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Bonus schemes and trading activity

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ABSTRACT

Little is known about how different bonus schemes affect traders' propensity to trade and which bonus schemes improve traders' performance. We study the effects of linear versus threshold bonus schemes on traders' behavior. Traders buy and sell shares in an experimental stock market on the basis of fundamental and technical information (past share price evolution, realized earnings, analysts' earnings forecasts, and evolution of the market index). We find that linear and threshold bonus schemes have different effects on trading behavior: traders make more transactions but of a smaller size under the threshold than under the linear bonus scheme. Furthermore, transaction frequency significantly decreases when bonus thresholds are reached but only after building in a safety margin. Under the threshold scheme, the traders' performance is lower (even when there are no transaction costs) than under the linear bonus scheme as a consequence of poorer market timing. This is especially the case when earning money by trading is relatively difficult (i.e., under low profitability conditions). Nevertheless, under low profitability conditions, traders seem to collect more information about the relationships between share price and market returns, earnings, and earnings forecasts, put more effort into understanding those relationships, and thus eventually learn to perform better.

1. Introduction

The proportion of U.S. public equities managed by professional investors has greatly increased over the last three decades, namely from 34% in 1980 to 67% in 2010 (Blume and Keim, 2012). While the main role of professionals is to invest on behalf of others, many of them also trade securities with their company's own money to make profits, i.e., they engage in proprietary trading, which involves extensive return volatility and skewness.[4] To sustain high risk levels, trading divisions usually offer compensation packages with a significant portion paid as a bonus depending on the trader's performance. According to Wall Street Oasis, bonuses account for around 54% of professional traders' total remuneration (WSO, 2013). Thus, bonuses are meant to influence trading behavior and make up a

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[4] While proprietary trading typically generates small revenues as a percentage of total revenues, it tends to generate extreme losses during financial downturns. For example, in the period from June 2006 to December 2010, stand-alone proprietary trading activities at the six largest bank holding companies produced combined revenues of $15.6 billion in 13 out of 18 quarters and combined losses of $15.8 billion in the remaining 5 quarters (United States Government Accountability Office, 2011).

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significant proportion of traders' pay. However, still little is known about how bonus schemes affect traders' propensity to trade and whether different bonus schemes used by the industry differentially improve traders' performance.

To our knowledge, this is the first study to investigate the influence of bonus schemes on traders' willingness to trade and on their performance. We set up two different bonus schemes to study trading behavior – more specifically, we study trading intensity and performance under controlled market conditions. We compare the impact of two different bonus schemes: (i) a linear bonus scheme, which always pays a fixed percentage of the total profit and which we use as a benchmark; and (ii) a threshold bonus scheme, which pays an increased percentage of the total profit when a threshold is reached (after which payment increases linearly until the next threshold is reached). Linear, but especially threshold bonus schemes are widely used by trading divisions of banks and funds, but the amounts, thresholds, and other details seem to be strictly confidential.[5]

The role of compensation schemes as a device to reduce agency costs has raised academic eyebrows over the last fifteen years (Bebchuk and Fried, 2004). The recent financial crisis has intensified this criticism not only in the academic literature but also on the part of investors and regulators. Public opinion is reflected in the observation of Timothy Geithner, the former US Treasury Secretary: "This financial crisis had many significant causes, but executive compensation practices were a contributing factor. Incentives for short term gains overwhelmed the checks and balances meant to mitigate against the risk of excess leverage" (Geithner, 2009). Whereas the relationship between the level and form of executive compensation and company performance has frequently been studied, little is known about how compensation packages and bonus schemes actually create incentives for traders.

Bonus schemes seem to play an eminent role in traders' motivation to trade and to perform well. Sometimes they evoke emotions, aspirations, and risk appetites that result in aberrant behavior, e.g., in the cases of Nick Leeson, Jérôme Kerviel, and Kweku Adoboli, whose fraudulent behavior cost their employers around 8 billion Euro. "Yes, I did it – but all I wanted was a bonus," commented Jérôme Kerviel on his trading loss of 4.9 billion Euros for Societe Generale (The Independent and The Times, 29 Oct. 2008). In a similar vein, Nick Leeson commented, "I suppose, I became indoctrinated by the lure of the salaries that were available and the whispered rumours of bonuses that were available" (Journal, ie, 19 Oct. 2011). These examples show that a misalignment between the interests of traders and their employers (be it investment banks, hedge funds, or corporations) may lead to severe problems. It is likely that specific compensation schemes induce suboptimal trading behavior that may ultimately lead to poor performance and significant corporate losses.

Bonus schemes may serve other purposes than increasing traders' risk taking. For example, they may be designed to increase trading intensity. This would be particularly relevant if a professional market maker earns higher profits by placing more trades or larger trades. However, empirical evidence suggests that such strategies do not necessarily lead to increased performance. Indeed, Garvey and Wu (2010) document that, for professional traders, higher trading activity on the last day of their evaluation period results in poorer performance due to poor market timing and higher transaction costs. Likewise, Barber and Odean (2000, 2001) demonstrate that, for individual investors, higher trading activity is likely to result in poorer performance due to higher transaction costs.

In our experimental study, we employ a two (bonus scheme: linear vs. threshold) by two (session profitability: low vs. high) between-subject experimental design. The linear bonus scheme always pays a fixed percentage of the profit earned by traders as their bonus. The threshold bonus scheme is piecewise linear; it sets two explicit performance goals at which a higher bonus and a steeper performance-bonus relationship can be reached. In particular, under the high-profitability conditions the lower threshold is relatively easy to reach, whereas under the low-profitability conditions, the same threshold is relatively difficult to attain.

We report a set of interesting results. First, under the threshold bonus scheme the traders trade more frequently but make transactions of a smaller size than under the linear one. Moreover, under the threshold scheme, transaction frequency significantly depends on whether or not a threshold is reached. Transaction frequency declines once a threshold is met; this effect is especially strong for the higher threshold. Our main finding is that the threshold bonus scheme fails to induce better performance, which is especially the case under low profitability conditions. Indeed, the quality of the investment decisions and the final performance are significantly lower under the threshold than the linear scheme. In our experiment, trading is costless, so the lower returns earned under the threshold scheme cannot be explained by transaction costs. We argue that reaching a threshold may itself become a target at the expense of optimal trading decisions. Thus, bonuses may be detrimental to performance at least in comparison with linear compensation schemes.

The remainder of this paper is organized as follows. Section 2 describes the experimental design and provides a detailed description of the two bonus schemes. Section 3 presents the results, and Section 4 concludes.

2. Experimental design

During fifty experimental trading rounds the participants in our experiment (henceforth called "traders") acted as the employees of a trading company (see appendix A for the experimental instructions). They bought and sold shares of a particular stock and were provided with fundamental (the company's past earnings and the analysts' earnings forecasts) and technical (the past evolution of the share price and the market index) information about the company and the market. All this information consisted of real data on the US company Praxair, Inc.[6] and on the US-based S&P500 market index. The data processes were linearly rescaled and Praxair's name was

[5] We have verified that our bonus schemes are realistic. Directors and traders of UBS, Goldman Sachs, JP Morgan, Merrill Lynch, and Deutsche Bank London confirmed that our schemes do make sense and are used in practice, although they were not willing to provide details or give examples of the threshold values or profit-sharing rules used in their companies. They also stated that the thresholds and degree of profit sharing not only depend on the individual traders' performance but also on their seniority, hierarchical rank, and the profitability of the department, division, and firm.

[6] We chose a company for which information on the earnings, analysts' forecasts, and share price performance was available for at least ten years. Moreover, the share price process did not experience sharp ups-and-downs and was characterized by a period with a prolonged upward movement and a period with a lower trend.

substituted by a neutral company name so that the traders would not be able to identify neither the firm nor the time period. Information about changes in earnings and analysts' earnings forecasts was given every third trading round (since Praxair reports on a quarterly basis and the share price and market data are on a monthly basis). The stock did not pay dividends and we did not provide a bid-ask spread to ensure zero transaction costs. The traders were price-takers and they were explicitly told that their decisions did not influence the stock price or other variables.

The traders started the first round without holding any shares but with an endowment of E$500 (experimental dollars, E$500 equaled 10 euro) in cash. At the beginning of every subsequent trading round, they received an additional E$100 in cash to ensure that they would have sufficient resources for trading. We thus enabled them to make investment decisions over the whole time span of the trading session. The total amount of cash received by each trader during the fifty rounds of the trading session was E$5400.

In each round, traders chose how many shares of stock to buy or sell (short selling was not allowed). They had 15 seconds to make their investment decisions; pre-testing showed that this interval was sufficient to make trading decisions. If a trader did not react within the given time span, a new round started, the share holdings remained unchanged and the cash holdings increased with an additional endowment of E$100. At the end of each round, traders' cumulative performance was displayed; each trader could see only his or her own performance but not that of others.

2.1. Bonus schemes and conjectures

In their overview, Bonner et al. (2000) show that in case of relatively simple tasks, quota schemes are the most likely to evoke positive incentive effects, such as higher effort levels or higher performance. A quota scheme is an example of a threshold scheme; it pays a lump-sum amount once a certain performance level is reached, i.e., it involves a specific goal.[7] Importantly, none of the papers considered by Bonner et al. (2000) deals with trading or market participation; the reviewed studies only consider simple tasks such as recalling words or solving arithmetic problems with no risk or uncertainty involved. In contrast, Kohlmeyer and Drake (2009) find that in a financial decision making context a threshold bonus scheme does not increase risk taking in new project selection relative to a linear bonus scheme. Moreover, Bonner and Sprinkle (2002) find that incentives are less likely to improve performance in difficult tasks or in tasks, in which the gap between task difficulty and subjects' skill is substantial. Our study focuses on trading, a difficult and risky activity that requires significant mental effort to detect information related to future stock performance. We conjecture that a threshold bonus scheme is likely to increase (relative to a linear bonus scheme) the level of effort exercised by traders, which increases their trading intensity.

Conjecture 1. Trading intensity is higher under the threshold than under the linear bonus scheme.

According to Heath et al. (1999), threshold goals may serve as reference points. Thus, trading performance should be evaluated in accordance with the value function of a corresponding reference point as suggested by prospect theory (Kahneman and Tversky, 1979). Then, outcomes below the threshold are coded by a trader as losses and those above the threshold as gains. Loss aversion and diminishing sensitivity to gains result in high trading intensity and risk seeking below the threshold and lower trading intensity and risk aversion above the threshold. Thus, we predict that traders trade less intensely once they have reached a threshold.

Conjecture 2. Once a bonus scheme threshold is met, trading intensity decreases.

In contrast to the above-mentioned benefits of threshold bonus schemes, the behavioral literature suggests that the requirement to reach specific performance thresholds may lead to suboptimal decision making. Kohn (1993) writes: “Do rewards motivate people? Absolutely! They motivate people to get rewards.” In other words, the threshold may itself become a target at the expense of the actual target, which is to make optimal trading decisions, given the opportunities. Hence, we argue that while the threshold bonus scheme may induce greater effort, it may fail to improve performance.

