Finance Experiments, and using markets to see whether biases can survive in a market.

We have seen several biases in decision making, here we will come back to 2 of them: Loss aversion and mental accounting.

We will see that when people have both of these biases, they will have a tendency to value a set of five identical gambles differently than each of these gambles separately.

The first experiment is here to test whether such a bias can be found.

The second experiment will provide a market place in which people will be able to trade, to determine whether this will reduce or eliminate the bias.

Loss aversion refers to the tendency that people seem to weigh losses larger than gains.

Remember, we saw Prospect theory, that says, people have a reference pint, evaluate outcomes according to changes towards that reference point, and that losses loom larger than gains.

Mental accounting: Implicit way to code gains and losses.

Problem 9. Imagine that you are about to purchase a jacket for ($125)[$15] and a calculator for ($15)[$125]. The calculator salesman informs you that the calculator you wish to buy is on sale for ($10)[$120] at the other branch of the store, a 20-minute drive away. Would you make the trip to the other store?

Problem 10. Imagine that you have decided to see a play, admission to which is $10 per ticket. As you enter the theater you discover that you have lost a $10 bill. Would you still pay $10 for the ticket to
the play? Yes: 88% No: 12%

Problem 11. Imagine that you have decided to see a play and paid the admission price of $10 per ticket. As you enter the theater you discover that you have lost your ticket. The seat was not marked and the ticket cannot be recovered. Would you pay $10 for another ticket?
Yes: 46%No: 54%
[Source: Tversky & Kahneman, 1981]

Suppose someone is subject to both: Loss aversion and mental accounting, such a person may be subject to Myopic Loss Aversion (Bernartzi and Thaler 1995 use that to put forward an explanation for the equity premium puzzle: The fact that the risk-return is (at least has been in the last century) so much more favorable for sticks than for bonds, that unreasonably high levels of risk aversion would be needed to explain why investors are willing ton hold bonds at all.

Suppose someone has a utility function of the sort:

$$U(z) = \begin{cases} z & \text{for } z \geq 0 \\ 2.5z & \text{for } z < 0. \end{cases}$$

Suppose this person can chose to whether to accept a gamble in which there is a 50% chance to won $ 200 and a 50% chance to lose $ 100.

The expected utility of one gamble: ½ (200) + ½ (-250) <0. However the same person would take 2 gambles if she evaluates them in combination:
¼ (400) + ½ (100) + ¼ (-500) >0.

Hence rejecting a single gamble while rejecting 2 gambles is explained by myopic loss aversion. Samuelson 1963, showed that it is not the case for someone with standard preferences.

Gneezy and Potters" An Experiment on Risk Taking and Evaluation Periods" QJE 1997
Gneezy, Kapteyn and Potters, "Evaluation Periods and Asset Prices in a Market Experiment", Journal of Finance, forthcoming.

The strategy in these papers is to try to manipulate the evaluation period, that is at what point subjects evaluate financial outcomes.

Consider the following gamble: 2/3 lose $1, 1/3 gain $ 2.5

If an individual weighs losses relative to gains at a rate λ, then the expected utility of a single lottery is positive only if $\lambda<1.25$. However if a subjects evaluates 3 lotteries in combination, the expected utility is positive whenever $\lambda<1.56$. If the financial consequences of the 3 lotteries are evaluated in combination rather than separately, then the lotteries should become more attractive.

The Experiment:

Subjects faced 12 identical, but independent lotteries. In each of the first nine rounds ("part 1" of the experiment), subjects were endowed with 200 cents. They had to decide which part (Xt) of this endowment they wanted to bet in the lottery ($0 \leq Xt \leq 200$, $t = 1, \ldots, 9$).

In the lottery there was a probability of 2/3 of losing the amount bet and a probability of 1/3 of winning two and a half times the amount bet.
In rounds 10 through 12 ("part 2" of the experiment) subjects had to make bets from the money earned in part 1.

