Can Regret and Pride explain the Disposition Effect?

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Abstract

We experimentally investigated the role of regret and pride in a behavioral anomaly, the disposition effect. First, we used affective forecasting to elicit participants potential feelings in hypothetical investment situations. Then our subjects participated in a two period stock market simulation, consisting of similar investment decisions. We linked the participants' reports of regret and pride to the trading behavior consistent with the disposition effect and found that higher reports of regret support the disposition effect in the domain of losses and higher reports of pride support the disposition effect in the domain of gains.

Keywords: Disposition Effect, Regret Theory

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1 Introduction

Imagine yourself in the situation of buying a racehorse. Prior to your acquisition you scanned through all the related literature and even asked a racehorse consultant. You finally make your buying decision and register for the first race with the best available jockey. You are looking forward to a great living as a race horse owner with all the attached amenities. Then, you lose your first race. Then the second, and then the third. You wonder how that could happen. Could you have bought a poor race horse? No, you think some day every horse will get its lucky day and keep going to races. Some odd day, it happens to be the biggest race of the year, your horse wins. Full of euphoria about your successful horse, an older gentleman approaches you, asking to sell him the horse. You do the math and sell the horse.

Shefrin and Statman (1985) coined this behavior, to ride losers too long and sell winners too early, the disposition effect. It is well documented both empirically and experimentally[1]. There were strong arguments proposed by Shefrin and Statman (1985) that the disposition effect could be explained by prospect theory and mental accounting[2]. However, recent studies suggest that this behavior cannot be explained by traditional theories. For example, Hens and Vlcek (2005) showed that the disposition effect cannot be explained by prospect theory. They argue that investors showing trading behavior consistent with the disposition effect would not invest in stocks in the very beginning. In this case, standard prospect theory explains an ex-post disposition effect, but the initial investment remains unexplained. Additionally, Odean (1998) has shown that avoiding higher trading costs at lower stock price ranges and portfolio rebalancing do not cause the disposition effect. Barberis and Xiong (2006) modeled a dynamic portfolio choice setting and implemented the value function as proposed by Kahneman and Tversky (1992). They showed that prospect theory often predicts the opposite of the disposition effect: momentum trading, keeping winning investments and selling losing investments. Weber and Welfens (2007) have shown that investors who often sell their winning investments are not the same investors, who hold on to their losing investments until they break even. They suggest that the two components of the disposition effect might not be systematically related. Their study showed that investors more commonly hold on to losing investments. Hence, it might be possible that investors only exhibit on side

[1] Odean (1998), Grinblatt and Keloharju (2001), Shapira and Venezia (2001), Coval and Shumway (2005), Dhar and Zhu (2006) provide empirical evidence and Weber and Camerer (1998), Chui (2001), Oehler et al. (2002) provided experimental evidence.

[2] Several studies cite prospect theory as the main driver behind the disposition effect, e.g. Garvey and Murphy (2004), Jordan and Diltz (2004), Dhar and Zhu (2006).

of the disposition effect. Some investors even have the tendency not to sell their investments regardless of gains or losses. An alternative explanation for behavior consistent with the disposition effect is provided by Muermann and Volkman (2006). Their model, based on regret theory by Bell (1982) and Loomes and Sugden (1982), incorporates anticipatory regret and pride in the preferences of investors. In their setting investors regret investing in a losing stock and hence hold on to them in the hope that the value might recover so they can avoid regret for their past decision. In the domain of gains, investors would like to feel pride for investing in a winning stock and fear that they might forgo feeling pride if the stock were to devalue later. That leads them to sell the winning stock too soon.

To explore the role of regret and pride in investment decisions we present an introductory approach to experimentally investigate the relation between anticipated feelings and the disposition effect. We modeled a two-part experiment. In the first part we drew on affective forecasting and asked participants to imagine certain investment situations and to reveal their hypothetical feelings. The second part consisted of structurally similar investment decisions in which the participants had to make payoff-relevant decisions.

The remainder of the paper is organized as follows. In section 2 and section 4 we give a short overview of the disposition effect and regret theory and their theoretical background. In section 3 we outline our experimental approach. Section 5 covers the experimental results and provides an analysis. The paper will conclude in section 6 with a discussion of the results and possible extensions for future research.

2 The Disposition Effect

The most common explanation for the disposition effect, as put forward in the study by Shefrin and Statman (1985), is prospect theory. As previously mentioned, many authors refer to prospect theory as the primary explanation. The central argument in this theory regarding the disposition effect is the concave/convex S-shaped value function. This function is concave in the domain of gains and convex in the domain of losses. This feature implies that individuals are risk averse over gains and risk seeking over losses. In most studies the purchase price of an investment serves as the reference point. If the investment has risen above the purchase price the investor is put in the concave region of the value function and hence will be risk averse. That leads to a sale of the investment. An investment whose value has fallen below the purchase price puts the investor in the convex region of the value function, and the investor becomes more risk seeking. That leads him to

hold on to the investment. This scheme of behavior clearly mirrors the behavior of individuals prone to the disposition effect. Hence, at the first glance prospect theory might explain the disposition effect very well. However, recent studies came to very different conclusion about the explanatory power of prospect theory regarding the disposition effect. Barberis and Xiong (2006) modeled trading behavior of investors under the assumption that their investors would evaluate risk according to prospect theory. They were able to generate artificial data, from optimal asset allocations. Based on simulated behavior of investors driven by prospect theory, they showed that prospect theory often predicts momentum trading, selling losing stocks and holding winning stocks. Using a similar strategy, Hens and Vlcek (2005) simulated a two-period portfolio choice model. The investors' preferences were described by prospect theory. They showed that investors prone to the disposition effect would not have bought the stock in the initial period. Thereby prospect theory may explain an ex-post disposition effect; however, it cannot be viewed as an ex-ante predictor of such behavior. Besides prospect theory, Shefrin and Statman (1985) put forward additional factors. They mentioned mental accounting, avoiding regret and seeking pride and a deficit in self-control as potentially explaining the disposition effect. In this context, self-control is beside the point. Investors need self-control only to overcome the reluctance to sell losing stocks when it is optimal. Here the interesting question is why there is reluctance. Prospect theory may explain the reluctance to realize losses, however it does not explain why investors are reluctant to make use of tax advantages as put forward by Constantinides (1983). In such situation, mental accounting as proposed by Thaler (1985) can explain such reluctance. Here the prospect theory value function is applied to each mental account separately. Thereby, the decision remains similar as if there were no tax advantage.

What remains as potential explanation of the disposition effect is seeking pride and avoiding regret. Here, regret can be defined as a feeling associated with the knowledge that the decision that was made, fared worse than a potential alternative. Pride can be defined as the positive counterpart, a feeling associated with the knowledge that the decision that was made, fared better than a potential alternative. In the setting of the disposition effect, if a loss occurred, the feeling of regret must only be experienced, if that loss is realized. Until then the feeling of regret may be anticipated, hence, leading the investor to further hold the losing stock in the hope it will regain in value and avoid the feeling of regret. Therefore, the driving force for the disposition effect in the domain of losses may be anticipated regret. The argument in the domain of gains is ambiguous. If a gain occurred, an investor may want to feel pride for his good investment decision. Hence, pride at realizing a gain

could lead to a tendency to sell winning investments. However, investors may also consider what happens after they sold their investment. It may go up further and they would regret their decision to sell the investment too soon. Here, anticipated regret in the domain of gains could lead investors to hold winning investment. Many authors suggest that regret may have a stronger influence on behavior than pride[3], which may even increase the ambiguity.