Conjecture 3. Under the threshold bonus scheme, traders make inferior investment decisions and finally perform worse than under the linear bonus scheme.

To test Conjectures 1-3, the traders were randomly assigned to one of two bonus schemes at the beginning of the experiment. Under the linear scheme, the traders always received 35% of the total profit. Fig. 1a shows the bonus paid under the linear scheme as a function of the total return earned at the end of fifty rounds. Table 1 and Fig. 1b show the bonus paid under the threshold scheme. If the trader's return at the end of the trading session was between 0 and 25%, she received 25% of the profit. If her return was between 25% and 45%, she received 35%, and if her return exceeded 45%, she received 45%. Thus, these two thresholds served as implicit performance targets for the traders.

Both linear and threshold bonus schemes reward positive performance but do not punish for negative returns as a trader is simply not paid a bonus if her return is below zero. Here we follow the tradition held in industry where traders' punishment for negative

[7] In terms of providing incentives to improve performance, threshold schemes are followed by linear schemes, tournaments, and fixed-rate schemes. Under linear schemes, every piece of output is rewarded with an equal payment; in tournaments, the winner takes all while the others get nothing; under fixed-rate schemes, the payment does not depend on performance.

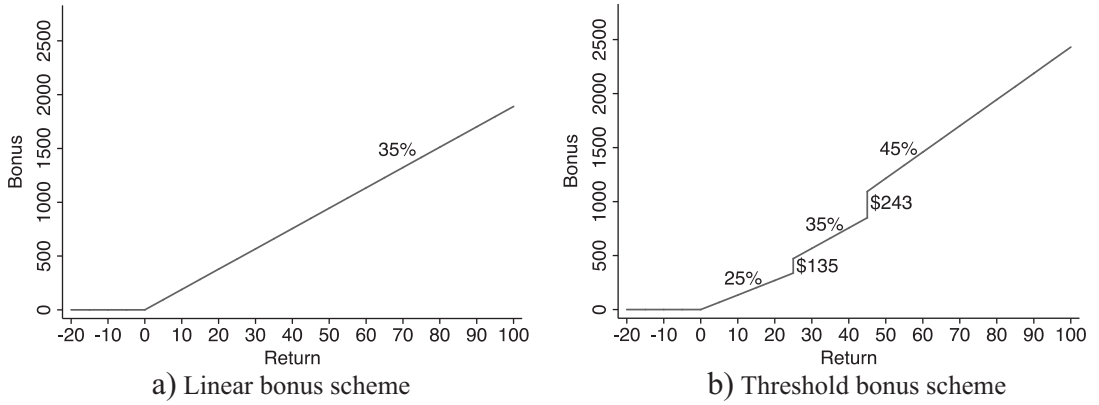

Fig. 1. Payoffs under linear and threshold bonus schemes. The figure shows the bonus paid under (1a) the linear and (1b) the threshold bonus schemes as a function of the total return (in percentage points of the total investment) earned at the end of the 50-round trading session. The total investment (the sum of the periodic endowments) at the end of the 50 rounds was E$5,400. Under the threshold bonus scheme an additional bonus was paid for attaining the thresholds; E$135 for the 25% threshold and E$243 for the 45% threshold.

performance is absence of bonus payment. Obviously, in cases of extreme losses, traders face a higher probability of being fired (Kempf et al., 2009), but in the present study we do not consider employment incentives for traders.

The final bonus was determined by the trader's performance (trader's return) at the end of fifty rounds and by the type of bonus scheme (linear or threshold). On average, the traders earned 12.50 Euros; their final bonus was paid privately and in cash.[8] Thus, only the trader's return achieved at the end of the fifty-round trading session determined the amount of money participants took home after the experiment; none of the intermediate performance results directly affected the final payment.

2.2. High and low share price returns

During bull markets, traders usually expect to earn higher returns than during the bear markets because they tend to base their expectations on the past stock market returns (Greenwood and Shleifer, 2014). These elevated expectations are likely to augment trading intensity, transaction frequency, and transaction size.[9] To assess the impact of market conditions, we manipulate profitability in our experiment (high vs. low profitability conditions) and formulate the following conjecture: Under high profitability conditions, it is relatively easy to earn money as average share price returns are high, whereas under low profitability conditions returns are lower and only elaborated trading strategies may result in good performance.

Conjecture 4. Trading intensity is higher under favorable market conditions.

To test Conjecture 4, at the beginning of the experiment, the traders were randomly assigned to one of two trading sessions that differed in terms of the average profitability of the traded stock. The stock-price process was more favorable in the "high stock return" (HighSR) session, with an average share price return of 2.35% per round. In the "low stock return" (LowSR) session, the average share price return was 0.82% per round. Table 2 compares the share price behavior in the HighSR and LowSR sessions. During the HighSR session the share price increased by 183.39%, whereas the increase was merely 24.12% in the LowSR session. In other words, E$1 invested in the stock in the first trading round was worth E$2.83 at the end of the HighSR session but worth only E$1.24 at the end of the LowSR session.

Taking bonus scheme and profitability conditions together, the traders were randomly assigned to one of four treatments: linear bonus scheme and low stock return session (LinLow); linear bonus scheme and high stock return session (LinHigh); threshold bonus scheme and low stock return session (ThresLow); and threshold bonus scheme and high stock return session (ThresHigh; see Table 3). We perform between-subject comparisons of the four treatments to identify how bonus schemes and share price profitability influence the trading behavior of traders.

The experiment was programmed using z-Tree software (Fischbacher, 2007) and all of the experimental sessions took place at Tilburg University, the Netherlands. The traders were undergraduate or graduate students (invited via the university website) who had previously indicated their interest in participating in paid experiments. A total of 123 students participated in the experiment: 64 females and 59 males, with an average age of 23 years, ranging from 18 to 37 years.

[8] To ensure that all participants had a fair chance of receiving a similar payoff, the bonus schemes were created in such a way that a random trading pattern would yield about the same payoff.

[9] In addition, it has been shown that traders credit themselves for success and positive performance, while attributing failures and negative performance to external factors such as bad luck or others' mistakes (the self-attribution bias). So, under favorable market conditions trading activity is likely to be higher, possibly due to higher trader optimism and overconfidence (Kim and Nofsinger, 2007; Statman et al., 2006; Glaser and Weber, 2009; Shi and Wang, 2010; Liu et al., 2010).

Table 1
Traders' bonus and total return earned.
The table shows how the bonus that traders receive depends on the final total return obtained under the threshold bonus scheme. A trader receives no bonus if her total return is negative. If the total return is between 0 and 25%, the bonus is 25% of the profit; a return greater than or equal to 25% but lower than 45% yields a bonus of 35%; and a return greater than or equal to 45% yields a bonus of 45%.

Investment (sum of endowments)	Value of total holdings (cash and share)	Profit earned for trading company (E$)	Total return (%)	Bonus rate (%)	Bonus (E$)	Bonus (€)
5400.00	5940.00	540.00	10.000	25.00	135.0	2.70
5400.00	6749.99	1349.99	24.999	25.00	337.5	6.75
5400.00	6750.00	1350.00	25.000	35.00	472.5	9.45
5400.00	7829.99	2429.99	44.999	35.00	850.5	17.01
5400.00	7830.00	2430.00	45.000	45.00	1093.5	21.87
5400.00	8640.00	3240.00	60.000	45.00	1458.0	29.16

Table 2
Stock price returns in high and low share return (SR) trading sessions.
The table compares the stock profitability in the HighSR and LowSR sessions. Total return refers to the cumulative stock return over the whole trading session of 50 rounds, in percent, while other variables describe the stock returns distribution.

Session	#obs.	Total Return	Mean Return	SD	Skewness	Kurtosis	p25	Median	p75
HighSR session	50	183.385	2.354	7.183	−0.049	2.776	−1.795	2.027	6.527
LowSR session	50	24.115	0.820	8.941	0.261	3.414	−4.553	−0.000	6.269

3. Results

We structure the presentation of our results as follows: we start by analyzing the impact of the bonus schemes and of the profitability of the traded stock on trading intensity, which is subsequently dissected into two dimensions (transaction frequency and transaction size). Next, we turn to a multivariate analysis of trading intensity, which controls for the impact of trading information and traders' characteristics. Finally, we focus on traders' performance.

3.1. Trading intensity

In each round, we calculate for each trader the maximum number of shares she can buy and sell. The maximum number of shares available for sale, S_{it}^{max}, is the number of shares the trader holds (short selling is not allowed); the maximum number of shares she can buy, B_{it}^{max}, equals her cash holdings divided by the current share price. To test Conjecture 1, we create a dependent variable called Trading Intensity, which is defined as the sum of two ratios: the number of shares bought, B_{it}, divided by the maximum number of shares that could be bought, B_{it}^{max}, plus the number of shares sold, S_{it}, divided by the maximum number of shares that could be sold, S_{it}^{max}:

$$\text{Trading Intensity}_{it} = B_{it}/B_{it}^{max} + S_{it}/S_{it}^{max}.$$

If in the current round a trader neither buys nor sells shares then the Trading Intensity is zero[10] (see appendix B for the detailed definitions of the variables). We assume that Trading Intensity reflects traders' beliefs about future share price development and traders' readiness to act on their beliefs. For example, if a trader strongly believes that the share price will go up in the next round, she would buy as many shares as possible in the current round and her Trading Intensity would equal 100%. She would sell all her shares if she strongly believes that the share price will decrease in the next round with a high probability. If the trader expects the share price to rise or fall with approximately the same probability, she would neither buy nor sell shares and would wait until the next round when more information arrives.[11]

Table 4 compares the four treatments in terms of average Trading Intensity. On average, 45.66% of the available shares are traded every round. There is no significant difference in average trading intensity across linear and threshold bonus schemes when observations from both profitability conditions are pooled together (column 2 of Table 4, Panel A). The difference becomes marginally

[10] For those traders who bought and sold shares in the same round, we calculate effective number of shares bought (or sold) such that Trading Intensity equals zero when a trader buys and sells the same amount of shares. Out of 123 subjects, 25 subjects simultaneously bought and sold shares more than 2 times within the trading session of 50 rounds. Our results are robust to exclusion of those subjects from the analysis.

[11] In real life, investors have other reasons to trade including liquidity needs and tax considerations. However, these issues are not relevant in the present experimental setting.

Table 3
Four treatments.

Treatment abbreviation	Treatment description
LinLow	Trading is under the Linear scheme and in the Low Share Return session.
LinHigh	Trading is under the Linear scheme and in the High Share Return session.
ThresLow	Trading is under the Threshold scheme and in the Low Share Return session.
ThresHigh	Trading is under the Threshold scheme and in the High Share Return session.

significant only in the HighSR session: 2.27% ($t = 1.65$, $p < 0.10$; column 4 of Table 4, Panel A). So we can corroborate Conjecture 1 (trading intensity is higher under the threshold scheme than under the linear scheme) but only under the high profitability conditions.

