice after stock price changes. It is therefore likely that psychological forces such as *group polarization* (Isenberg, 1986) may enhance the perception of decision-dependent emotions. The reason may be that teams' perception of regret is more extreme after discussing investment decisions. In line with this our regressions reveal that team members reporting high levels of regret have higher disposition effects than individuals. Hence, it may be that teams delay their selling actions to avoid the regret when realizing capital losses.

The data adequately replicate the results of Weber and Camerer (1998) who point out that single investors exhibit disposition effects in the lab. Our paper extends these findings, emphasizing that teams in particular exhibit disposition effects. Thus, we confirm the empirical results of Cici (2012) in the laboratory. The author suggests that psychological forces such as *groupthink* may intensify any behavioral biases which are present. Following this line of reasoning, our findings are an indication that group dynamics may enhance emotions, leading to pronounced disposition effects of teams. Therefore, our results may help to provide important explanations for the observed findings of Cici (2012).

Together with Cici (2012) our results contribute to the debate of whether investing jointly may increase investor rationality. Importantly, we find that team investment decisions may have detrimental effects for the attenuation of disposition effects. The finding that teams may worsen the outcome is in contrast to experiments on statistical assessments and strategic decisions. In this regard, Charness et al. (2007) show that teams are better in Bayesian updating, whereas Kocher and Sutter (2005) demonstrate that they do a better job in level-k reasoning. An explanation might be that these settings correspond to judgmental settings where decision-dependent emotions are less important. By contrast, teams in our experiment are constantly faced with wealth changes such as capital losses and gains, triggering regret and rejoice. Although stylized by nature, our experiments may help to gain a better understanding on the role of emotions in team-portfolio decisions. This may be of importance, as field data on emotions is scarce. The

finding that joint investment decisions may particularly suffer from emotions is exciting. Thus, it may be intriguing to further disentangle potential conflicts of rational decision making and emotions in social contexts.

## References

- Baker, R., S. Laury, and A. Williams (2008). Comparing small-group and individual behavior in lottery-choice experiments. *Southern Economic Journal* 75, 367–382.
- Bär, M., A. Kempf, and S. Ruenzi (2011). Is a team different from the sum of its parts? Evidence from mutual fund managers. *Review of Finance* 15, 359–396.
- Barberis, N. and R. Thaler (2003). A survey of behavioral finance. *Handbook of the Economics of Finance* 1, 1053–1128.
- Bénabou, R. (2013). Groupthink: Collective delusions in organizations and markets. *The Review of Economic Studies* 80, 429–462.
- Blinder, A. S. and J. Morgan (2000). Are two heads better than one? an experimental analysis of group vs. individual decisionmaking. Technical report, National Bureau of Economic Research.
- Bliss, R. T., M. E. Potter, and C. Schwarz (2008). Performance characteristics of individually-managed versus team-managed mutual funds. *Journal of Portfolio Management* 34, 110–119.
- Charness, G., E. Karni, and D. Levin (2007). Individual and group decision making under risk: An experimental study of bayesian updating and violations of first-order stochastic dominance. *Journal of Risk and uncertainty* 35, 129–148.
- Cheung, S. and S. Palan (2009). Two heads are less bubbly than one: Team decision-making in an experimental asset market. *Experimental Economics* 15, 1–25.
- Chui, P. (2001). An experimental study of the disposition effect: Evidence from macau. *The Journal of Psychology and Financial Markets* 2, 216–222.
- Cici, G. (2012). The prevalence of the disposition effect in mutual funds’ trades. *Journal of Financial and Quantitative Analysis* 47, 795–820.
- Cooper, D. and J. Kagel (2005). Are two heads better than one? Team versus individual play in signaling games. *American Economic Review* 95, 477–509.
- Coval, J. D. and T. Shumway (2005). Do behavioral biases affect prices? *Journal of Finance* 60(1), 1–34.
- Da Costa Jr, N., M. Goulart, C. Cupertino, J. Macedo, and S. Da Silva (2013). The disposition effect and investor experience. *Journal of Banking and Finance* 37, 1669–1675.