The experience of a loss may also give rise to cognitive dissonance, as pointed out by Festinger (1957). Most individuals see themselves as making good decisions. When their decisions turn out to be suboptimal they may feel cognitive dissonances. In the context of the disposition effect that would add to the negative state at a point where the investment has been devalued. Zuchel (2001) investigated the influence of cognitive dissonance in the disposition effect and came to the conclusion that it may explain the avoidance of loss realization. However, Chui (2004) experimentally tested the influence of cognitive dissonance to the disposition effect and found no significant effect.

Using the most promising approach to explain the disposition effect, Muermann and Volkman (2006) used a dynamic portfolio choice model that incorporates anticipatory regret and pride in the investor's preferences to show that investors might demonstrate a trading behavior consistent with the disposition effect. Their model will be outlined in more detail in section 4. The next section will explain the experimental setting we used to model the disposition effect. We then turn to the theoretical background by outlining the model of Muermann and Volkman (2006) and emphasize the changes of the model that we applied.

3 Experimental approach

The experiment consisted of two parts and was programmed and conducted with the software z-Tree (Fischbacher (2007)). The first part was intended to identify each subject's feelings of regret and pride regarding hypothetical investment decisions. In the second part, the subjects participated in a two-period stock market game.

In the first part we used affective forecasting as a method to elicit the feelings of regret and pride[4]. In the context of a two-period stock market game, we identified twelve different situations in which investors could potentially feel regret or pride. We designed six hypothetical situations in which the subjects were supposed

[3]Landman (1987) empirically demonstrated such an asymmetry between regret and pride.

[4]Wilson and Gilbert (2005) showed how people make predictions about their feelings regarding hypothetical future events and how people regularly make mistakes about their future emotional states (see section 6).

to primarily feel regret and six hypothetical situations in which the subjects were supposed to primarily feel pride. As shown in table 1, each of these two blocks of six situations was differentiated between feelings due to action and feelings due to in-action. Furthermore, we differentiated between the different stages in an invest-

Table 1: Six possible situations for feeling regret or pride

	Regret		**Pride**	
	Action	**In-Action**	**Action**	**In-Action**
$t = 0$	Buy	no Buy	Buy	no Buy
	Loss	Gain	Gain	Loss
$t = 1$	Gain	Gain	Gain	Gain
	Sell	no Sell	Sell	no Sell
	Gain	Loss	Loss	Gain
$t = 1$	Loss	Loss	Loss	Loss
	Sell	no Sell	Sell	no Sell
	Gain	Loss	Loss	Gain

ment decision. Feelings might occur after the initial investment decision in $t = 0$ or after the subsequent investment decision in $t = 1$. The latter was again separated in the domains of gains and losses. Table 11 (see appendix B) shows these twelve hypothetical situations. Situations one to six relate to the left part of table 1 and situations seven to twelve relate to the right part of table 1. In the beginning of the experiment we ordered the questions randomly. Each situation was displayed to the subjects separately and they were asked to imagine themselves in the described situation. We then asked them, what they would feel in the described situation. In each question, the subjects could choose from six feelings: regret, disappointment, elation, pride, dissatisfaction and satisfaction. They, as well, could choose the intensity of the feelings, ranging from very weak (coded as 0) to very strong (coded as 10). We used additional feelings other than regret and pride to avoid the priming of the subjects towards those two feelings.

In the second part, the subjects made investment decisions in a two-period stock market game that was modeled by a recombining binomial tree (see figure 5 in appendix B) with additive equal jumps, where the probability of an up-move and the value change were exogenously given. The game consisted of eight periods with different market specifications. Table 2 shows the specifications of each investment decision the subjects had to make. Every subject encountered a different random sequence of these eight investment decision. In each period the subjects were endowed with either 100 or 150 points. The value of 100 points was 3 €. For every decision, information about the probability of an up-move and the change in value

Table 2: Different conditions for the risky asset

Endowment	**Volatility(absolute)**	**Volatility(%)**	$\boldsymbol{p}$
100	10	0.1	0.6
100	20	0.2	0.6
100	30	0.3	0.6
100	10	0.1	0.7
100	20	0.2	0.7
100	30	0.3	0.7
150	30	0.2	0.6
150	30	0.2	0.7

were given. In the first stage, subjects had to decide which amount I of their initial endowment E they wanted to invest in the described stock market. The part of the initial endowment which was not invested had the risk-free rate of zero. Based on the subject's investment choice, the resulting value of their wealth was either $I(1+x)+E-I$ with probability p for a up-move in $t=1$ or $I(1-x)+E-I$ with probability $1-p$ for a down-move in $t=1$, where I is the amount invested and $E-I$ the amount they decided to keep at the risk-free rate of zero, which we labeled as private income. If the subjects chose in $t=0$ to invest a positive amount in the stock market, they were required to decide in $t=1$ whether to keep the risky asset or to sell it at its current value, thereby locking in their potential payoff. If the asset was sold in $t=1$, the hypothetical payoff associated with keeping the asset until $t=2$, the value of the invested amount and the amount that initially was not invested were displayed. If the asset was not sold in $t=1$, the value in $t=2$ could change again, resulting in a level of wealth of $I(1+2x)+E-I$ with probability p or E with probability $1-p$ if the stock had gone up in $t=1$ or in a level of wealth of $I(1-2x)+E-I$ with probability p or E with probability $1-p$ if the stock had gone down in $t=1$. At the end of $t=2$ the resulting payoff and the initially not invested amount were displayed. If the subject had refrained from investing in the stock market in $t=0$, the hypothetical payoff in $t=2$ associated with investing the whole initial endowment E in the stock market was displayed. For the final payoff only the second part of the experiment was relevant. The subjects' final payoff was defined by a random draw of one of the eight realized payoffs of the second part.

The following section outlines the model by Muermann and Volkman (2006) and the theoretical background of our experiment including the adjustments we made to the model.

4 Regret Theory

As previously stated, we implemented a two-period stock market game similar to the dynamic portfolio choice model proposed by Muermann and Volkman (2006). There are three periods, $t = 0, 1$ and 2 and two assets: a risk free bond with zero normalized returns and a risky stock. To be consistent with the mental accounting framework proposed by Thaler (1985), we only considered one risky asset. The risky asset can either gain in value $1 + x$ with probability p or lose in value $1 - x$ with probability $1-p$. In our setting the investors at $t = 0$ decides how much of his initial wealth to invest in the stock or in the bond[5]. At $t = 1$ he observes his realized level of wealth, and decides whether to hold that investment for one further period or to liquidate the investment. At $t = 2$ all positions are liquidated.