In accordance with Conjecture 4, trading intensity in the HighSR session is significantly higher than in the LowSR session (diff. = 3.87%; $t = 3.82$, $p < 0.01$, see row 2 of Table 4, Panel A). This difference is also somewhat larger under the threshold bonus scheme (diff. = 5.22%; $t = 3.76$, $p < 0.01$) than under the linear bonus scheme (diff. = 2.46%; $t = 1.67$, $p < 0.10$). However, an ANOVA reveals no significant interactions between type of bonus scheme and stock profitability conditions (Table 4, Panel B). Thus, we conclude that higher profitability conditions lead to more intensive trading irrespective of bonus scheme, while the threshold bonus scheme only induces higher trading intensity in the presence of high profitability opportunities.

Note that two types of trading behavior may cause higher trading intensity: traders may buy and sell stock shares more frequently and traders may buy and sell a higher percentage of shares available for trade. These behaviors are not mutually exclusive and can both be activated by bonus schemes or/and profitability conditions. To further investigate what drives the differences in trading intensity between the treatments, we dissect Trading Intensity into two variables: Transaction and Transaction Size. Transaction is a dummy variable that equals 1 if a trader buys ($B_{it} > 0$) or sells stock shares ($S_{it} > 0$) in the current round (i.e., if any transaction takes place) and 0 otherwise:

$$\text{Transaction}_{it} = \begin{cases} 1, \text{ if } B_{it} > 0 \text{ or } S_{it} > 0 \\ 0, \text{ otherwise} \end{cases}$$

Table 4
Trading intensity by bonus scheme and profitability treatments.
The table compares the four treatments (LinLow, ThresLow, LinHigh, and ThresHigh) in terms of their average Trading Intensity. Trading Intensity is defined as the number of shares bought divided by the maximum number that could be bought plus the number of shares sold divided by the maximum number that could be sold. Trading Intensity equals zero if a trader does not trade in a given round.

Panel A. Mean for trading intensity

		Session profitability			
		Low and high	Low	High	Difference between low- and high- profitability sessions
Bonus scheme	Linear and threshold	0.4566	0.4358	0.4745	−0.0387***
		(0.3967)	(0.398)	(0.3933)	{3.82}
		[6150]	[2850]	[3300]	
	Linear		Treatment LinLow	Treatment LinHigh	
		0.4511	0.4382	0.4628	−0.0246*
		(0.4074)	(0.4190)	(0.3963)	{1.67}
		[3050]	[1450]	[1600]	
	Threshold		Treatment ThresLow	Treatment ThresHigh	
		0.4619	0.4333	0.4855	−0.0522***
		(0.3860)	(0.3751)	(0.3933)	{3.76}
		[3100]	[1400]	[1700]	
	Difference between linear and threshold schemes	−0.0108	0.0050	−0.0227*	
		{1.07}	{0.33}	{1.65}	

Panel B. ANOVA for trading intensity: variance measure

Source	Sum of squares	df	Mean square	F	P-value
ThresBS	0.176	1	0.176	0.11	0.738
HighSR	0.461	1	0.461	2.94	0.087
ThresBS × HighSR	0.292	1	0.292	1.86	0.173
Residual	965.09	6146	0.157		
Total	967.83	6149	0.157		

The cells contain the means, (standard deviations), and [number of observations]. The right-hand column and the bottom row give the differences between the means of the different groups and the {t-statistics}.
* stands for $p < 0.10$, ** for $p < 0.05$, and *** for $p < 0.01$.
Note: Higher means indicate a higher average trading intensity during the trading session.

Table 5
Transaction frequency by bonus scheme and profitability treatments.
The table compares the four treatments (LinLow, ThresLow, LinHigh, and ThresHigh) in terms of their average transaction frequency (average values of the Transaction variable). The variable Transaction equals 1 if a trader buys or sells shares in a given round (i.e. if a transaction takes place) and 0 otherwise.

Panel A. Mean for transaction

		Session profitability			
		Low and high	Low	High	Difference between low- and high-profitability sessions
Bonus scheme	Linear and threshold	0.7841	0.7835	0.7845	−0.001
		(0.4115)	(0.4119)	(0.4112)	{0.09}
		[6150]	[2850]	[3300]	
	Linear		Treatment LinLow	Treatment LinHigh	
		0.7518	0.7407	0.7619	−0.0241
		(0.4320)	(0.4384)	(0.4261)	{1.35}
		[3050]	[1450]	[1600]	
	Threshold		Treatment ThresLow	Treatment ThresHigh	
		0.8158	0.8279	0.8059	0.0220
		(0.3877)	(0.3776)	(0.3956)	{1.57}
		[3100]	[1400]	[1700]	
	Difference between linear and threshold schemes	−0.0640***	−0.0872***	−0.0440***	
		{6.12}	{5.68}	{3.08}	

Panel B. ANOVA for transaction: variance measure

Source	Sum of squares	df	Mean square	F	P-value
ThresBS	5.412	1	5.412	32.16	0.000
HighSR	0.341	1	0.341	2.03	0.154
ThresBS × HighSR	0.712	1	0.712	4.23	0.040
Residual	1034.22	6146	0.168		
Total	1041.24	6149	0.169		

Cells contain means, (standard deviations), and [number of observations]. The right-hand column and the bottom row give the differences between the means of the different groups and the {t-statistics}.
* stands for $p < 0.10$, ** for $p < 0.05$, and *** for $p < 0.01$.
Note: Higher means indicate a higher transaction frequency (more transactions made) during the trading session.

Transaction Size is defined only for those rounds in which a trader buys or sells shares (i.e., when Transaction equals 1):

$$\text{Transaction Size}_{it} = \begin{cases} B_{it}/B_{it}^{max}, & \text{if } B_{it} > 0 \\ S_{it}/S_{it}^{max}, & \text{if } S_{it} > 0 \end{cases}$$

Table 5 compares the four treatments in terms of the average Transaction[12] (or transaction frequency) per trading session of fifty rounds. In total, the traders buy and sell shares in more than 78% of the trading rounds. While there is no difference in transaction frequency between high and low profitability sessions (row 2 of Table 5, Panel A), there is a clear difference between the linear and threshold bonus schemes. The transaction frequency is significantly higher under the threshold than under the linear scheme (the diff. = 6.40%, t = 6.12, $p < 0.01$, column 2 of Table 5, Panel A), which provides additional support for Conjecture 1.

Next, we compare transaction frequency between bonus schemes separately in the LowSR session and the HighSR session. In both cases, transaction frequency is higher under the threshold than the linear scheme (LowSR: diff. = 8.72%, t = 5.68, $p < 0.01$, column 3; HighSR: diff. = 4.40%, t = 3.08, $p < 0.01$, column 4). Since the information set is the same under both bonus schemes, the higher transaction frequency is presumably driven by the pressure to reach the implicit goals under the threshold scheme. This pressure seems to be especially high when the opportunities for good performance are limited, i.e., in the LowSR session. An ANOVA analysis (Table 5, Panel B) confirms a significant interaction effect between bonus-scheme type and profitability conditions. Thus, Table 5 provides clear evidence supporting Conjecture 1, namely that the threshold scheme induces more aggressive trading behavior in the form of higher transaction frequency. However, contrary to Conjecture 4, transaction frequency is not affected by profitability conditions.

Table 6 compares the average Transaction Size by treatment. On average, traders traded around 58.23% of the number of shares available (conditional on a transaction taking place). We unveil that Transaction Size is lower under the threshold scheme than under the linear scheme but only in the LowSR session (see columns 2 and 3 of Table 6, Panel A). While the effect of the threshold bonus scheme on transaction frequency is positive and stable across profitability conditions, the effect of threshold scheme type on transaction size is negative and depends on profitability conditions (confirmed by a significant interaction between the two factors,

[12] While Transaction is a dummy variable, it is logical to refer to its average across the trading session of fifty rounds as "transaction frequency." We make the distinction between the two variables whenever appropriate.

Table 6
Transaction size by bonus scheme and profitability treatments.
The table compares the four treatments (LinLow, ThresLow, LinHigh, and ThresHigh) in terms of the average transaction size. The variable Transaction Size is defined as the number of shares bought (sold) divided by the maximum number of shares the trader could have bought (sold) if a trader buys (sells) shares in a given round.

Panel A. Mean for Transaction Size

		Session profitability			
		Low and high	Low	High	Difference between low- and high-profitability sessions
Bonus scheme	Linear and threshold	0.5823	0.5562	0.6048	−0.0486***
		(0.3571)	(0.3677)	(0.3462)	{4.73}
		[4822]	[2233]	[2589]	
	Linear		Treatment LinLow	Treatment LinHigh	
		0.6001	0.5916	0.6075	−0.0159
		(0.3624)	(0.3824)	(0.3438)	{1.05}
		[2293]	[1074]	[1219]	
	Threshold		Treatment ThresLow	Treatment ThresHigh	
		0.5662	0.5233	0.6025	−0.0791***
		(0.3515)	(0.3508)	(0.3485)	{5.67}
		[2529]	[1159]	[1370]	
	Difference between linear and threshold schemes	0.0339***	0.0683***	0.0050	
		{3.29}	{4.40}	{0.36}	

Panel B. ANOVA for Transaction Size

Source	Sum of squares	df	Mean square	F	P-value
ThresBS	2.600	1	2.600	20.56	0.000
HighSR	0.144	1	0.143	1.14	0.286
ThresBS × HighSR	1.196	1	1.196	9.46	0.002
Residual	609.31	4818	0.126		
Total	614.77	4821	0.128		

Cells contain means, (standard deviations), and [number of observations]. The right-hand column and the bottom row give the differences between the means of the different groups and the {t-statistics}.
* stands for $p < 0.10$, ** for $p < 0.05$, and *** for $p < 0.01$.
Note: Higher means indicate a larger transaction size during the trading session.

Table 6, Panel B). In fact, in the LowSR session traders under the threshold bonus scheme trade more frequently but make transactions of a smaller size than under the linear bonus scheme. These divergent effects of the threshold bonus scheme on transaction frequency (positive) and transaction size (negative) explain why we do not find any significant effect for the trading intensity in the LowSR session (see column 3 of Table 4, Panel A).

The difference in the average Transaction Size in the HighSR versus LowSR session is significant under the threshold bonus scheme only and amounts to 7.91% ($t = 5.67$, $p < 0.01$, row 4 of Table 6, Panel B). Thus, under favorable profitability conditions, the traders trade a higher percentage of shares available for trading, but only under the threshold bonus scheme. This result partially supports Conjecture 4, also suggesting that we primarily find support for Conjecture 4 in terms of transaction size rather than transaction frequency.