- Da Costa Jr, N., C. Mineto, and S. Da Silva (2008). Disposition effect and gender. *Applied Economics Letters* 15, 411–416.
- Dhar, R. and N. Zhu (2006). Up close and personal: Investor sophistication and the disposition effect. *Management Science* 52, 726–740.
- Ferris, S., R. Haugen, and A. Makhija (1988). Predicting contemporary volume with historic volume at differential price levels: Evidence supporting the disposition effect. *Journal of Finance* 43, 677–697.
- Fischbacher, U. (2007). z-tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics* 10, 171–178.
- Fischbacher, U., G. Hoffmann, and S. Schudy (2014). The causal effect of stop-loss and take-gain orders on the disposition effect. Technical report, Thurgauer Wirtschaftsinstitut, Universität Konstanz.
- Frydman, C. and A. Rangel (2014). Debiasing the disposition effect by reducing the saliency of information about a stock’s purchase price. *Journal of Economic Behavior & Organization* 107, 541–552.
- Gächter, S., E. J. Johnson, and A. Herrmann (2010). Individual-level loss aversion in riskless and risky choices. Technical report, CeDEx discussion paper series.
- Garvey, R. and A. Murphy (2004). Are professional traders too slow to realize their losses? *Financial Analysts Journal* 60, 35–43.
- Genesove, D. and C. Mayer (2001). Loss aversion and seller behavior: Evidence from the housing market. *The Quarterly Journal of Economics* 116, 1233–1260.
- Goulart, M., N. Da Costa Jr, A. Santos, E. Takase, and S. Da Silva (2013). Psychophysiological correlates of the disposition effect. *PloS one* 8, e54542.
- Greiner, B. (2004). The online recruitment system orsee 2.0—a guide for the organization of experiments in economics. *University of Cologne, Working paper series in economics* 10, 63–104.
- Harrison, G. W., M. I. Lau, E. E. Rutström, and M. Tarazona-Gómez (2012). Preferences over social risk. *Oxford Economic Papers*, gps021.
- Isenberg, D. J. (1986). Group polarization: A critical review and meta-analysis. *Journal of Personality and Social Psychology* 50, 1141.
- Janis, I. (1972). *Victims of Group Thinking*. Boston: Houghton Mifflin.
- Kahneman, D. and A. Tversky (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the Econometric Society* 47, 263–291.

- Kocher, M. and M. Sutter (2005). The decision maker matters: Individual versus group behaviour in experimental beauty-contest games. *The Economic Journal* 115, 200–223.
- Kugler, T., E. E. Kausel, and M. G. Kocher (2012). Are groups more rational than individuals? A review of interactive decision making in groups. *Wiley Interdisciplinary Reviews: Cognitive Science* 3, 471–482.
- Masclet, D., N. Colombier, L. Denant-Boemont, and Y. Loheac (2009). Group and individual risk preferences: A lottery-choice experiment with self-employed and salaried workers. *Journal of Economic Behavior & Organization* 70, 470–484.
- Odean, T. (1998). Are investors reluctant to realize their losses? *The Journal of Finance* 53, 1775–1798.
- Prather, L. and K. Middleton (2002). Are  $n + 1$  heads better than one? The case of mutual fund managers. *Journal of Economic Behavior & Organization* 47, 103–120.
- Rau, H. A. (2014). The disposition effect and loss aversion: Do gender differences matter? *Economics Letters* 123.
- Rockenbach, B., A. Sadrieh, and B. Mathauschek (2007). Teams take the better risks. *Journal of Economic Behavior & Organization* 63, 412–422.
- Shefrin, H. and M. Statman (1985). The disposition to sell winners too early and ride losers too long: Theory and evidence. *Journal of Finance* 40, 777–790.
- Shupp, R. and A. Williams (2008). Risk preference differentials of small groups and individuals. *The Economic Journal* 118, 258–283.
- Summers, B. and D. Duxbury (2012). Decision-dependent emotions and behavioral anomalies. *Organizational Behavior and Human Decision Processes* 118, 226–238.
- Sutter, M. (2007). Are teams prone to myopic loss aversion? An experimental study on individual versus team investment behavior. *Economics Letters* 97, 128–132.
- Thaler, R. (1985). Mental accounting and consumer choice. *Marketing science* 4, 199–214.
- Weber, M. and C. Camerer (1998). The disposition effect in securities trading: An experimental analysis. *Journal of Economic Behavior & Organization* 33, 167–184.
- Weber, M. and F. Welfens (2007). *An individual level analysis of the disposition effect: Empirical and experimental evidence*. Working Paper University of Mannheim.
- Whyte, G. (1993). Escalating commitment in individual and group decision making: A prospect theory approach. *Organizational behavior and human decision processes* 54, 430–455.