To that purpose, a subject's earnings in the nine rounds of part 1 were first totaled and then divided by three. The resulting amount was a subject's endowment (S) for each of the three rounds of part 2. Again, for each round a subject had to decide which part (Xt) of the endowment S to bet in the lottery ($0 \leq Xt \leq 200$, t = 10, 11, 12).

Two different treatments: Treatment H (high frequency) and Treatment L (low frequency).

In Treatment H the subjects played the rounds one by one. Round 1 investment choice, realization of the first lottery, then round 2 investment choice… Subjects made nine betting decisions in part 1 and three decisions in part 2.

In Treatment L, however, subjects played the rounds in blocks of three. At the beginning of round 1, subjects had to decide how much of their endowment of 200 cents to bet in the lotteries of rounds 1, 2, and 3. In addition, these bets were restricted to be equal. Subjects were informed about the combined realization for rounds 1, 2, and 3. That is, they could not assign a gain or loss to any particular round, but only knew the aggregate result. Subsequently, subjects decided how much to bet in rounds 4, 5, 6, and so on. Hence, in Treatment L subjects make three decisions in part 1, and one decision in part 2.
So here subjects have less freedom and less information than in treatment H.

TABLE I

AVERAGE PERCENTAGE OF ENDOWMENT BET (PART 1)

	Treatment H[a]	Treatment L[a]	Mann-Whitney z[b]
Rounds 1–3	52.0 (30.2)	66.7 (29.5)	−2.08 [0.018]
Rounds 4–6	44.8 (30.0)	63.7 (30.3)	−2.78 [0.003]
Rounds 7–9	54.7 (28.9)	71.9 (29.4)	−2.51 [0.006]
Rounds 1–9	50.5 (26.7)	67.4 (27.3)	−2.86 [0.002]

a. # obs. = 41 (42) for treatment H (L). Standard deviations are in parentheses.
b. One-tailed significance levels (p-values) are in brackets.

The difference between the 2 treatments is significant already in the first round. In H subjects bet on average 50.1% of their endowment, whereas in treatment L the bet is 66.7%.

They find no effect of different experiences with gains and losses between subjects. The fraction of endowment bet is not significantly affected by subjects' experiences with the occurrence of gains and losses in the preceding round(s).

Part 2 of the experiment:

TABLE II
AVERAGE AMOUNT BET, AVERAGE PERCENTAGE BET, AND AVERAGE TOTAL EARNINGS

	Treatment H[a]	Treatment L[a]	Mann-Whitney z[b]
Amount bet (Y)	707.3 (614.5)	887.1 (662.1)	−2.14 [0.016]
Percentage bet (F)	39.0 (30.0)	48.9 (32.1)	−1.62 [0.053]
Total earnings (parts 1 and 2)	1822 (1015)	2134 (745)	−1.78 [0.038]

a. # obs. = 41 (42) for treatment H (L). Standard deviations are in parentheses.
b. One-tailed significance levels (p-values) are in brackets.

Manipulating the evaluation period has a big effect.

Although these experimental results provide some direct evidence for Myopic Loss Aversion, they are concerned with individual decision-making rather than market interaction.

Each participant makes her own independent decisions but these have no effect on the decisions of other participants or vice versa. Stocks and bonds, however, are traded in markets. An essential feature of markets is that prices are determined by the marginal traders. As a consequence, individual violations of the standard expected utility theory (EUT) do not necessarily imply that market outcomes will violate EUT. A small number of rational agents may be enough to make market outcomes rational.
Another important issue is that market interaction will affect individuals' experience and information feedback.

The learning process in repeated individual decision tasks will be different from the learning process in repeated market interaction. Traders can learn from observing the choices of other traders and from the information contained in prices.

Hence, there are a number of reasons to question whether phenomena that are observed in individual decision making will carry over to market interaction.