To conclude this section, we find that in our experiment trading activity is significantly higher under the threshold than under the linear scheme in terms of transaction frequency and average share turnover (HighSR session only). By extension, the results suggest that increased trading intensity may be caused not only by traders' overconfidence (Barber and Odean, 2001) or past individual performance (Glaser and Weber, 2009; Grinblatt and Keloharju, 2001; Nicolosi et al., 2009; Statman et al., 2006) but also by the type of bonus scheme.

3.2. Trading intensity around bonus thresholds

To investigate how trading behavior changes around the thresholds and to test Conjecture 2, we analyze the average Transaction[13] in the rounds preceding and following the round in which a threshold is met. First, we define Round 0 as a round in which a threshold (25% or 45%) is met for the first time. For instance, if in Round 13 a trader achieves a return equal to 25.0% or higher, while in Round 12, her performance was strictly below 25.0%, then we redefine Round 13 as Round 0. On average, the traders reached the 25% threshold at the 28th round and the 45% threshold at the 37th trading round, leaving a substantial amount of time until the end of the trading session. Then, if in the next trading round (and the following ones) the trader's performance stays above 25%, we define that round as Round 1 (Round 2, etc.). Once the trader's performance drops below 25% in one of the following rounds, we stop counting. The rounds preceding Round 0 are numbered as Round −1, Round −2, etc. Finally, we calculate average values for the Transaction and Trader's

[13] We use transaction frequency instead of trading intensity because we showed in the previous section that transaction frequency is affected by the type of bonus scheme but not by the profitability conditions.

Return variables for every round for both thresholds (25% and 45%) and for both bonus schemes (linear and threshold bonus schemes; see Fig. 2).

Fig. 2a shows that there are no significant differences in transaction frequency before and after reaching the 25% threshold under the linear bonus scheme. The difference in transaction frequency in the rounds preceding Round 0 (when the 25% threshold is reached) and in the subsequent rounds is only 0.015 ($t = 0.62$, $p > 0.10$). In contrast, under the threshold bonus scheme, the transaction frequency significantly drops after the 25% threshold is reached (diff. = 0.055, $t = 2.37$, $p < 0.05$; see Fig. 2b). Moreover, the drop in transaction frequency is even considerably larger after reaching the 45% threshold under the threshold bonus scheme (diff. = 0.144, $t = 4.32$, $p < 0.001$; see Fig. 2d). Note also that the transaction frequency drops even further once a certain safety margin (about 5–10%) in Trader's Return is accumulated. So, in accordance with Conjecture 2, the traders make significantly fewer transactions after reaching a threshold. Despite a gradual decrease in trading frequency, there is no significant drop in transaction frequency after reaching the 45% threshold under the linear bonus scheme (diff. = 0.027, $t = 0.77$, $p > 0.10$; see Fig. 2c). The gradual decrease in trading activity may be explained by traders' general tendency to cease trading as their performance improves and/or as the end of the trading session approaches. To account for these possibilities as well as for the effect of traders' characteristics on their trading behavior, we perform the multivariate analysis in the following section.

3.3. Trading activity in a multivariate setting

We analyze the influence of bonus schemes and stock-price profitability on trading behavior by investigating the transaction intensity, frequency, and size in a multivariate setting:

$$Y = \alpha + \beta_1 \text{ThresBS} + \beta_2 \text{HighSR} + \beta_3 \text{ThresBS} \times \text{HighSR} + \sum \gamma_i \text{Threshold Variable}_i + \sum \theta_j \text{Information Variable}_j + \sum \lambda_m \text{Trader's Performance}_m + \sum \delta_k \text{Trader's Characteristics}_k + \varepsilon \quad (1)$$

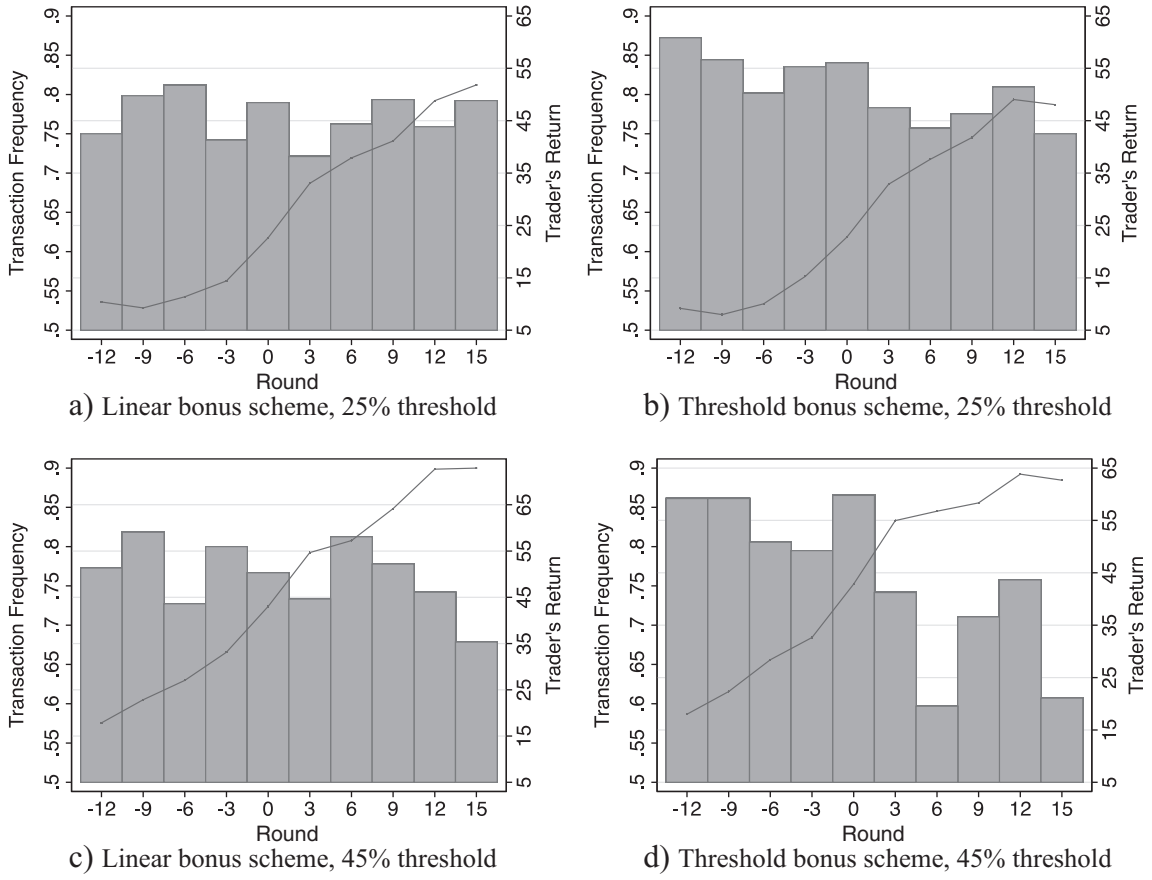

Fig. 2. Transaction frequency and trader's return around the thresholds. The figure shows how transaction frequency and trader's return change over time before and after reaching the 25%(45%) threshold under the linear and the threshold bonus schemes. Traders reach the 25%(45%) threshold at Round 0 for the first time. The bars depict transaction frequency (left y-axis) and the line graph depicts the average Trader's Return (right y-axis) in the trading rounds preceding and following Round 0, in which the threshold is attained for the first time. Transaction frequency is calculated as the average Transaction across subjects in each trading round.

In the equation above, Y stands for Trading Intensity, Transaction, or Transaction Size. The main explanatory variables used to capture the effects of the bonus scheme type and stock-return profitability on the various dimensions of trading activity are: type of bonus scheme (the dummy variable ThresBS), type of stock profitability of the trading session (the dummy variable HighSR), and their interaction term (ThresBS × HighSR). To further test Conjecture 2, we include several threshold variables, namely dummies for the post-threshold return intervals, Return [30%, 35%] and Return [50%, 55%], and their interaction terms with ThresBS. For example, Return [30%, 35%] equals 1 if the return earned by a trader so far (Trader's Return) falls into the interval [30%, 35%]; that is we use a safety margin of 5% to determine the above-mentioned intervals. Moreover, we add the information variables (the most recent stock return prior to a trade,[14] the market return, the earnings return, and the forecasted earnings' return; see B for definitions) as control variables. We also control for traders' performance, such as the return earned by a trader from the beginning of the trading session to the current round (Trader's Return) and the change in her return since the last round (Change in Trader's Return), as well as for a trader's general trading activity, proxied by the number of her transactions in all of the previous rounds (# of Past Trades). Because a higher risk aversion is likely to decrease trading intensity,[15] we include in the regression analysis a measure of the trader's risk attitude, namely the average percentage of her wealth invested in the stock (Average % in Stock). This variable is a proxy for traders' risk attitudes since more risk-tolerant traders are more likely to invest more into a risky asset.[16] Moreover, we control for traders' personal characteristics such as gender, age, and educational background as a proxy for their familiarity with trading environments.

3.3.1. Trading intensity, propensity, and size

For the dependent variable Trading Intensity, we estimate a panel Tobit model, because short selling and borrowing cash are not allowed in our experimental setting (i.e., Trading Intensity cannot exceed 1). Models (1)–(3) of Table 7 estimate the influence of the type of bonus scheme and stock profitability on trading intensity. In the multivariate setting, we do not find any significant effect of bonus scheme type or profitability conditions on trading intensity.

In support of Conjecture 2, we find that the thresholds under the threshold bonus scheme negatively affect the trading intensity once they are achieved with a sufficient safety margin; see models (2) and (3) of Table 7. The coefficients of the interaction terms Return [30%, 35%] × ThresBS, and Return [50%, 55%] × ThresBS are both negative and significant ($t = 1.70$, $p < 0.10$ and $t = 3.03$, $p < 0.01$, respectively). Moreover, trading intensity decreases significantly more once the second 45% threshold is passed: the to coefficient for Return [50%, 55%] × ThresBS is larger in absolute value than the coefficient of Return [30%, 35%] × ThresBS ($\chi^2 = 3.00$, $p = 0.083$). Note that under the linear scheme the same intervals do not have a significant influence on trading intensity (i.e., the coefficients for Return [30%, 35%] and Return [50%, 55%] are not significant).

To further investigate how bonus-scheme types and profitability conditions influence trading activity, we dissect trading intensity into the propensity to trade (the dependent variable is Transaction; see probit models (4)–(6) of Table 7) and Transaction Size (see Tobit models (7)–(9)). In models (4)–(6), the ThresBS dummy is positive and significant (the p-values are below 5%), which upholds Conjecture 1 that the traders are more likely to trade under the threshold than under the linear bonus scheme. The coefficients for HighSR and for the interaction term between the ThresBS and HighSR variables are not significant, which implies that profitability conditions do not affect traders' propensity to make a transaction. We again find that trading frequency significantly decreases when a threshold is passed with a 5% safety margin: the coefficients of Return [30%, 35%] × ThresBS, and Return [50%, 55%] × ThresBS are both negative and significant at the 10% level.