# Appendix

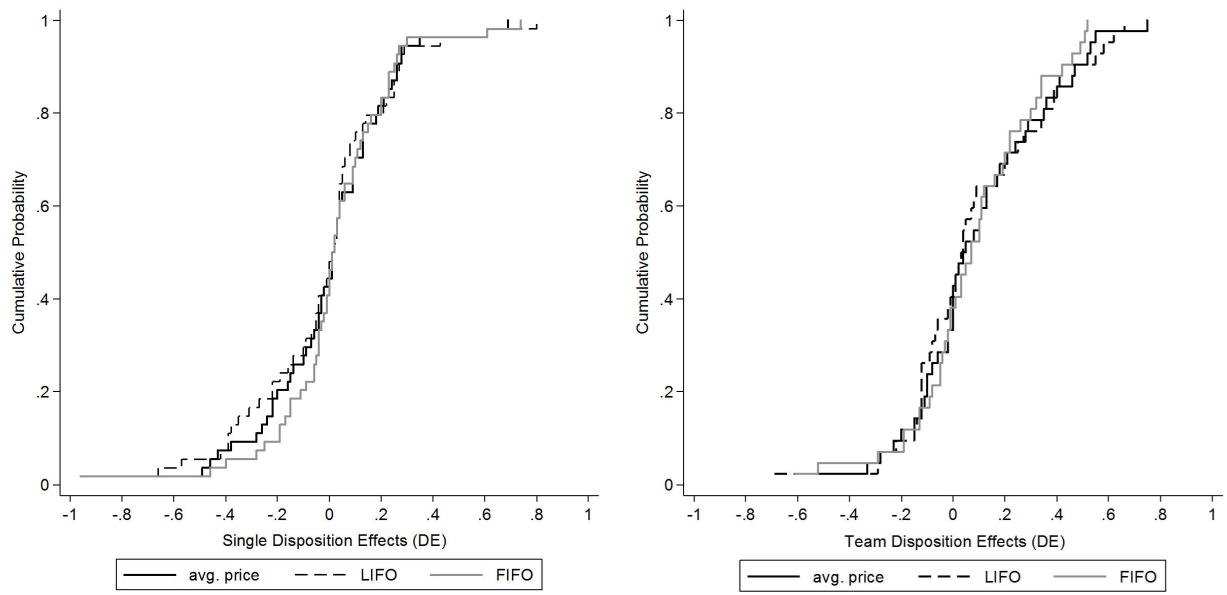


Figure 4: CDFs of Single and Team investors' Disposition Effects (the three pricing methods).

## Experimental Instructions: Team treatment (not intended for publication)

Welcome to this experiment about decision theory. Please read these instructions carefully. At the end of the instructions there will be some control questions. Please answer these questions. After every participant has answered the questions correctly, the experiment will start. In this experiment you will decide together with another participant who has been randomly matched to you. That is, all of your decisions in this experiment can be decided together with the participant you are matched with.

- During the experiment you are always allowed to consult with the other participant you are matched with
- In course of the experiment you and the matched participant have the possibility to earn “Taler”.

This depends on your joint decisions. At the end of the experiment you and the other participant earn these Talers. The exchange-rate is:

$$1000 \text{ Talers} = 1\text{€}$$

Here, **each** of the two participants earns exactly the profit which was yielded commonly. For participating in this experiment each participant also receives 4€. After the experiment, please wait at your desk until we will ask you to come to get your payoff.

Please notice that you are only allowed to talk with your matched participant. If you will talk to the other persons the experiment will be finished. Please only talk quietly to the matched partner. If you have a question, please raise your hand. We will come to your desk to answer it individually.

The experiment consists of 14 periods. In every period you and your matched participant have the possibility to buy shares of the firms A, B, C, D, E, and F. Every share has a certain value in Talers in every period.