The Experiment:

8 participants can trade in a market units of a risky asset in a sequence of 15 trading periods. Each unit of the asset is a lottery ticket which, at the end of a trading period, pays 150 cents with probability 1/3 and 0 cents with probability 2/3. At the beginning of each period, a trader is endowed with a cash balance of 200 cents and 3 units of the asset. If a trader buys a unit, the price is subtracted from her cash balance, and one unit of the asset is added to her portfolio. If a trader sells a unit, the price is added to her cash balance and a unit is subtracted from her portfolio. At the end of the period, the asset expires and its value is revealed through a lottery.

2 Treatments: High Frequency H and Low frequency L.

In the ’high frequency’ (H) treatment, the market opens in each of the 15 periods of the experiment, and in each period traders can adjust their portfolio by buying and selling units. At the end of each period, traders are informed about the realized value of the asset for that period, and then the next period starts.

In the ’low frequency’ (L) treatment, the market opens for trading only in the first period of a block of three periods, that is, trading takes place only in periods 1, 4, 7, 10, and 13. In each of these trading periods, units are traded in blocks of three. That is, if a unit is bought (sold) at a particular price in period t, then also a unit is bought (sold) at that same price in periods t+1 and t+2. Hence, traders fix their asset holdings for three periods. After trading period t is over (with t = 1, 4, 7, 10 or 13), three independent draws determine the values of the units in periods t, t + 1 and t + 2, respectively. Traders are informed about the three realized values simultaneously.

Trading took place according to standard double auction rules.
Traders could submit bids to buy and asks to sell. All traders were instantaneously informed about all bids and asks submitted to the market. At any time during a trading period traders could decide to buy at the lowest ask or to sell at the highest bid. When a unit was traded, the accepted offer was withdrawn from the market and all traders were informed that a trade had occurred at that price. Units traded one by one, that is, all price offers were for one unit only. Traders could submit as many offers to the market as

they liked, and sell and buy as many units as they liked. An individual offer improvement rule was enforced, requiring a new ask (bid) price to be lower (higher) than that trader's standing ask (bid).

Traders could not sell when they had no units in their portfolio, and they could not buy when their cash balance was insufficient.

Table 1: Average Price per Block of Three Rounds[a]

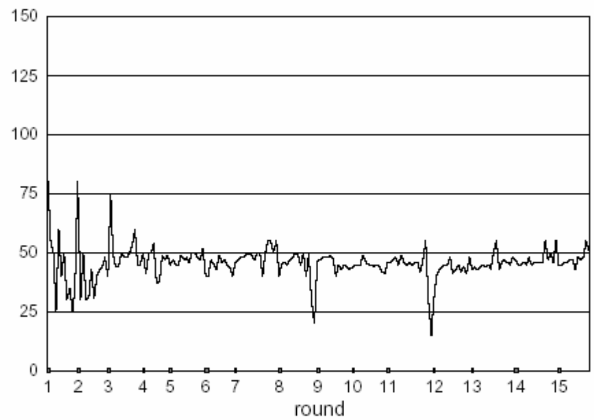
rounds	Treatment H	Treatment L	Mann-Whitney p[b]
1-3	49.7 (9.4)	60.4 (16.6)	0.06
4-6	48.6 (5.8)	57.6 (10.3)	0.06
7-9	48.9 (3.7)	56.8 (5.4)	0.01
10-12	49.3 (2.4)	57.6 (3.0)	0.03
13-15	50.1 (2.2)	59.6 (3.4)	0.01
all rounds	49.3 (4.7)	58.4 (7.7)	0.01

a Standard deviations in parentheses. Averages and standard deviations are calculated ...rst over the transaction prices within a round and then averaged over the rounds and sessions.