Tobit regressions with Transaction Size as a dependent variable are presented in models (7)–(9) of Table 7. As before, the threshold bonus scheme negatively affects the transaction size: the coefficient for ThresBS is negative and significant at the 1% level. However, for model (9), this effect is significant only under the low profitability conditions, since we cannot reject the null hypothesis that the sum of the coefficients for ThresBS and ThresBS × HighSR equals zero ($\chi^2 = 0.09$, $p = 0.758$). Thus, under the threshold bonus scheme traders are more likely to make smaller transactions, especially under the low profitability conditions. Transaction Size is also affected by the distance to the last 45% threshold as the coefficient for the interaction term Return [50%, 55%] × ThresBS is negative and significant.

Note that under the linear bonus scheme a trader can secure her bonus in terms of an absolute amount if she exits the stock market completely. If at some point the trader considers the bonus earned to be sufficiently high and does not want to take further risks, she can sell all available shares and secure the bonus paid at the end of the trading session.[17] Under the threshold scheme, this strategy is

[14] Stock Return is defined as the most recent change in the stock price in round t (the stock price in the current round, t versus stock price in the previous round, $t-1$), in percentage points:

$$\text{Stock Return}_t = \frac{\text{Stock Price}_t - \text{Stock Price}_{t-1}}{\text{Stock Price}_{t-1}}.$$

The same definition is applied to market index return, earnings return, and forecasted earnings return.

[15] Though Odean (1998) and Hirshleifer and Luo (2001) mainly consider the effect of overconfidence on trading behavior, it can be shown that in their models trading volume decreases with greater risk aversion, after controlling for overconfidence.

[16] As an alternative control for risk aversion we also used Holt and Laury (2002, 2005) measure, which turned out to be insignificant.

[17] In our experiment, new endowments can deteriorate the returns. For example, a trader's return equals 30% at round t and her endowment is E$700. After selling all her shares, she has 130% of her endowment (E$700*130%) in cash. As of the next round ($t+1$), she adopts a passive strategy and no longer invests; she receives an additional investment of E$100, such that her return is 30%*E$700/(E$700 + E$100) = 26.25% < 30%. At ($t+2$), the return is 30%*E$700/(E$700 + E$200) = 23.33%. Under the threshold bonus scheme, if the trading session ends at ($t+1$), the trader receives a bonus of 35% or E$245 but if the end of the trading session is at ($t+2$), she only receives a bonus of 25% or E$175. Thus, a passive strategy of holding no shares can erode the bonus. In contrast, under linear bonus scheme, the bonus depends only on the additional money earned, so the trader's bonus equals 35%·E$700 = E$245.

Table 7
Trading activity, transaction frequency and transaction size.
The table reports regression results for Trading Intensity, Transaction, and Transaction Size. Models (1)–(3) and (7)–(9) are estimated using a Tobit-regression model; models (4)–(6) are estimated using a probit-regression model. Robust standard errors are reported in parentheses. *, **, and *** stand for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Dependent variable	Trading Intensity			Transaction			Transaction Size		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bonus scheme and session profitability									
ThresBS	−0.077	−0.097	−0.126	0.238***	0.200**	0.192**	−0.201**	−0.206**	−0.226**
	(0.093)	(0.093)	(0.090)	(0.088)	(0.089)	(0.089)	(0.096)	(0.096)	(0.092)
HighSR	−0.069	−0.083	−0.112	0.013	−0.008	−0.027	−0.086	−0.088	−0.100
	(0.088)	(0.088)	(0.087)	(0.062)	(0.062)	(0.064)	(0.093)	(0.093)	(0.092)
ThresBS × HighSR	0.110	0.133	0.182	−0.055	−0.013	0.002	0.173	0.178	0.215*
	(0.120)	(0.121)	(0.116)	(0.076)	(0.077)	(0.079)	(0.128)	(0.128)	(0.124)
Return [30%, 35%]		0.032	0.030		0.077	0.085		−0.034	−0.035
		(0.053)	(0.053)		(0.121)	(0.121)		(0.036)	(0.036)
Return [50%, 55%]		−0.055	−0.055		−0.105	−0.090		−0.024	−0.023
		(0.086)	(0.085)		(0.182)	(0.182)		(0.059)	(0.059)
Return [30%, 35%] × ThresBS		−0.126*	−0.126*		−0.279*	−0.293*		0.023	0.023
		(0.074)	(0.074)		(0.169)	(0.169)		(0.050)	(0.050)
Return [50%, 55%] × ThresBS		−0.358***	−0.355***		−0.491**	−0.514**		−0.180**	−0.179**
		(0.117)	(0.117)		(0.243)	(0.243)		(0.084)	(0.084)
Trader's performance and strategy									
Trader's return	−0.002***	−0.002**	−0.002**	−0.001	0.000	0.000	−0.002***	−0.002***	−0.002***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Change in trader's return	−0.007***	−0.007***	−0.007***	−0.005	−0.005	−0.005	−0.008***	−0.008***	−0.008***
	(0.002)	(0.002)	(0.002)	(0.005)	(0.006)	(0.006)	(0.002)	(0.002)	(0.002)
Average % in stock	0.014***	0.014***	0.011***	0.002**	0.002**	0.002*	0.016***	0.016***	0.016***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
# of past trades	−0.004	−0.004	−0.004	0.081***	0.081***	0.080***	−0.001	−0.001	−0.001
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
Stock and market performance									
Stock return	0.007***	0.007***	0.007***	0.009**	0.008*	0.008*	0.007***	0.007***	0.007***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)
Market return	0.005**	0.005**	0.005**	0.011**	0.012**	0.012**	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)
Earnings return	0.003	0.003	0.003	0.007	0.008	0.008	0.000	0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Forecasted earnings return	0.003	0.003	0.003	0.008*	0.008*	0.008*	−0.001	−0.001	−0.001
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Time									
Round number	−0.002	−0.002	−0.002	−0.068***	−0.068***	−0.068***	−0.001	−0.001	−0.001
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
ThresBS × round number	0.002*	0.003***	0.003***	−0.004	−0.002	−0.002	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Trader's characteristics									
Female			−0.214***			0.036			−0.233***
			(0.062)			(0.042)			(0.066)
Age			0.002			−0.004			0.008
			(0.010)			(0.007)			(0.011)
Finance and Economics			0.091			0.052			0.054
			(0.066)			(0.044)			(0.070)
Constant	−0.085	−0.078	0.102	0.751***	0.760***	0.809***	0.080	0.081	0.146
	(0.108)	(0.108)	(0.273)	(0.088)	(0.088)	(0.189)	(0.112)	(0.112)	(0.294)
Observations	6027	6027	6027	6027	6027	6027	4721	4721	4721
χ^2	206.3	233.9	252.5	451.5	458.8	461.5	165.5	177.9	198
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

only feasible if the trader is below a threshold. Because the trader receives additional cash at the beginning of every round, holding only cash decreases her return (expressed as a percentage of the total cash received) and hence the part of the total profit she receives as a bonus. While this experimental setup does not punish the trader for inactivity under the threshold bonus scheme,[18] it penalizes

[18] Traders can hold stock shares, do nothing, and still stay above a threshold during stock price growth periods.

her for holding no stock if her return is above a threshold. Nevertheless, we find no differences across the two bonus schemes in the way the traders adjust their stock holdings in response to changes in their performance and over time.[19]

In sum, we find mixed evidence in favor of Conjecture 1 as traders make a higher number of transactions but of a smaller size under the threshold bonus scheme (as compared with the linear bonus scheme), such that their trading intensity remains unaffected. We provide strong support for Conjecture 2: trading intensity and both of its dimensions, transaction frequency and size, significantly drop once a threshold is met with a safety margin (the effect is especially strong for the last threshold). We find only partial evidence for Conjecture 4: high profitability conditions increased transaction size only under the threshold bonus scheme. We therefore conclude that trading activity is affected by profitability conditions only in the presence of specific compensation schemes, at least in our experimental setting.

3.3.2. Traders' performance and strategy

The total returns traders earn influence trading intensity via transaction size: the coefficient for Trader's Return is negative and significant at the 1% level in models for Trading Intensity, (1)–(3) and Transaction Size, (7)–(9). More specifically, if Trader's Return increases, then trading intensity decreases mostly because traders start trading at smaller stakes. Moreover, Change in Trader's Return also negatively affects trading intensity and transaction size (see models (1)–(3) and (7)–(9)). When traders earned a higher total return in the current round than in the previous round then they start making transactions of a smaller size. This result is in line with predictions from prospect theory that people tend to become more (less) risk averse when their performance is above (below) their reference point (the previous round performance in our case).

The share of a trader's wealth invested in stocks (Average % in Stock), which could be seen as a proxy for risk tolerance in the investment domain, is positively related to trading intensity, transaction frequency, and transaction size. So traders with higher risk tolerance trade more frequently and at higher stakes: the coefficient for the Average % in Stock variable is positive and significant for all models, (1)–(9). The number of previous transactions (# of Past Trades) is also positively related to trading intensity and its components. In other words, traders who start trading intensively at the beginning of the trading session, are more likely to continue doing so.

3.3.3. Stock and market performance (information variables)

The influence of the information variables is in line with our expectations. It seems that the participants are using both technical and fundamental information: Stock Return has a positive and strongly significant effect on trading intensity and its two dimensions (frequency and size; see models (1)–(9)), while Market Return positively affects trading intensity via transaction frequency; see models (1)–(6)). Past earnings (Earnings Return) do not affect trading behavior, but their forecasts positively affect transaction frequency.

3.3.4. Timing

Trading intensity is lower in later trading rounds than at the beginning of the trading session, mostly due to a significant decrease in transaction frequency; the coefficient for Round Number is negative and significant in models (4)–(6). We also find a small interaction effect between Round Number and ThresBS variables for the Trading Intensity variable (see models (1)–(3)). Although it is possible that trading activity decreases somewhat more slowly under the threshold than under the linear bonus scheme, we cannot reject the null hypothesis that the sum of the coefficients for the Round Number and Round Number × ThresBS variables is zero ($\chi^2 = 0.06$, $p = 0.805$; see models (1)–(3)). Thus, we do not find enough evidence to conclude that the trading intensity declines at different rates under the threshold and linear bonus schemes.

3.3.5. Traders' characteristics

Finally, in models (3), (6), and (9), we consider the effect of traders' characteristics such as gender, age, and educational background on trading intensity and its dimensions. In accordance with Barber and Odean (2001), we find that women trade less intensively than men (see model (3)). The main difference is that in our experiment female traders trade smaller stakes (see model (9)), but they do not trade less frequently (see model (6)) as Barber and Odean (2001) reported. We find that the traders' age is not significantly related to their trading behavior. To control for the traders' educational background, we create a dummy variable Finance and Economics, which equals 1 for subjects with majors in Economics, Econometrics, Finance, or Accounting, and 0 otherwise. The Finance and Economics dummy equals 1 for 81 out of 123 students in our sample. Although the coefficient for the Finance and Economics variable is positive, it is not significant, so we find no effect of financial education on trading activity.