Muermann and Volkman (2006) followed Bell (1982) and Loomes and Sugden (1982) and started from a two-attribute utility function that includes regret and pride as arguments of the individuals utility function

$$v(w) = u(w) - g[u(w^{alt}) - u(w)]. \tag{1}$$

In the general setting of the model, w presents a variable for individuals level of wealth that is not further defined. Our experimental setting requires us to use a more complex definition of wealth, as outlined in section 3. The first of the two attributes of equation 1 represents the individuals constant relative risk aversion preferences, which can take the form of equation 2. It is characterized by the individuals utility function of actual wealth, w and is assumed to be an increasing and concave function. They considered

$$u(w) = \frac{w^{1-\gamma}}{1-\gamma} \tag{2}$$

for parameter values of $\gamma \neq 1$ and

$$u(w) = ln(w) \tag{3}$$

for parameters values of $\gamma = 1$ as the individuals utility function, with γ as the coefficient for relative risk aversion. The second attribute $g(\cdot)$ is a function itself,

[5]We thereby deviate from the assumption by Muermann and Volkman (2006) that investors only could invest all or nothing. They do provide reasonable justification for only considering indivisible investments. However, we believe for regret and pride to playing a crucial role in explaining investment behavior, investors must feel responsibility for their decisions. This feeling will be weakened, if we initially endow investors with a stock and only require them to make the subsequent sell or hold decisions. We would thereby mix the feelings of regret and disappointment or pride and elation respectively.

representing the individual's feelings of regret and pride. If the realized level of wealth, w, is below the considered alternative level of wealth, w^{alt}, the individual feels regret for its decision. The $g(\cdot)$-function will be positive and hence will decrease the overall utility. If the considered alternative level of wealth is lower than the realized level of wealth, $g(\cdot)$ will be negative and the individual will experience pride for its decision. The function is assumed to be increasing and convex with $g(0) = 0$. The individual, hence, puts a larger weight on the disutility resulting from regret than the additional utility resulting from pride[6]. This implies that an investor having such a utility function as equation 1 is pride-seeking and regret-averse.

In line with Muermann and Volkman (2006), we assume that disutility or additional utility from regret and pride only incurs in the final period. Investors thus follow an investment strategy that maximize expected utility using $v(\cdot)$. If the investor's decision turns out to be ex-post optimal he will feel pride towards a forgone worst alternative. If the investors decision turns out to be ex-post suboptimal he will feel regret towards a forgone best alternative. In our experiment, we additionally ensured that the risk premium is high enough, so that investors who do not consider regret and pride always want to invest in the risky asset. Muermann and Volkman (2006) draws on Bell (1982) assuming that investors do not observe stock returns, if they do not hold that stock. We deviated from that assumption in a way that participants in our experiment always had the information about the performance of the stock[7]. In the following we will show under what conditions it will be optimal for investors to follow a trading scheme consistent with the disposition effect.

Suppose the investor initially invested I of his initial endowment E in the stock at $t = 0$ and the stock gained in value over the first period. The investors level of wealth at $t = 1$ is then given by $I(1 + x) + E - I$ (see figure 5 in appendix B). The expected utility from selling the stock in $t = 1$ is

$$u[I(1+x)+E-I] - pg[u[I(1+2x)+E-I] - u[I(1+x)+E-I]] \\ - (1-p)g[u[E] - u[I(1+x)+E-I]]. \quad (4)$$

Note that we deviated from the assumption that the investor can not observe the stock performance after the stock is sold. In our setting, the investor gets the information on how the stock performed after it was sold. Hence, in our approach,

[6]The assumption that regret matters relatively more than pride found experimental support by Bleichrodt et al. (2010)

[7]We believe that this assumption by Muermann and Volkman (2006) does not reflect real investment situations, e.g. investors might want to further observe the stock performance to wait for a suitable re-entry.

if the investor considers the foregone worst alternative or the foregone best alternative, he needs to form expectations about the alternatives. Thus, in the above setting the foregone worst alternative is not to have not invested in $t = 0$, as in Muermann and Volkman (2006), but an expected value of how the stock might perform in $t = 2$ after the investor sold it in $t = 1$. Thus, after selling the stock and receiving the information on the hypothetical performance of the stock the investor may experience pride with probability $1 - p$ if the stock went down or regret with probability p if the stock went up. The expected utility from holding the stock in $t = 1$ is

$$pu[I(1+2x)+E-I]+(1-p)u[E]-pg[u[E]-u[I(1+2x)+E-I]] \\ -(1-p)g[u[I(1+2x)+E-I]-u[E]]. \quad (5)$$

The reasoning is as follows. If in $t = 1$ the investor decides to hold the stock and the stock gains value in $t = 2$, the foregone worst alternative is that the stock went down after holding it. If in $t = 1$ the investor decides to hold the stock and the stock loses value in $t = 2$, the foregone best alternative is that the stock went up after holding it. The above term consists of the expected additional utility in $t = 2$, and anticipated regret and pride in the respective $g(\cdot)$-functions.

Consider now the situation in which the investor invested in the stock at $t = 0$ and the stock lost in value over the first period. The expected utility from selling the stock in $t = 1$ is

$$u[I(1-x)+E-I]-pg[u[E]-u[I(1-x)+E-I]] \\ -(1-p)g[u[I(1-2x)+E-I]-u[I(1-x)+E-I]] \quad (6)$$

and the expected utility from holding the stock in $t = 1$ is

$$pu[E]+(1-p)u[I(1-2x)+E-I]-pg[u[I(1-2x)+E-I]-u[E]] \\ -(1-p)g[u[E]-u[I(1-2x)+E-I]]. \quad (7)$$

Proposition 1 *If the subject bought the stock in $t = 0$, it is then optimal for the subject at $t = 1$ to sell the stock if it went up and to hold the stock if it went down over the first period if following conditions hold:*

$$\begin{aligned} &u[I(1+x)+E-I]-pu[I(1+2x)+E-I]-(1-p)u[E]> \\ &pg[u[I(1+2x)+E-I]-u[I(1+x)+E-I]]+(1-p)g[u[E]-u[I(1+x)+E-I]] \\ &\quad -pg[u[E]-u[I(1+2x)+E-I]]-(1-p)g[u[I(1+2x)+E-I]-u[E]] \quad (8) \end{aligned}$$

and

$$\begin{aligned} &pg[u[E]-u[I(1-x)+E-I]]+(1-p)g[u[I(1-2x)+E-I]-u[I(1-x)+E-I]] \\ &\quad -pg[u[I(1+2x)+E-I]-u[E]]-(1-p)g[u[E]-u[I(1-2x)+E-I]] \\ &\quad > u[I(1-x)+E-I]-pu[E]-(1-p)u[I(1-2x)+E-I]. \quad (9) \end{aligned}$$

If we now use the same parameterization as in Muermann and Volkman (2006), that is using $u(x) = ln(x)$ and $g(x) = exp(x) - 1$, and use the realizations of E, I, x and p from the experiment we can simulate how condition 8 and 9 behave with our data[8]. In total, we had 168 investment decisions of our subjects, in ten cases the subjects chose not to invest in $t = 0$. For each of the remaining 158 decisions, we calculated the expected utility from selling or holding the stock in $t = 1$ either in the domain of gains or in the domain of losses. Taking these values of expected utility we simulated if it would be optimal for the subjects to sell or hold the stock in $t = 1$. Surprisingly, we found that in only 4 out of 158 investment decisions it would have been optimal for the subject to sell the stock $t = 1$. In all other 154 situations it would have been optimal to hold the stock in $t = 1$. According to the data there were 47 decisions consistent with the disposition effect in the domain of losses and 35 decisions consistent with the disposition effect in the domain of gains. However, using the parameterization there were only 55 decisions predicted to be optimal following the disposition strategy, all of them were to hold losers. Out of these 55 predicted decisions 43 actually occurred, hence in these cases the data is consistent with the models prediction, using the above parameterization.