You start the experiment with an endowment of 10,000 Talers

### Performance of shares

The shares A-F will change in prices at the beginning of each of the 14 periods, i.e., in the subsequent period there will be no share which will have the same price as in the previous

period. The share price changes have been predetermined before the experiment started. That is, all price changes of all shares are completely independent of all your buying and selling decisions. The same is true for all buying and selling decisions of the other participants of the experiment. Each of the shares A-F is of a certain type. The share types differ in their probability of increasing (decreasing) in value at the beginning of the period. The distributions of the types are given in the table below. In the experiment there will be exactly one share (of the shares A-F) which follows type “++” and the same is true for one share of type “+”, “-”, and “--”. There will be two types (of the shares A-F) which follow type “0”. All types are displayed at the below table.

shares in the market	type	probability of increase	probability of decrease
1	++	65%	35%
1	+	55%	45%
2	0	50%	50%
1	-	45%	55%
1	--	35%	65%

Example:

- assume that share X is of type: ‘++’
- at the beginning of each period the probability of a price increase of X is: 65%
- at the beginning of each period the probability of a price decrease of X is: 35%

**The share price is determined as follows:**

1. At the beginning of each period a share either increases (decreases). The probability depends on the share’s type (see table).
2. Afterwards the magnitude of the price change (increase/ decrease) will be determined. The magnitude of the price change can either be of 1, 3 or 5 Talers. Every magnitude (1, 3 or 5 Talers) can happen with the same probability. That is, every magnitude (1, 3 or 5 Talers) can happen with a probability of one-third. This is the same for every type, independently of its type.

## Buying and selling actions of shares

In each of the 14 periods you and your matched participant have the possibility to buy and sell shares. You will find a screen shot at the next page which depicts all of your decision possibilities in the course of the experiment. In the upper part you will find the share price window, displaying shares A-F. The price changes of shares A-F in periods 1-14 will be displayed here. To give you an idea of shares' past price changes, you will also find the prices of periods -3, -2, -1 and 0. In the following you are given an overview of the price changes of the shares A-F in the periods -3, -2, -1 and 0.

The screenshot displays the experiment interface, divided into two main sections: the Share Price Window and the Transaction Window.

**Share Price Window:** This window shows the price of six shares (A-F) over five periods (Per. -3 to Per. 1). The current period is 1. The price of each share in the current period is displayed in a 'price' array. The 'Bought/sold' array shows the number of shares bought or sold in each period. The 'periodical prices of shares A-F' are also displayed.

Share	price	Per. -3	Per. -2	Per. -1	Per. 0	Per. 1
Share A	76	76	73	74	79	80
Anteil A	0	0	0	0	0	0
Anteil B	51	64	59	56	53	51
Anteil B	0	0	0	0	0	0
Anteil C	120	130	127	128	125	120
Anteil C	0	0	0	0	0	0
Anteil D	98	88	87	90	95	98
Anteil D	0	0	0	0	0	0
Anteil E	150	150	149	148	145	150
Anteil E	0	0	0	0	0	0
Anteil F	100	92	93	98	97	100
Anteil F	0	0	0	0	0	0

**Transaction Window:** This window shows the number of shares owned (In Besitz) and the current price (aktueller Wert) for each share. It also displays the 'Buy/sell one share' buttons for each share.

Share	In Besitz	aktueller Wert
Anteil A	0	80
Anteil B	0	51
Anteil C	0	120
Anteil D	0	98
Anteil E	0	150
Anteil F	0	100

The interface also shows the current period (1 von 15), the current price (80), and the number owned (0). The 'Buy/sell one share' buttons are labeled '1 Anteil kaufen' and '1 Anteil verkaufen'. The 'continue' button is located at the bottom right.

## Possibilities of decisions in the experiment

The upper part of the window is the *share price window*:

- The array labeled “price” displays the exact price of a share in the current period. For instance, in the screen shot share A had a price of 76 Talers in period -3.

- Furthermore the array “Bought/sold” displays the number of bought/sold shares in the current period. The screen uses the following symbols: “--” which means that there was no transaction. “1” which means that one share was bought. “-1” which means that one share was sold.

The window at the bottom is the transaction window. Here, you can decide in each period whether you would like to buy/sell one or more shares of shares A-F.

- The array “number owned” displays the current number of shares owned
- The array “current price” depicts the price which has to be paid in order to buy new shares. At the same time you would receive this price for each share sold.
- The array “endowment” displays your endowment.

For instance if you decide to buy shares of a firm then you have to pay for each share its current price. **The sum of your expenditures cannot exceed your actual endowment.**

If you want to buy shares, you or your matched participant have to click the button labeled “Buy one share”. If you want to buy more than one share, e.g., three shares, you or the matched participant have to click these button for three times.