3.4. Effect of thresholds

To further investigate the role of the observed 5% safety margins after traders met a threshold, we re-estimate Eq. (1) for Trading Intensity, Transaction, and Transaction Size with alternative breakpoints specifications. We also include the terms Return [25%, 30%], Return [45%, 50%], and their interaction terms with ThresBS, the dummy for the threshold bonus scheme, in order to check whether trading eases immediately after a threshold is met. As alternatives to the variables Return [30%, 35%] and Return [50%, 55%], we also

[19] For the sake of brevity, the results are not reported but available upon request.

Table 8
The effects of thresholds.
The table reports regression results for Trading Intensity, Transaction, and Transaction Size using different thresholds. Models (1)–(3) and (7)–(9) are estimated using a Tobit-regression model; models (4)–(6) are estimated using a probit-regression model. Robust standard errors are reported in parentheses. Control variables are the traders' performance, strategy, characteristics, the stock and market performance and they are included in all models; for brevity, the coefficients are not reported. *, **, and *** stand for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Dependent variable	Trading Intensity			Transaction			Transaction Size		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ThresBS	−0.122	−0.133	−0.138	0.200**	0.183**	0.188**	−0.228**	−0.226**	−0.225**
	(0.090)	(0.090)	(0.091)	(0.090)	(0.091)	(0.093)	(0.092)	(0.093)	(0.093)
HighSR	−0.101	−0.106	−0.111	−0.011	−0.020	−0.021	−0.098	−0.092	−0.090
	(0.087)	(0.088)	(0.087)	(0.065)	(0.066)	(0.067)	(0.092)	(0.093)	(0.093)
ThresBS × HighSR	0.170	0.183	0.187	−0.020	−0.003	−0.007	0.213*	0.209*	0.207*
	(0.117)	(0.118)	(0.118)	(0.081)	(0.083)	(0.086)	(0.124)	(0.125)	(0.125)
Return [25%, 30%]	−0.096*	−0.096*	−0.082	−0.203*	−0.192*	−0.169	−0.038	−0.054	−0.055
	(0.049)	(0.050)	(0.051)	(0.109)	(0.110)	(0.111)	(0.035)	(0.036)	(0.036)
Return [45%, 50%]	−0.108	−0.102	−0.079	−0.138	−0.125	−0.082	0.008	−0.011	−0.016
	(0.073)	(0.074)	(0.076)	(0.162)	(0.163)	(0.166)	(0.053)	(0.053)	(0.055)
Return [25%, 30%] × ThresBS	0.120*	0.109	0.104	0.217	0.201	0.206	0.076	0.085*	0.087*
	(0.073)	(0.074)	(0.075)	(0.167)	(0.168)	(0.170)	(0.050)	(0.051)	(0.051)
Return [45%, 50%] × ThresBS	0.080	0.057	0.050	0.130	0.102	0.111	−0.034	−0.022	−0.017
	(0.103)	(0.105)	(0.107)	(0.234)	(0.236)	(0.238)	(0.072)	(0.072)	(0.074)
Return [30%, 35%]	0.009			0.055			−0.040		
	(0.054)			(0.122)			(0.037)		
Return [50%, 55%]	−0.082			−0.131			−0.026		
	(0.086)			(0.183)			(0.060)		
Return [30%, 35%] × ThresBS	−0.104			−0.263			0.031		
	(0.075)			(0.171)			(0.051)		
Return [50%, 55%] × ThresBS	−0.332***			−0.476*			−0.177**		
	(0.118)			(0.245)			(0.084)		
Return [30%, 40%]		−0.015			0.069			−0.089***	
		(0.045)			(0.100)			(0.030)	
Return [50%, 60%]		0.024			−0.004			−0.025	
		(0.072)			(0.159)			(0.050)	
Return [30%, 40%] × ThresBS		−0.084			−0.199			0.053	
		(0.064)			(0.144)			(0.043)	
Return [50%, 60%] × ThresBS		−0.314***			−0.449**			−0.084	
		(0.097)			(0.206)			(0.069)	
Return [30%, 45%]			0.021			0.133			−0.080***
			(0.043)			(0.094)			(0.029)
Return [50%, 65%]			0.083			0.070			0.005
			(0.067)			(0.148)			(0.046)
Return [30%, 45%] × ThresBS			−0.074			−0.169			0.053
			(0.060)			(0.136)			(0.041)
Return [50%, 65%] × ThresBS			−0.273***			−0.302			−0.077
			(0.089)			(0.191)			(0.061)
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	6027	6027	6027	6027	6027	6027	4721	4721	4721
χ^2	257.7	250.1	242.1	466.3	461.7	457.0	200.4	201.1	198.4
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

use the following sets of variables, respectively: Return [30%, 40%] and Return [50%, 60%], and Return [30%, 45%] and Return [50%, 65%]. We also adjust the interaction terms with ThresBS accordingly. The results are reported in Table 8.[20]

Our main results for the effect of the threshold bonus scheme, high session profitability, and their interactions remain virtually the same. The coefficients for the interaction terms (Return [25%, 30%] × ThresBS; Return [45%, 50%] × ThresBS), are not statistically significant for all of our models with exception of model (9) where the statistical significance is only weak. So, we find no consistent evidence that trading lessens immediately after a threshold is passed. On the contrary, the coefficients for all interaction terms between ThresBS and Trader's Return intervals, which allow for a 5% safety margin, are mostly negative and significant, especially those for the last 45% threshold.

3.5. Performance

In the previous sections, we have shown that traders trade more frequently (though in smaller quantities) under the threshold bonus scheme than under the linear scheme. On the one hand, there are reasons why one might expect the higher trading activity

[20] We also control for traders' performance, strategy, and characteristics, as well as for stock and market performance. For the sake of brevity, the coefficients are not reported in Table 8.

under the threshold scheme to not necessarily result in poor performance. For example, the desire to reach thresholds and to earn more money may result in traders putting more effort into estimating market opportunities and making better decisions (Locke and Mann, 2009). On the other hand, increased transaction frequency may result in inferior performance due to higher transaction costs (Barber and Odean, 2000, 2001), mediocre stock picking (Shi and Wang, 2010), or inferior market timing (Kim and Nofsinger, 2007). Our experimental market contains only one stock (i.e., does not allow for stock picking) and does not involve any transaction costs. Hence, our set-up enables us to study the effect of bonus scheme type on market timing. To this effect, we compare the quality of the trading decisions under the different bonus schemes.

To maximize their final personal payoff, the traders need to maximize their return at the end of the trading session of 50 rounds. Since the share does not pay dividends and short selling is not possible in our experiment, the strategy "buy low and sell high" is the only one that can provide positive returns. Traders can try to implement this strategy by buying shares before the share price goes up and selling them before it declines. To estimate the quality of the trading decisions, we calculate the difference in the share price returns after shares are bought and sold. If this difference is positive on average, the traders make good investment decisions and on average correctly predict/guess the share price movements.

We calculate the difference in the returns as follows. First, we calculate an average purchase-based return: for all the rounds in which a trader has bought shares, we calculate an average next-round stock return, i.e., we sum all the next-round stock price returns for the rounds in which a trader buys shares and divide that sum by the total number of rounds in which shares are bought. Then, using the same procedure, we compute an average sale-based stock price return and subtract it from the average purchase-based stock return. We call the result Return Difference.

$$\text{Return Difference}^{i} = \sum_{t}\left(\text{Stock Return}_{t+1} | B_{t}^{i} = 1\right) - \sum_{t}\left(\text{Stock Return}_{t+1} | B_{t}^{i} = 0\right)$$

where **B** is 1 when trader i buys shares and 0 when she sells shares. To test Conjecture 3, which states that traders make poorer investment decisions under the threshold scheme because of the pressure to reach the targets, we regress Return Difference on a set of variables, including dummies for the threshold bonus scheme, high profitability conditions, their interaction term, and trader's characteristics:

$$\begin{aligned}\text{Return Difference} = {} & \alpha + \beta_1 \text{ThresBS} + \beta_2 \text{HighSR} + \beta_3 \text{ThresBS} \times \text{HighSR} \\ & + \sum \delta_k \text{Trader}'\text{s Characteristics}_k + \varepsilon\end{aligned} \tag{2}$$

Table 9
Quality of investment decisions and trader's performance.
The table reports regression results for Return Difference, Size-Weighted Return Difference, and Trader's Final Return. Robust standard errors are reported in parentheses. *, **, and *** stand for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Return Difference			Size-Weighed Return Difference			Trader's Final Return		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ThresBS	−1.134**	−0.911**	−1.088**	−1.178**	−0.980*	−1.130**	−5.778*	−5.385*	−6.076*
	(0.489)	(0.496)	(0.481)	(0.499)	(0.560)	(0.518)	(3.139)	(3.190)	(3.130)
HighSR	−1.024**	−0.779*	−1.116**	−0.618	−0.347	−0.598	19.940***	17.092***	15.646**
	(0.490)	(0.456)	(0.527)	(0.691)	(0.711)	(0.736)	(3.817)	(3.156)	(3.286)
ThresBS × HighSR	−0.093	−0.301	−0.026	−0.029	−0.228	0.025	6.615	7.098	8.083*
	(0.947)	(0.963)	(0.948)	(1.014)	(1.032)	(1.009)	(5.184)	(4.542)	(4.559)
# of Transactions		−2.495*	−2.700*		−2.159	−2.253		−7.547	−8.288
		(1.409)	(1.446)		(1.572)	(1.633)		(7.622)	(7.660)
Average % in Stock		−0.018	−0.027*		−0.023*	−0.033**		0.439***	0.418***
		(0.014)	(0.014)		(0.014)	(0.015)		(0.068)	(0.075)
Trader's characteristics									
Female			−0.487			−0.562			−1.309
			(0.462)			(0.512)			(2.376)
Age			−0.123			−0.057			−0.671
			(0.079)			(0.082)			(0.480)
Finance and Economics			0.416			0.457			0.967
			(0.523)			(0.569)			(2.541)
Constant	2.211***	4.876***	8.501***	2.203***	4.882***	6.919***	14.697**	−0.568	17.478
	(0.508)	(1.250)	(2.486)	(0.584)	(1.382)	(2.615)	(2.263)	(6.718)	(13.416)
Observations	122[1]	122	122	122	122	122	123	123	123
Adj. R-squared	0.069	0.086	0.092	0.035	0.054	0.045	0.384	0.536	0.537

[1] One subject is excluded from the analysis as he bought shares, but never sold any shares during the entire trading session. So we cannot calculate return difference or value-weighted return difference for this subject.

We also calculate a volume-based difference in returns whereby the next-round return after a purchase (sale) is weighted using the percentage of shares bought (sold) in the current round divided by the average percentage of shares bought (sold). The resulting variable is called Size-Weighted Return Difference. As a robustness check, we re-estimate Eq. (2) with Size-Weighted Return Difference as a dependent variable.