The above outline gives first insights on how the model can be applied in an experimental approach. To closer follow Muermann and Volkman (2006) we need to further investigate the initial investment decision that is under what conditions the true disposition effect occurs. We need to setup the expected utility from investing

[8]By implementing a functional form of the utility and regret function we put strong assumptions on the behavior of individuals that may turn out not to be realistic. However, the aim is to get a first impression of how well the experiment was suited to simulate the theory.

in the stock in $t = 0$ and then following a disposition behavior in $t = 1$. The following equation represents the expected utility from the true disposition effect.

$$\begin{aligned}
&pu[I(1+x)+E-I] - p^2 g[u[I(1+2x)+E-I] - u[I(1+x)+E-I]] \\
&- p(1-p)g[u[E] - u[I(1+x)+E-I]] + (1-p)pu[E] + (1-p)^2 u[I(1-2x)+E-I] \\
&- (1-p)pg[u[I(1-2x)+E-I] - u[E]] - (1-p)^2 g[u[E] - u[I(1-2x)+E-I]])
\end{aligned}$$

We further need to specify all other possible trading strategies and compare them to the disposition strategy. We then have to show under what specification it will be optimal to follow the disposition strategy. We would then be able to set up a parameter range for the investment decisions, as in table 2, for which we expect the disposition effect to occur. However, we leave this to future research, because it is beyond the scope of this paper. In the following section we will turn to the results of the experiment in greater detail.

5 Results

The participants in our experiment were 21 students from the University of Konstanz. The experiment was conducted in a session of experiments for a seminar at the Chair of Applied Research in Economics. The experiment took approximately 20 minutes, not including registration and payout. The average subjects' age was 23 and there was one female participant more than male participants. The average subjects payoff was 3.67 € and so the expected hourly payoff was roughly 11 €, which is equivalent to a good hourly wage for students in Germany. From part one of the experiment we gained data about how subjects felt in situations from table 11, and with what intensity they felt any particular emotion. We transformed the data, so that for all situations the reports were on a scale between 0 and 1. Thereby, we can compare the reports between subjects. The reports of regret for situations one to six and the reports of pride for situations seven to twelve conform to the intuition behind the situations[9]. A further structural property of the data, as stated by Muermann and Volkman (2006), should be that investors are more concerned about regret than about pride. In part one of our experiment, this assumption would be reflected in higher reports of regret than reports of pride.

[9]We are aware of the fact, that if people do not know exactly how they feel in a situation, they tend to align with feelings of other persons that are in the same situation or they may search in social norms how they should feel. That means that the reports of the feeling might not be the actual feelings a subject felt in the specific investment situation. It rather could be that subjects recalled past experiences, e.g. losing money, and reported the associated feeling or they drew on social norms, e.g. earning money is associated with pride.

Hypothesis 1 *Investors are more concerned about regret than happy about pride.*

To test this hypothesis, we accumulated for each subject their reported feelings of regret and pride for all twelve situations of table 11. If the assumption holds, the reports of regret should tend to be higher than the reports of pride. That should result in a higher mean for the reports of regret than for pride. Table 4 shows the accumulated reports of each subject. From the data it can be seen that there is no big differences in the reports of regret and pride for either the transformed data or the original data. Table 6 and table 7 report the test results. For both data sets we found no support for the hypothesis. To gain further insights about how regret and pride may influence the disposition effect, we analyze if feelings for an action might be more intense than for an in-action. If feelings matter more for action than for in-action, then they would influence the active selling and buying decision more than the passive holding decision.

Hypothesis 2 *Regret and pride are stronger for actions than for in-actions.*

To test the hypothesis we accumulated the reports of regret and pride (see table 5) first for situations in which an action was relevant and second for situations were in-action was relevant[10]. The test results for regret can be obtained from table 8 and the test results for pride can be obtained from table 9. We find no support for regret and pride being stronger for actions than for in-actions.

As mentioned in section 3 we also collected reports of feelings other than regret and pride. For future research it will be interesting to investigate the detailed differences in regret and disappointment or elation and pride with respect to investment decision. We believe that not only two feelings play a role while decisions are made, rather there exist an interaction between several feelings. Just consider the situation four and five or eleven and twelve from table 11.

We now turn to the second part of our experiment where the subjects actually made payoff-relevant decision. We first measured the disposition effect analogously to Odean (1998). We compared the proportion of gains realized relative to the proportion of losses realized in the context of a single risky investment. For this comparison we calculated the following proportions:

$$\frac{\textit{Realized Gains}}{\textit{Gains after Invest}} = \textit{Proportion of Gains Realized (PGR)} \tag{10}$$

[10]For regret under action we accumulated situations 1,3,5 and 11. For regret under in-action we accumulated situations 2,4,6 and 12. For pride under action we accumulated situations 3,7,9 and 11. For pride under in-action we accumulated situations 4,8,10 and 12.

$$\frac{Realized\ Losses}{Losses\ after\ Invest} = Proportion\ of\ Losses\ Realized\ (PLR) \tag{11}$$

For the disposition effect to occur in this setting PGR should be larger than PLR. That is subjects should have more often realized their gains than their losses. Table 3 shows the respective values for PGR and PLR. It can be seen from the data that in 14 cases subjects realized a higher proportion of their gains than of their losses. That effect is significant at a 5% level (see table 10). Now the question

Table 3: Proportion of gains realized and proportion of losses realized

Subjects	**PGR**	**PLR**	**PGR-PLR**	**1 if PGR-PLR¿0**
1	0.60	0.00	0.60	1
2	0.00	0.67	-0.67	0
3	0.20	0.00	0.20	1
4	0.33	-	-	-
5	0.17	0.00	0.17	1
6	0.60	0.00	0.60	1
7	0.80	0.33	0.47	1
8	0.60	0.00	0.60	1
9	0.00	0.00	0.00	0
10	0.29	0.00	0.29	1
11	0.25	0.00	0.25	1
12	0.00	0.50	-0.50	0
13	0.20	0.00	0.20	1
14	0.17	0.00	0.17	1
15	0.43	0.00	0.43	1
16	0.40	0.00	0.40	1
17	0.50	0.00	0.50	1
18	0.80	0.00	0.80	1
19	0.50	1.00	-0.50	0
20	0.13	-	-	-
21	0.00	0.00	0.00	0
Mean	0.33	0.13	**Sum**	14

arises: which factors drive this behavior? As stated before the aim of this paper is to link the feelings of regret and pride to the disposition effect. We first looked at the data from part two of the experiment and checked for each of the 168 decision if the disposition effect occurred in the domain of gains or in the domain of losses. If the behavior was consistent with the disposition effect in the domain of gains the binary variable DE_{GAIN} took the value of 1, if otherwise the value of 0. If the behavior was consistent with the disposition effect in the domain of losses the binary variable DE_{LOSS} took the value of 1, if otherwise the value of 0. We had 35

observations for DE_{GAIN} and 47 for DE_{LOSS}. Then we checked for each investment decision to which situations from table 11 it relates. Except for decisions in which the subjects refrained from investing, we assigned two situations from table 11 to each investment decision. The first situation is the initial buying situation and the second is the subsequent selling or holding situation. By assigning two situations to each investment decision we assigned two reports of regret and two reports of pride to each investment decision. For the respective investment decision the variable *REGRET* represents the sum of the two reports of regret and the variable *PRIDE* represents the sum of the two reports of pride[11]. Figure 1 and figure 2 plot the reports of regret and pride against the binary variables for the disposition effect.