**Example:**

- Share A’s current price in period 1 is 110 Talers. You decide to buy five shares of A.
- The expenditures for this transaction are given by:  **$5 * 110 \text{ Talers} = 550 \text{ Talers}$**
- This amount will be subtracted of your endowment

If you already own some shares at the beginning of a period, then you have the possibility to **sell** these shares. You will receive the current price of each share which is sold. However, the numbers of sold shares cannot exceed the total number of shares owned.

**Example:**

- Share C's current price in period 5 is 90 Talers. Assume, you own a total of four shares C and decide to sell 3 shares C.

In order to sell a share you or your matched participant click on the button “**Sell one share**”. If you would like to buy 3 shares you or your matched participant click on the same button for three times. etc.

- This will lead to a payoff of:  $3 * 90 \text{ Talers} = 270 \text{ Talers}$ .
- This amount will be directly credited to your endowment. Afterwards you will still own one share of C.

The experiment ends after 14 periods. Then you and your matched participant do not have the possibility to buy or sell shares.

Afterwards **all shares that you own at this point in time are automatically liquidated. The resulting money amount will automatically credited to your endowment.**

After the end of period 7 and 14, you and your matched participant have to jointly guess which stock A-F followed the types: “++”, “+”, “0”, “--”, “-”.

You will be credited **200 Talers** to your endowment for every correct guess.

The total payoff you will earn in this experiment is given by:

**Total payoff = your endowment which was not invested + value of the shares in your portfolio + earnings of your guesses**

**Note, that you and your matched participant both receive the total payoff earned in the experiment.**

## Questions

After you and your matched participant have correctly answered the control questions you will receive a questionnaire consisting of ten questions. Please answer the questionnaire. To answer each of the ten questions you will either have to chose “accept” or “reject”.



Note that you will not be paid for answering the questionnaire. Afterwards the experiment will start and you will have the possibility to buy (sell) shares in each of the 14 periods. Now, please answer the control questions.

## Questionnaire (at the beginning of the experiment)

What is your ID-number?

What is your gender?

### Please answer the following ten questions

Assume that for each of the ten questions a coin is thrown. The coin can either land at “heads” or “tail”. To answer each of the ten questions you will either have to chose “accept” or “reject”. Note that all ten questions are hypothetical questions and thus will not influence your payoff.

- 1.) If the coin shows “heads” you will lose €2; if it shows “tail” you will win €10.  
accept/ reject?
- 2.) If the coin shows “heads” you will lose €3; if it shows “tail” you will win €10.  
accept/ reject?
- 3.) If the coin shows “heads” you will lose €4 if it shows “tail” you will win €10.  
accept/ reject?
- 4.) If the coin shows “heads” you will lose €5; if it shows “tail” you will win €10.  
accept/ reject?
- 5.) If the coin shows “heads” you will lose €6; if it shows “tail” you will win €10.  
accept/ reject?
- 6.) If the coin shows “heads” you will lose €7; if it shows “tail” you will win €10.  
accept/ reject?
- 7.) If the coin shows “heads” you will lose €8; if it shows “tail” you will win €10.  
accept/ reject?
- 8.) If the coin shows “heads” you will lose €9; if it shows “tail” you will win €10.  
accept/ reject?

9.) If the coin shows “heads” you will lose €10; if it shows “tail” you will win €10.  
accept/ reject?

10.) If the coin shows “heads” you will lose €11; if it shows “tail” you will win €10.  
accept/ reject?

## Control questions

share X	period 1	period 2	period 3
price	80	83	82
bought (+) / sold (-)	5	-5	0

1.) You start with an endowment of 10,000 Talers. In periods 1-3 the transactions of the table above are processed.

1. What is your endowment after period 1?
2. What is your endowment after period 2?
3. What is your endowment after period 3?

share X	period 1	period 2	period 3
price	100	95	90
bought (+) / sold (-)	10	0	-10

2.) You start with an endowment of 10,000 Talers. In periods 1-3 the transactions of the table above are processed.

1. What is your endowment after period 1?
2. What is your endowment after period 2?
3. What is your endowment after period 3?

share X	period 1	period 2	period 3
price	25	30	31
bought (+) / sold (-)	4	10	0
share Y	period 1	period 2	period 3
price	50	55	54
bought (+) / sold (-)	10	-10	0

3.) You start with an endowment of 10,000 Talers. In periods 1-3 the transactions of the table above are processed.

1. What is your endowment after period 1?
2. What is your endowment after period 2?
3. What is your endowment after period 3?