Models (1)–(3) and models (4)–(6) of Table 9 report the results for Eq. (2), where the dependent variable is Return Difference and Size-Weighted Return Difference respectively. We find that on average, traders make significantly poorer investment decisions under the threshold scheme than under the linear scheme; the coefficient for ThresBS is negative and significant in models (1)–(6). Thus, we conclude that under the threshold bonus scheme the traders' attention to the implicit targets and the pressure to perform well makes them worse investors, which supports Conjecture 3.

We also find that the traders make slightly better decisions in the low profitability session than in the high profitability session. The coefficient for HighSR is negative and significant in models (1)–(3); in models (4)–(6) the coefficient for HighSR is still negative but insignificant. Our results suggest that when earning money by trading is relatively difficult and requires more active mental involvement than pure return chasing, the traders are more likely to collect information about the relationships between the share price and the market returns, earnings, and earnings forecasts and put more effort into understanding those relationships. Hence, they perform better. In contrast, under high profitability conditions when the need for learning is rather low as profits come in anyway and bad decisions are not punished, the traders seem to merely chase high past returns. This result is in accordance with the previous literature, which finds that individual and professional investors build up investment experience mostly during bad times. Mutual fund managers become successful stock-pickers specifically in industries, for which they have experienced a period of severe underperformance (Kempf et al., 2014). Individual investors make inferior investment decisions during bull markets rather than in bear markets due to both poorer market timing and stock selection (Kim and Nofsinger, 2007; Shi and Wang, 2010).

In the previous section, we have shown that the threshold bonus scheme increases transaction frequency, which by itself can cause lower trading decision quality (Barber and Odean, 2001). To verify whether the lower decision quality under the threshold bonus scheme only results from increased trading, we control for the total number of transactions made by a trader in the trading session ("# of Transactions) and the percentage of a trader's wealth invested in the stock over the trading session (Average % in Stock); see models (2)–(3) and (5)–(6). Though both variables have negative coefficients, their inclusion in the regression does not substantially change the effects of the threshold bonus scheme and the profitability conditions on the decision quality. So, the lower trading quality under the threshold bonus scheme cannot be fully explained by increased transaction frequency, and the presence of thresholds and bonuses remains crucial in distracting traders from their main goal, namely earning the highest possible returns under the current conditions. We also control for traders' characteristics such as gender, age, and educational background, though we do not find significant effects.

The results described so far are based on the returns calculated after the trade. We now evaluate the *actual* performance obtained over the entire trading session. Do traders under the threshold scheme do better? Are they able to exploit the different share price profitability conditions? To answer these questions, we estimate Eq. (2) using Trader's Final Return as a dependent variable (see models (7)–(9) of Table 9).

First, we confirm that the final performance is significantly worse under the threshold bonus scheme than under the linear bonus scheme as the coefficient for the ThresBS variable is negative and significant at the 10% level in models (7)–(9) of Table 9. However, the negative effect of the threshold bonus scheme disappears under high profitability conditions: Although the coefficient for the interaction term ThresBC × HighSR is significant only in model (9), we cannot reject the null hypothesis that its sum with the coefficient for the ThresBS variable is zero for models (7)–(9) (the highest F-statistic = 0.35, p-value = 0.557). Thus, it seems that the pressure put on traders to perform well may have distracted them from efficient information collection under the threshold bonus scheme and this pressure and its effects on final performance are particularly pronounced when the opportunities for good performance are limited.

As expected, the traders' returns at the end of the 50th round are significantly influenced by the profitability conditions. The coefficient for HighSR is positive and significant at the 5% significance level; see models (7)–(9). We also find that traders who invest a higher percentage of their wealth in stock are more likely to achieve higher performance by the end of the trading session. In our experiment, high returns can only be obtained via a successful trading strategy and a substantial amount of wealth invested in this strategy. So, a high percentage of wealth invested in stock shares should be considered as a necessary but not a sufficient condition for good performance since it is of primary importance to have a good trading strategy.

4. Conclusion

To study the impact of different types of bonus schemes on the trading intensity of individual traders, we set up an experimental market in which traders buy and sell shares without transaction costs. The traders are price takers and are provided with fundamental and technical information (evolution of the market index, past share price evolution, realized earnings, and analysts' earnings forecasts). We trade off a basic linear bonus scheme against a threshold bonus scheme, both of which reflect practices used in investment banks and brokerage houses.

We find that the threshold bonus scheme has an opposite effect on transaction frequency and transaction size. It induces higher transaction frequency, but at the same time decreases transaction size in comparison with a linear bonus scheme. Under the threshold bonus scheme, after reaching a return threshold that translates into a higher bonus, traders make significantly fewer transactions.

Interestingly, the transaction frequency does not drop immediately after the thresholds are surpassed: the traders decrease their transaction frequency only after they build up a 5% safety margin above the threshold.

To estimate the quality of the trading decisions, we examine the difference in the share price returns immediately after the traders bought and sold shares as well as their overall performance over the whole trading session of 50 rounds. Our main finding is that the traders make significantly poorer investment decisions under the threshold than under the linear bonus scheme. Moreover, inferior decision quality cannot be explained by differences in trading frequency or traders' characteristics. As reflected in traders' final returns by the end of a trading session, this effect is especially pronounced when earning money by trading is relatively difficult (in trading sessions with lower profitability conditions). Then, the traders seem to collect more information about the relationships between the share price and the market returns, earnings, and earnings forecasts, put more effort into understanding those relationships, and finally perform better under the linear bonus scheme, whereas they seem to focus more on reaching and maintaining threshold returns under the threshold bonus scheme. The negative effects of the threshold bonus scheme on final returns and quality of investment decisions arise also when we control for the higher trading frequency induced by the threshold scheme. Thus, our data suggest that bonuses may be detrimental to performance, at least when threshold and linear bonus schemes are compared and the profitability of markets is low.

It should be noted that in the set-up of this realistic experiment, both the profitability conditions and the bonus schemes have an impact on the total returns and hence the traders' bonus. While share prices and market evolution cannot be significantly influenced by traders or their employers, the traders' bonus schemes are nevertheless under the direct control of the companies.

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Appendix A. Instructions

The appendix contains the instructions for the trading session under the linear bonus scheme. The instructions under the threshold scheme are identical, except for the calculation of the bonus.

This experiment will last about 1.5 hours and will consist of:

1. These instructions and a short quiz;
2. 20 rounds training session;
3. Twice a trading session of 50 rounds;
4. Final questionnaire.

5.1. Experimental market

You will buy and sell shares on behalf of a trading company “Aurum”, which will provide you with cash necessary for trading. The amount of cash given to you is called investment. In the 1st round of each trading session you receive E$500 (experimental dollars) from Aurum. In each further round of the session you will get an additional E$100.

Your goal is to maximize Aurum's total return, the ratio of additional money you earn to the investment. You are free to decide how many shares to buy or sell. Choose the optimal trading strategy and buy shares at low prices, sell them at high prices.

5.2. Buying and selling shares

Using cash you will be able to buy and sell shares of one company, let's call it “Egias”. You can sell/hold previously purchased shares or buy additional ones. Shares and cash together constitute your holdings in every round. You will start with 0 shares. So in the first round you cannot sell shares; you can only buy shares. The maximum number of shares you can buy multiplied by the current share price cannot exceed your current cash holdings. See Example 1.

5.2.1. Example 1

You have E$119 in cash and the current share price is E$30. The maximum number of shares you can buy equals 3, as $3 \times$ E$30 $=$ E$90 $<$ E$119. You cannot buy 4 shares as $4 \times$ E$30 $=$ E$120 $>$ $E119. If you buy 3 shares, then E$29 is left in your cash holdings.

5.4. When you buy shares:

- your cash holdings are reduced by the number of shares bought multiplied by the current share price;
- your share holdings (or shares' value) are increased by the same amount;
- the number of shares you own increases by the number of shares bought.

5.5. When you sell shares

- your cash holdings are increased and your share holdings are decreased by the number of shares sold multiplied by the current share price;
- the number of shares you own decreases by the number of shares sold.

If you do not buy nor sell any shares, then the number of shares you own stays the same, but the value of your shares may increase or decrease depending on the share price movement. See example 2.

5.5.1. Example 2

In the beginning of the current round you own 20 shares and E$1000 cash. The current share price is E$10. The share holdings are 20×E$10 = E$200 and the total holdings are E$1200. You buy 10 more shares at the current price and spend E$100 cash such that you have E$900 left (E$900 = E$1000 − E$100).

In the next round the share price rises up to E$15 and your share holdings equal 30 shares × E$15 = E$450. In the beginning of the next round you will have E$1000 in cash because you also receive E$100 extra cash from Aurum in the beginning of each round.

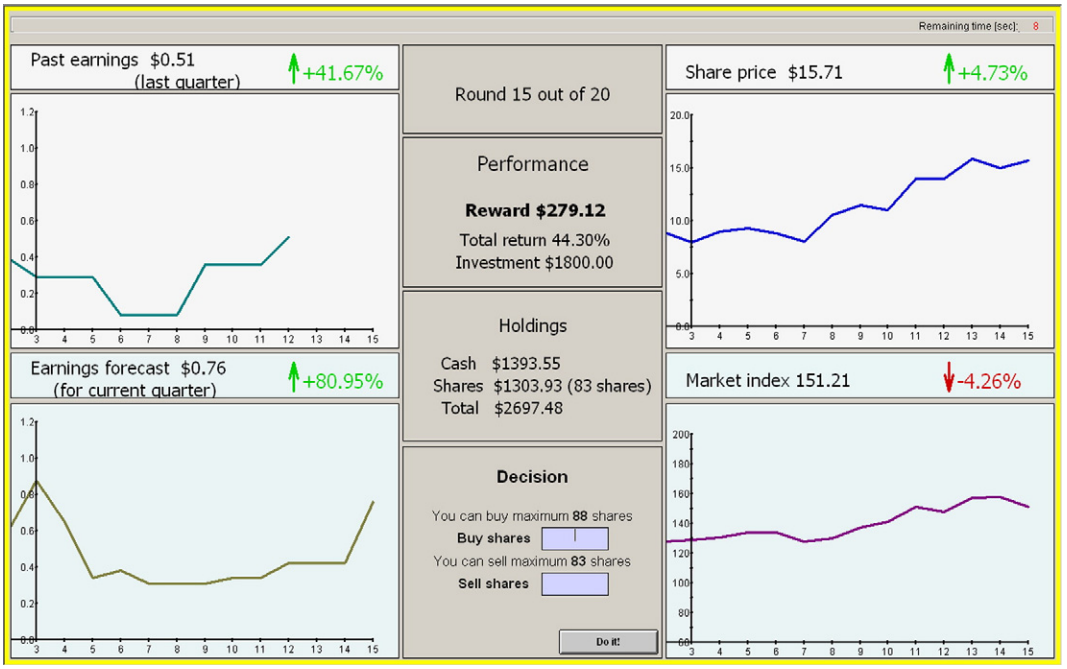
	Cash holdings	Share holdings	Number of shares owned	Total holdings	Share price
Beginning of the round: round Your decision: + 10 shares	E$1000	E$200	20 shares	E$1200	E$10
End of the round: In the beginning of the next round, the share price goes up by E$5	E$900	E$300	30 shares	E$1200	E$10
Beginning of the next round	E$1000	E$450	30 shares	E$1450	E$15

◄.