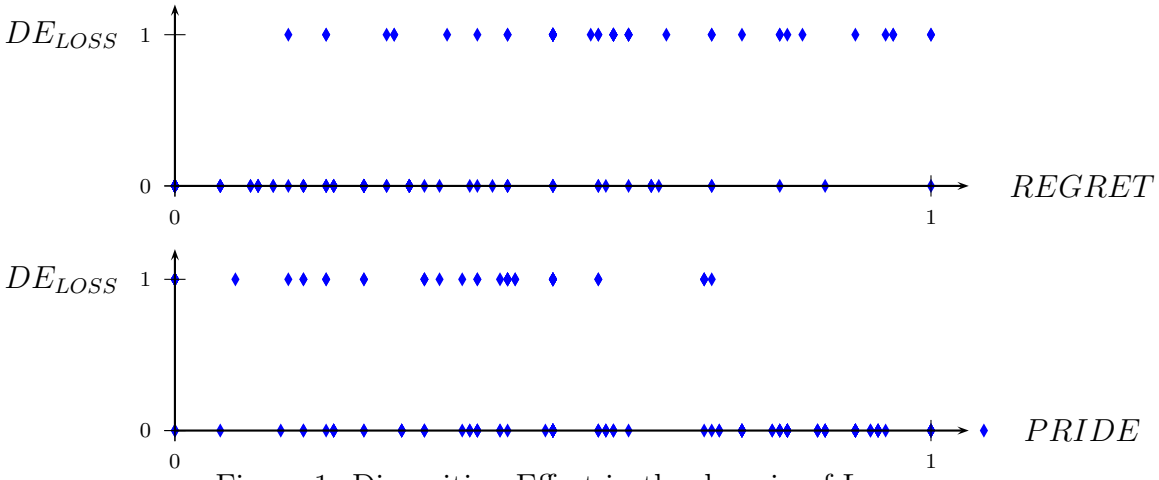

Figure 1: Disposition Effect in the domain of Losses

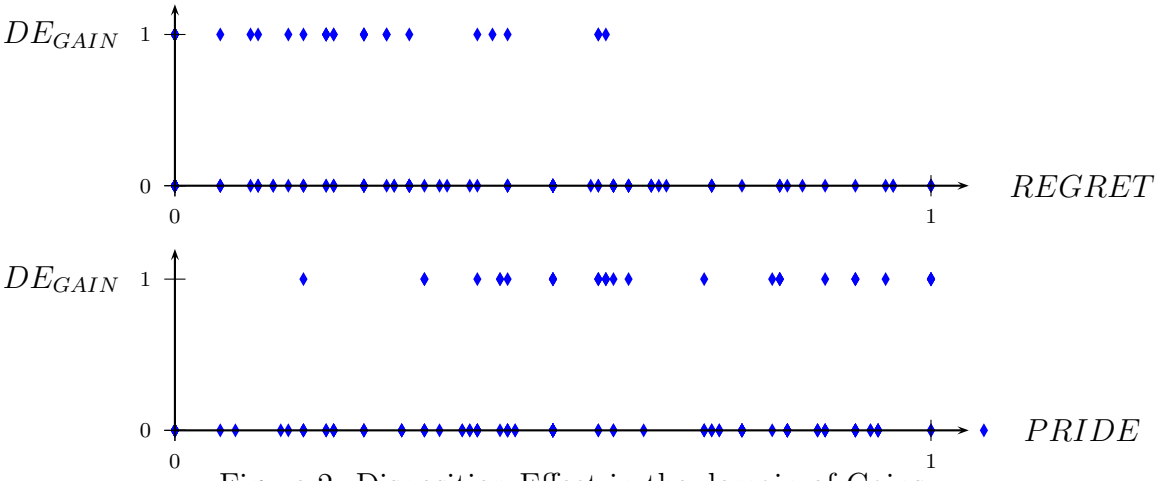

Figure 2: Disposition Effect in the domain of Gains

[11]In ten cases subjects refrained from investing and here the variables DE_{GAIN} and DE_{LOSS} take both the value of zero and the variables *REGRET* and *PRIDE* only consist of one report each.

We are now able to set up a very simple binary probit regression model linking the disposition effect in the respective domain to the feelings of regret and pride.

$$DE_{LOSS} = c + \beta_1 REGRET + \beta_2 PRIDE + \epsilon \tag{12}$$

$$DE_{GAIN} = c + \beta_1 REGRET + \beta_2 PRIDE + \epsilon \tag{13}$$

Table 12 and table 13 show the regression output for equation 12 and equation 13. We find that regret influences the disposition effect in the domain of losses positively, that means disposition behavior is supported by the feeling of regret. The feeling of pride has a negative influence on the disposition behavior, it hinders the disposition effect to occur in the domain of losses. Both effects are significant with $p < 0.01$. For the disposition effect in the domain of gains we find less significant results. Nevertheless, it seems that pride influences the occurrence of disposition behavior positively, while regret has a negative effect on the disposition effect in the domains of gains. As argued in section 2 anticipated regret in the domain of gains could lead investors to hold on to winning stocks, not following a disposition strategy. The intuition behind the two sides of the disposition effect is consistent with signs of regression coefficients. In the domain of losses, investors want to avoid feeling regret, and therefore postpone or even potentially avoid the realization of a loss. Thus, the stronger the importance of regret the higher the probability to hold on to losers. We therefore see a positive relation. In the domain of gains, the same arguments hold for pride. Investor want to feel pride for their investment decision by realizing their gains. Hence, the stronger that feeling the higher the probability to realize gains.

We now consider a measurement of how prone a subject is to the respective feelings. We computed the variances of the relevant reports of regret and pride for each investment decision and defined the variables VAR_{REGRET} and VAR_{PRIDE}. If a subject is not very concerned about a feeling with respect to the investment decision in table 11 it may not use the whole scale of intensity to report the respective feeling and the variance may be small. If the subject is strongly prone to the respective feelings it may differentiate between the different situations more accurately and its reports will show a larger variance.

Hypothesis 3 *Subjects with higher variance in their reports of regret and pride are more likely to fall for disposition effect consistent behavior.*

According to this argument a subject with a larger variance in its reports of regret and pride may put more weight to these feelings in investment decisions. To test the above hypothesis we modified our previous model as follows:

$$DE_{LOSS} = c + \beta_1 REGRET + \beta_2 PRIDE + \beta_3 VAR_{REGRET} + \beta_4 VAR_{PRIDE} + \epsilon \quad (14)$$

$$DE_{GAIN} = c + \beta_1 REGRET + \beta_2 PRIDE + \beta_3 VAR_{REGRET} + \beta_4 VAR_{PRIDE} + \epsilon \quad (15)$$

The regression output for equation 14 and equation 15 can be found in table 14 and table 15. Using our second model we find for the disposition effect in the domain of losses, that it is positively influenced by regret and negatively influenced by pride, both with $p < 0.001$. If we use the variance as an indicator of how strong a subject is influenced by feelings we can find an additional significant positive effect of regret for the disposition effect in the domain of losses. In the domain of gains the effects are not as significant as in the domain of losses. Using our second regression model the signs of the coefficients *REGRET* and *PRIDE* do not change, but their p-values increase. The indicators for the strength of feelings both have a negative effect on the occurrence of the disposition effect in the domain of gains.