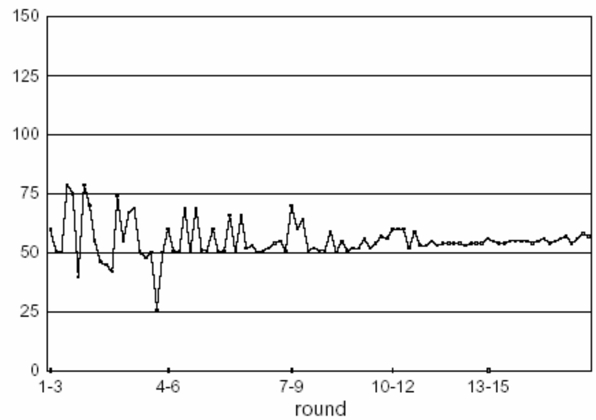
b Two-tailed signi...cance levels with the 10 session data as units of observations.

(a) Standard deviations in parentheses. Averages and standard deviations are calculated first over transaction prices within a round and then averaged over rounds and sessions.
(b) two-tailed significance levels with 10 session data as units of observations.

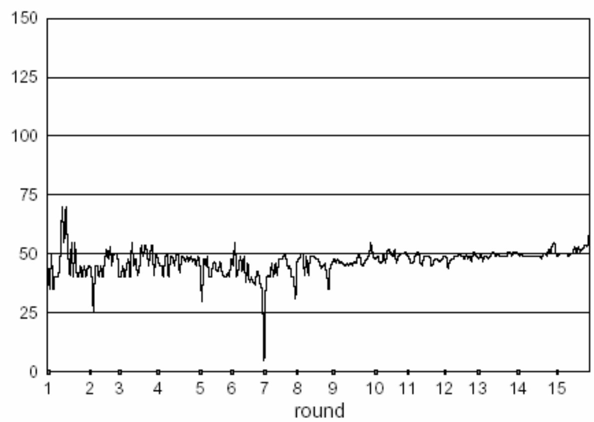
Prices Session 1 (Treatment H)



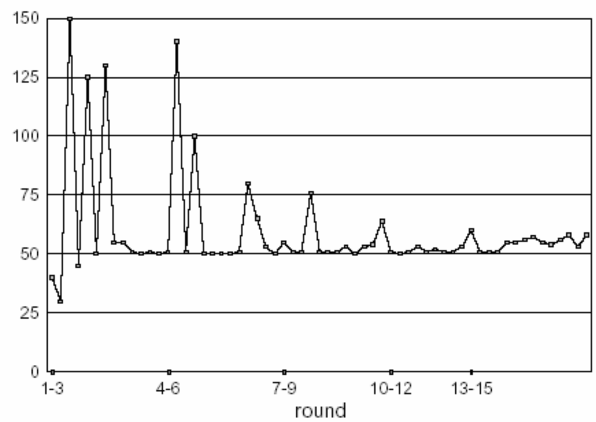
Prices Session 2 (Treatment L)



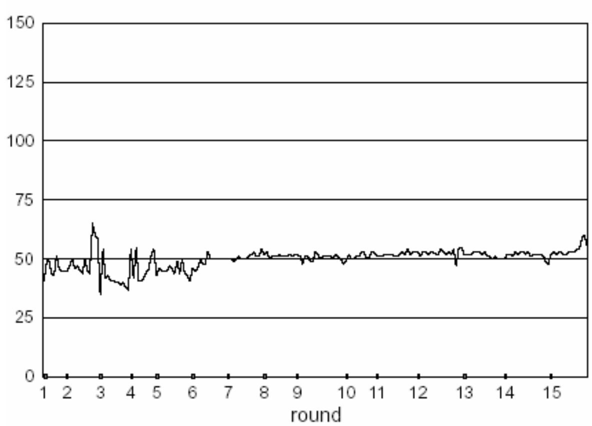
Prices Session 3 (Treatment H)