Your total holdings are E$1450 = E$1000 (cash) + E$450 (shares).

5.7. Trading stage

Every trading round starts with a trading stage, where you can buy and/or sell shares.



5.8. Screenshot of a trading stage

This screen shows the information helpful in your investment decisions:

- Egias' share price,
- the market index,
- Egias' earnings information (past and forecast),
- your current holdings and performance;
- in the same screen you can make your investment decisions.

The upper right corner of the screen shows the time remaining for your decision in the current round. The screen will appear for 15 seconds. Within 15 seconds you must specify your decision whether you want to buy or sell shares. If you do not reach any decision within 15 sec, you will proceed to the next round with your share holdings unchanged.

To the left you see past Egias' earnings and earnings forecast. You also see percentage changes in earnings and earnings forecasts from the last past round and the graphs of historical values of earnings and earnings forecasts (up to 12 past rounds), which give you a broader picture and could allow you to identify a link between earnings and their forecasts.

► Company's earnings are an after-tax profit (or loss), which a company produces during a specific time period. For example, Egias calculates and reports its earnings every three rounds. In some periods companies generate profit (and their earnings are positive), whereas in other periods companies can incur losses (earnings are negative). On the screen you see Egias' earnings per share (earnings divided by the number of shares outstanding, which is constant throughout all sessions).
► An earnings forecast is value of earnings expected by analysts for the next period. Analyst is a person who studies company's accounts, strategy, and economic outlook. On the screen you see the average expected value from many analysts.
In the right bottom corner you see the current market index value, its percentage change from the last past round, and a graph of its historical values (up to 12 past rounds).
► The market index measures the price changes of the overall stock market, which consists of all publicly traded companies. Changes in the market index reflect changes in the whole economy. For example, a recession is typically accompanied by a drop in the market index and the economic expansion goes along with an increase in the market index.

The share price may be influenced by past earnings, earnings forecast, and by the market index movements, but the degree of this relation may in some time periods be strong or weak and may occasionally be inversed.

In the right upper corner you see the current share price, its percentage change and the graph of its historical values (up to 12 past rounds).

5.9. The central part of the screen contains the following four boxes (down)

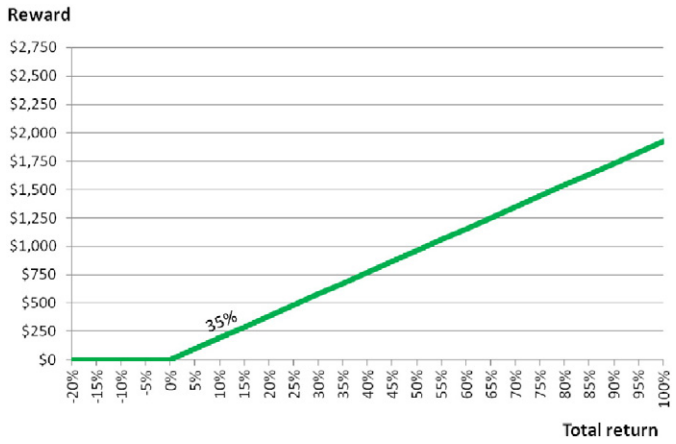
1. *Round* shows the current round and the total number of rounds in the current trading session.
2. *Performance* shows your current reward, the total return you earned for Aurum and the total investment you received from Aurum.
3. *Holdings* shows your current cash and share holdings, including the number of shares owned. Total holdings equal the sum of cash and share value.
4. *Decision*, where you can specify the number of shares you want to buy or sell.
   a. If you want to buy shares, specify the number you want to buy in the upper blue box. Leave it blank if you don't want to buy any shares.
   b. If you want to sell shares, specify the number you want to sell in the lower blue box. Leave it blank if you don't want to sell any shares.
   c. If you don't want to buy nor sell any shares, leave both blue boxes blank.
   d. Press the button “Do it!” when you are ready with your investment decisions and you will automatically proceed to the next round. If you don't press the button before the time is over, then your decisions will not be executed.

The experimental stock market employs real historical share price, earnings, earnings forecast, and market index data. So it is fully independent from your decisions/performance or the decisions/performance of other participants.

5.10. Reward calculation

For your services you will receive a reward. It depends on your own performance: the more you earn for Aurum, the more you get as a reward. Your reward is calculated at the end of each trading session and constitutes a fixed percent, 35% of the additional money (additional money = holdings − investment) you earned for Aurum over the entire 50 rounds.If total return > 0, then reward = (holdings − investment) × 35%If total return is negative, then your reward is zero.

$$\text{Total return} = (\text{holdings} - \text{investment}) / \text{investment}$$



5.10.1. Example 3

►After 50 rounds your holdings (combined in cash and shares) equal E$7400, whereas the total investment from Aurum was E$5400.

So you have earned E$7400 − E$5400 = E$2000 of additional money for Aurum and the total return is E$2000/E$5400 = 32.07% > 0.

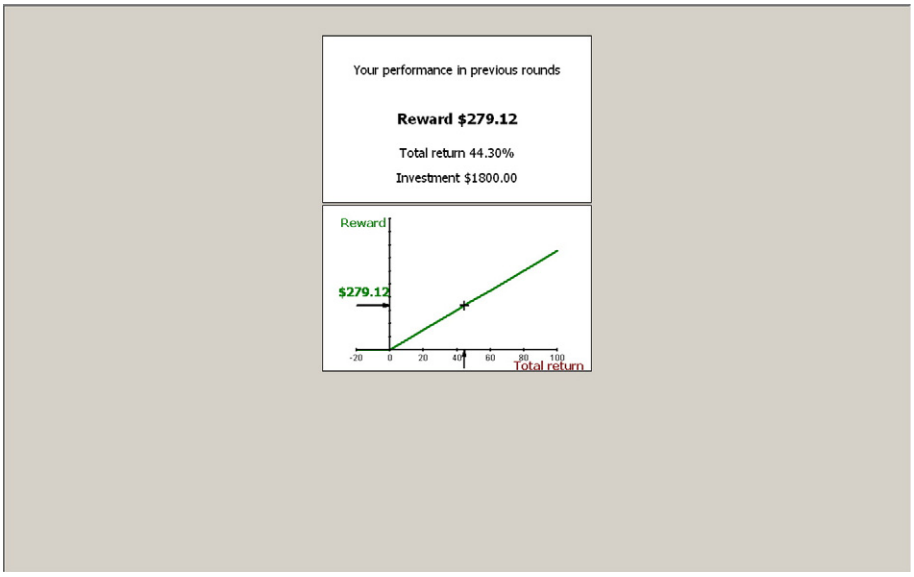
Your reward is E$2000 × 35% = E$700 = €14.

Below is a graph of the final reward depending on total return you earn for Aurum at the end of the trading session.

5.12. Performance stage

After the decision stage you will be shown a screen with your performance to date (resulting from the previous rounds) for 2 sec. Your current reward, the total return earned for Aurum, and investment will appear in the upper box of the screen. In the lower box you will see a graphical representation of your reward depending on the total return earned for Aurum. On the graph the x-axis is the total return earned for Aurum, and the y-axis is your reward. Two arrows show your current performance in terms of reward and the total return earned for Aurum.

5.13. Screenshot of a performance stage



5.13.1. Final payoff

You earn €2 for showing up. The variable part of your payment depends on your performance during the experiment. Your final payoff will be randomly chosen from two rewards earned in the two trading sessions.

For example,

- E$650 (€13) is your reward in the 1st trading session.
- E$800 (€16) is your reward in the 2nd trading session.

One trading session will be randomly selected to determine your payment. You will be paid your total reward in cash and in private at the end of the experiment.

Now you will start with a training session, which aims to familiarize you with the experimental environment and does not count towards your final payment.

Appendix B. Variable definitions

Variable name	Description
# of Past Trades	Number of transactions made by a trader in the previous rounds.
# of Transactions	Number of transactions made by a trader in the trading session.
Age	Trader's age, in years.
Average % in Stock	Average percentage of a trader's wealth invested in the stock over the trading session.
Change in Trader's Return	Difference between trader's return earned from the beginning of the trading session to the beginning of the current round (Trader's Return) and trader's return earned from the beginning of the trading session to the beginning of the previous round (Trader's Return lagged), in percentage points.
Earnings Return	The most recent return in earnings relative to the previous round (current versus previous round), in percentage points.
Female	Dummy variable, which equals 1 for female traders and 0 for male traders.
Finance and Economics	Dummy variable, which equals 1 for students with major in Economics, Econometrics, Finance or Accounting and 0 otherwise.
Forecasted Earnings	The most recent forecasted earnings return to the previous round (current versus previous round), in percentage points.
HighSR	Dummy for the high-stock-return session, which equals 1 if the current trading session has high-profitability conditions and 0 otherwise.
LowSR	Dummy for the low-stock-return session, which equals 1 if the current trading session has low-profitability conditions and 0 otherwise.
Market Return	The most recent return of the market index (the market index in the current round versus the market index in the previous round), in percentage points.
Return [X%, Y%]	Dummy variable, which equals 1 when Trader's Return is between X% and Y%.
Return [X%, Y%] × ThresBS	Interaction term between Return [X%, Y%] and ThresBS.
Return Difference	Average share price return for the rounds after purchases minus average share price return for the rounds after sales.
Round Number	Number of the current trading round.
Size-Weighted Return Difference	Average share price return multiplied by a percentage of shares bought for the rounds after purchases minus average share price return multiplied by a percentage of shares sold for the rounds after sales.
Stock Return	The most recent stock return (the stock price in the current round versus the stock price in the previous round), in percentage points.
ThresBS x HighSR	Dummy for the threshold bonus scheme, which equals 1 if in the current trading session a trader operates under the threshold scheme and zero for the linear bonus scheme.
ThresBS x HighSR	Interaction term between ThresBS and HighSR.
ThresBS × Round Number	Interaction term between ThresBS and Round Number.
Trader's Final Return	Return earned by a trader at the end of the trading session, which equals Trader's Return at the end of the 50th trading round.
Trader's Return	Total return earned by a trader from the beginning of the trading session to the beginning of the current round, in percentage points.
Trading Instensity	The number of shares bought divided by the maximum number that could be bought plus the number of shares sold divided by the maximum number that could be sold, in percentage points.
Transaction	Dummy variable, which equals 1 if a trader buys or sells shares in the current round (i.e., if a transaction takes place) and 0 otherwise.
Transaction Size	The number of shares bought (sold) divided by the maximum number of shares the trader could have bought (sold) if a trader buys (sells) shares in the current round, in percentage points.

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