The results of the two regression models have shown that the experiment delivered more accurate results for the disposition effect in the domain of losses than in the domain of gains. The first indicator of this result was shown in section 4 by the parameterization. The second indicator is the significance of the coefficients in the models 12 to 15, which are far better for the disposition effect in the domain of losses than in the domain of gains. We thereby find evidence for the hypothesis by Weber and Welfens (2007), that the two sides of the disposition effect may be separated. That is, investors more commonly hold on to losing investments than selling winning investments.

6 Discussion

As we have seen in section 5 our experimental approach in general is suited to help explain the disposition effect with regard to feelings. As far as we know, the approach taken, was the first explicitly trying to link feelings of regret and pride with investment behavior according to the disposition effect. Nevertheless, there are several parts of the experimental approach that need to be modified in order to get stronger results. In part one of our experiment we drew on affective forecasting, which we believed to be an effective method to elicit feelings similar to feelings in

real investment situation. However, we are aware of the several cognitive biases that adulterate the reports of feelings if one relies on affective forecasting. An alternative approach could be to ask the subjects after each investment decision how they feel after they know the outcome. If after each decision the subjects were asked about specific feelings, we probably would observe a strong priming effect that overrides the independence of each investment decision. An extension of the approach we took, is to elicit feelings not related to investment decisions. One could ask subjects rather general questions about regret and pride and may use these reports as indicator of how important these feelings are for a subject. To elicit reports of regret, one could draw on Bleichrodt et al. (2010), who provides a method to quantitatively measure regret. However, this approach would greatly extend the scale of the experiment. A second promising and easy-to-implement extensions would be to extend the range of value changes in the hypothetical investment decisions. We thereby elicit reports of feelings for different values of gains and losses. This leads to a similar shortcoming in part two of our experiment. To get deeper results, future experiments should include a wider range of values for the investment decisions. The values for endowment should span a wider range and the value changes and probabilities should be more differentiated. That would offer a chance to observe the disposition effect over a wider range of investments. In our approach we deviated from a crucial assumption by Muermann and Volkman (2006) and Bell (1982). We did not apply the setting that investor only observe stock returns if they hold the stock. In real life investment situations, investors do observe stock returns after they sold a stock. Hence, there should be a theory that explains the disposition effect without that strong assumption. Nevertheless, not controlling for this assumption, might be a reason for the results of the parameterization in section 4, as Muermann and Volkman (2006) pointed out that observing stock returns after a initial gain makes holding more attractive and may lead to momentum trading, holding winning stocks. Even though our experimental approach can be improved in several ways, we believe that our design provides a promising method to link the feelings of regret and pride to the disposition effect. As we have seen in our experimental results, regret and pride do help to explain the disposition effect.

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Appendices

A Instructions

The experiment was conducted during a session of four experiments within the same subject pool. Our experiment ranked second and was introduced by the following instructions (originally in German).

2. Experiment
The following Experiment consists of two parts.

Part 1
In part 1 you will be faced with 12 different situations. Those situations are buying and selling situations in a stock market. The following information will be given to you:

- Buying price of a stock
- First price-change
- Your decision after the first price-change
- Second price-change

Your task is to describe, how you would feel in those situation and to indicate the intensity of the feeling. You can choose between 6 different alternatives. Please make your choice in the bottom box. When you finished your choice, please press "OK" and you will be shown the next situation.

- Screenshot 1 -

Part 2
In part 2 you will make investment decisions. Sequentially, you will face 8 different situation in which you have to decide how many tokens of your endowment you invest in a stock market. After a price-change you have to decide to sell or to hold the stock. You will be given information regarding your endowment, possible price-changes and the probability of a price-change. The procedure is as follows:

- You decide how many tokens of your endowment you invest in the stock market.

- If you invest zero, the current investment decision ends and you will continue with the next investment decision. In this case, your endowment will be booked on your payoff account.
- If your investment is positive, it may change its value.
- After a change in value, you have to decide whether to hold or to sell the stock. If you sell the stock, its value will be booked on your payoff account. If you hold the stock, a second price-change may occur.
- After the second price-change, the value of the stocks will automatically be booked on your payoff account and you will continue to the next investment decision.
- If you do not invest your total endowment, the not invested amount of your endowment will be booked to your payoff account.

- Screenshot 2 -

Payoff in part 2

In part 2 you will be endowed with tokens. **100 tokens = 3 €.** In each of the 8 investment decision the amount of your endowment that is not invested will be booked to your payoff account. The amount of your endowment that is invested will be booked to your payoff account with the corresponding value. At the end of the experiment 1 of th 8 investment decision will be randomly selected and paid out to you.

If your have further questions, please refer to the experimenter.

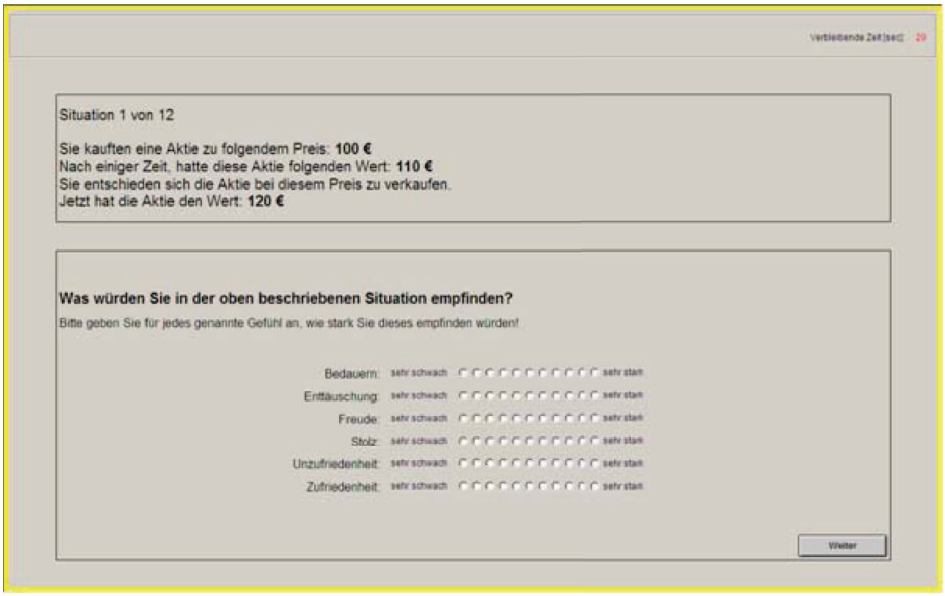

Figure 3: Screenshot 1

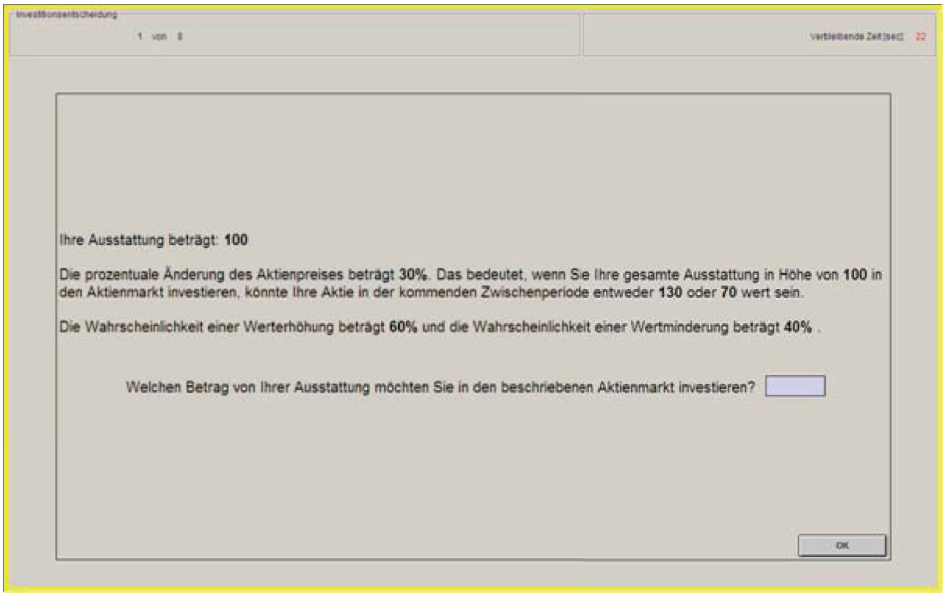

Figure 4: Screenshot 2

B Data

Table 4: Accumulated reports of regret and pride

	Transformed data		Original data	
Subject	**Regret**	**Pride**	**Regret**	**Pride**
1	4.20	6.10	42.00	61.00
2	3.86	4.57	27.00	32.00
3	5.40	4.00	54.00	36.00
4	6.63	4.57	53.00	56.00
5	2.90	3.50	29.00	28.00
6	6.00	7.00	66.00	59.00
7	3.00	3.43	15.00	24.00
8	5.00	7.50	50.00	75.00
9	4.63	5.00	37.00	40.00
10	6.88	7.29	55.00	51.00
11	3.86	5.71	27.00	40.00
12	3.20	4.70	32.00	47.00
13	4.00	4.88	36.00	39.00
14	3.83	3.20	23.00	16.00
15	4.22	5.38	38.00	67.00
16	5.13	3.33	41.00	32.00
17	4.30	4.90	43.00	49.00
18	4.70	5.80	47.00	58.00
19	7.29	4.17	51.00	25.00
20	5.75	5.13	46.00	41.00
21	6.00	5.80	60.00	53.00
Mean	4.80	5.05	41.52	44.24

Table 5: Accumulated reports of regret and pride for action and in-action

	Regret		**Pride**	
Subject	**action**	**in-action**	**action**	**in-action**
1	2.10	2.10	2.90	3.20
2	2.29	1.57	2.14	2.43
3	2.70	2.70	2.11	1.78
4	3.00	2.88	2.43	1.57
5	1.40	1.50	1.75	1.75
6	3.00	2.40	3.00	2.60
7	1.80	1.20	2.00	1.43
8	0.00	3.00	3.60	1.40
9	2.88	1.75	2.50	2.50
10	2.75	3.25	2.14	3.43
11	2.29	1.57	3.00	2.71
12	2.20	1.00	2.50	1.80
13	2.00	1.78	2.75	1.88
14	2.50	1.33	1.80	1.40
15	1.44	2.22	1.75	2.88
16	2.38	2.00	1.50	1.50
17	1.80	2.50	2.50	1.90
18	2.50	2.20	3.10	2.50
19	2.29	3.86	1.67	1.67
20	3.00	2.75	2.25	2.63
21	2.33	2.83	2.60	2.20
Mean	2.22	2.21	2.38	2.15

Table 6: Test for equality of means of reports of regret and pride for original data

Sample: 1 21
Included observations: 21

Method	df	Value	Probability
t-test	40	0.616965	0.5408
Anova F-statistic	(1, 40)	0.380646	0.5408

Table 7: Test for equality of means of reports of regret and pride for transformed data

Sample: 1 21
Included observations: 21

Method	df	Value	Probability
t-test	40	0.6364	0.5281
Anova F-statistic	(1, 40)	0.4051	0.5281

Table 8: Test for equality of means of reports of regret for action and in-action

Sample: 1 21
Included observations: 21

Method	df	Value	Probability
t-test	40	0.0524	0.9585
Anova F-statistic	(1, 40)	0.0027	0.9585

Table 9: Test for equality of means of reports of pride for action and in-action

Sample: 1 21
Included observations: 21

Method	df	Value	Probability
t-test	40	1.2853	0.2061
Anova F-statistic	(1, 40)	1.6521	0.2061

Table 10: Test for equality of means of PGR and PLR

Sample: 1 21
Included observations: 21

Method	df	Value	Probability
t-test	38	2.330256	0.0252
Anova F-statistic	(1, 38)	5.430092	0.0252

Figure 5: Two-period stock market game

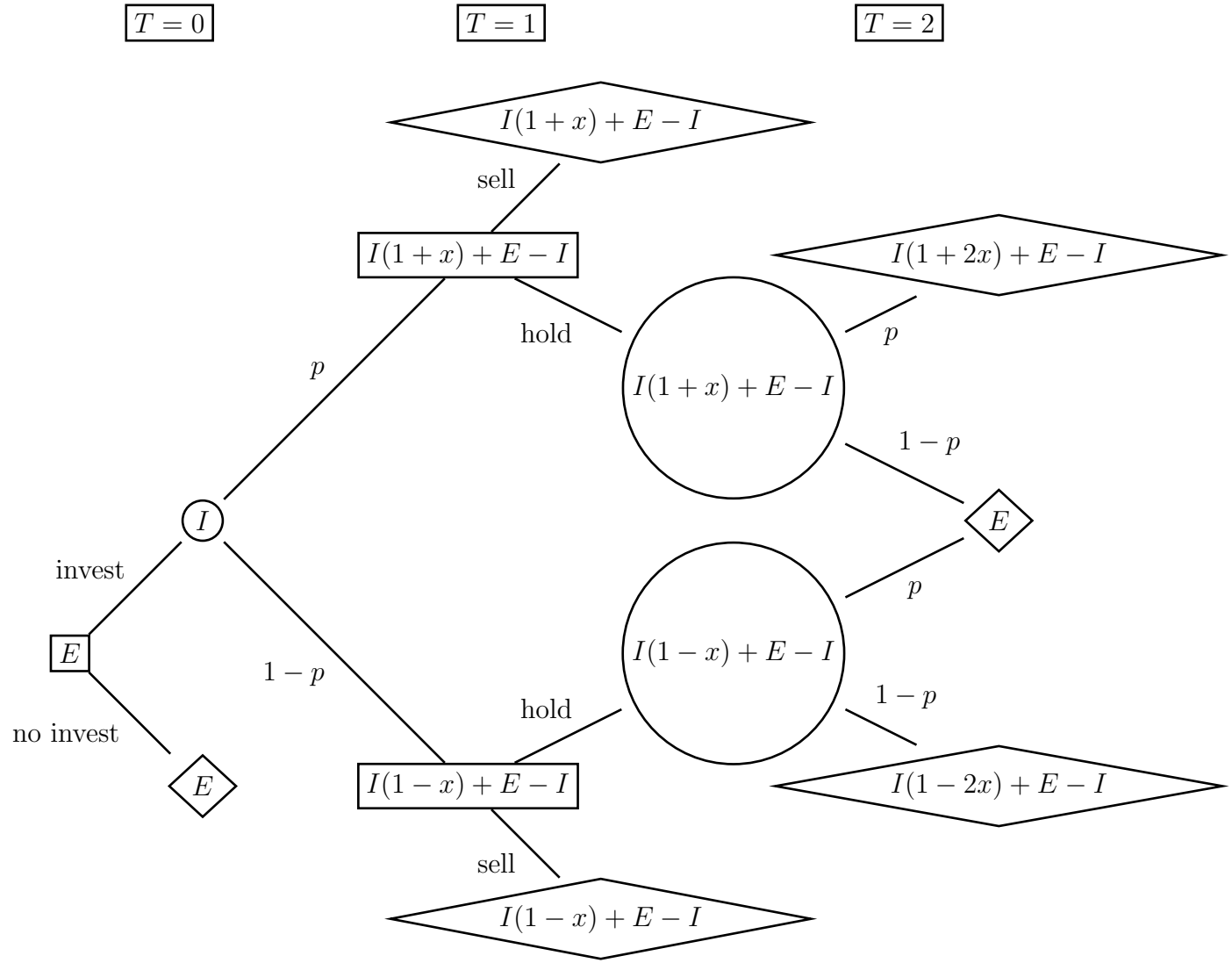

Table 11: Twelve hypothetical investment situations

1	You bought the share for the following price:	100
	Now, the share is traded for the following price:	90
2	You did not buy the share while it was trading for the following price:	100
	Now, the share is traded for the following price:	110
3	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	110
	Subsequently, you decided to sell your share at this price.	
	Now, the share trades for the following price:	120
4	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	110
	You decided to hold your share.	
	Now, the share trades for the following price:	100
5	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	90
	Subsequently, you decided to sell your share at this price.	
	Now, the share trades for the following price:	100
6	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	90
	You decided to hold your share.	
	Now, the share trades for the following price:	80
7	You bought the share for the following price:	100
	Now, the share is traded for the following price:	110
8	You did not buy the share while it was trading for the following price:	100
	Now, the share is traded for the following price:	90
9	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	110
	Subsequently, you decided to sell your share at this price.	
	Now, the share trades for the following price:	100
10	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	110
	You decided to hold your share.	
	Now, the share trades for the following price:	120
11	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	90
	Subsequently, you decided to sell your share at this price.	
	Now, the share trades for the following price:	80
12	You bought the share for the following price:	100
	After a while, the share was traded for the following price:	90
	You decided to hold your share.	
	Now, the share trades for the following price:	100

Table 12: Regression output for DE_{LOSS}

Dependent Variable: DE_{LOSS}
Method: ML - Binary Probit (Quadratic hill climbing)
Sample: 1 168
Included observations: 168
Convergence achieved after 5 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.286870	0.377952	-3.404849	0.0007
REGRET	0.203023	0.034532	5.879279	0.0000
PRIDE	-0.079880	0.030763	-2.596627	0.0094
Mean dependent var	0.279762	S.D. dependent var		0.450224
S.E. of regression	0.344016	Akaike info criterion		0.743540
Sum squared resid	19.52730	Schwarz criterion		0.799325
Log likelihood	-59.45738	Hannan-Quinn criter.		0.766181
Restr. log likelihood	-99.57836	Avg. log likelihood		-0.353913
LR statistic (2 df)	80.24194	McFadden R-squared		0.402909
Probability(LR stat)	0.000000			
Obs with Dep=0	121	Total obs		168
Obs with Dep=1	47			

Table 13: Regression output for DE_{GAIN}

Dependent Variable: DE_{GAIN}
Method: ML - Binary Probit (Quadratic hill climbing)
Sample: 1 168
Included observations: 168
Convergence achieved after 4 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.179756	0.358549	-3.290358	0.0010
REGRET	-0.043348	0.029543	-1.467318	0.1423
PRIDE	0.056972	0.025833	2.205407	0.0274
Mean dependent var	0.208333	S.D. dependent var		0.407331
S.E. of regression	0.394205	Akaike info criterion		0.980041
Sum squared resid	25.64060	Schwarz criterion		1.035826
Log likelihood	-79.32345	Hannan-Quinn criter.		1.002681
Restr. log likelihood	-85.97233	Avg. log likelihood		-0.472163
LR statistic (2 df)	13.29776	McFadden R-squared		0.077337
Probability(LR stat)	0.001295			
Obs with Dep=0	133	Total obs		168
Obs with Dep=1	35			

Table 14: Regression output for DE_{LOSS}

Dependent Variable: DE_{LOSS}
Method: ML - Binary Probit (Quadratic hill climbing)
Sample: 1 168
Included observations: 158
Convergence achieved after 5 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.195304	0.438717	-2.724547	0.0064
REGRET	0.176020	0.038829	4.533237	0.0000
PRIDE	-0.128867	0.037868	-3.403020	0.0007
VAR_{REGRET}	0.043607	0.014931	2.920554	0.0035
VAR_{PRIDE}	0.009985	0.016663	0.599243	0.5490
Mean dependent var	0.297468	S.D. dependent var		0.458598
S.E. of regression	0.322878	Akaike info criterion		0.663758
Sum squared resid	15.95023	Schwarz criterion		0.760676
Log likelihood	-47.43692	Hannan-Quinn criter.		0.703118
Restr. log likelihood	-96.17523	Avg. log likelihood		-0.300234
LR statistic (4 df)	97.47661	McFadden R-squared		0.506766
Probability(LR stat)	0.000000			
Obs with Dep=0	111	Total obs		158
Obs with Dep=1	47			

Table 15: Regression output for DE_{GAIN}

Dependent Variable: DE_{GAIN}
Method: ML - Binary Probit (Quadratic hill climbing)
Sample: 1 168
Included observations: 158
Convergence achieved after 4 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.890980	0.395385	-2.253448	0.0242
REGRET	-0.042032	0.031704	-1.325745	0.1849
PRIDE	0.043446	0.026914	1.614282	0.1065
VAR_{REGRET}	-0.010199	0.014956	-0.681911	0.4953
VAR_{PRIDE}	-0.009110	0.014650	-0.621868	0.5340
Mean dependent var	0.221519	S.D. dependent var		0.416589
S.E. of regression	0.406328	Akaike info criterion		1.033045
Sum squared resid	25.26062	Schwarz criterion		1.129963
Log likelihood	-76.61056	Hannan-Quinn criter.		1.072405
Restr. log likelihood	-83.55416	Avg. log likelihood		-0.484877
LR statistic (4 df)	13.88719	McFadden R-squared		0.083103
Probability(LR stat)	0.007664			
Obs with Dep=0	123	Total obs		158
Obs with Dep=1	35			