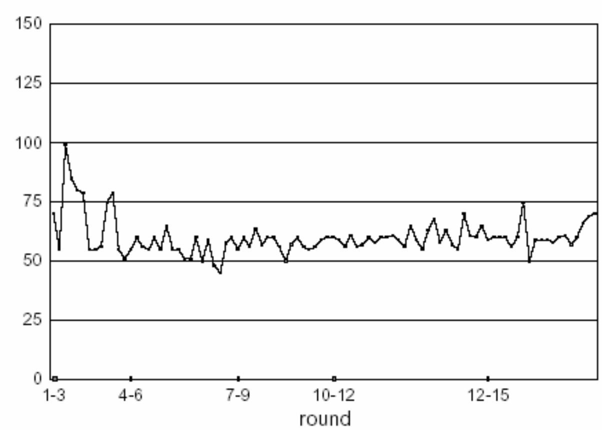
Prices Session 4 (Treatment L)



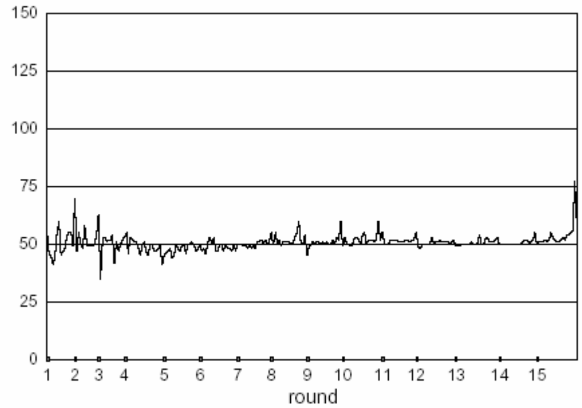
Prices Session 5 (Treatment H)



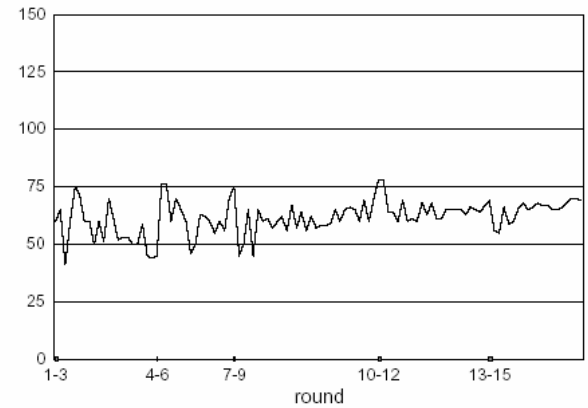
Prices Session 6 (Treatment L)



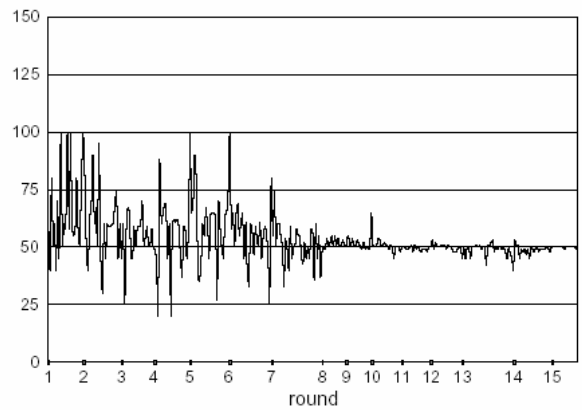
Prices Session 7 (Treatment H)



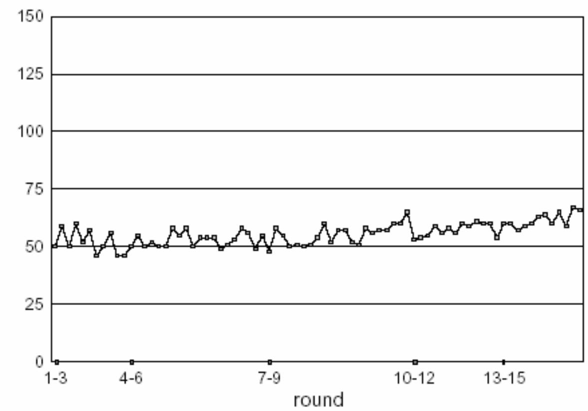
Prices Session 8 (Treatment L)



Prices Session 9 (Treatment H)



Prices Session 10 (Treatment L)



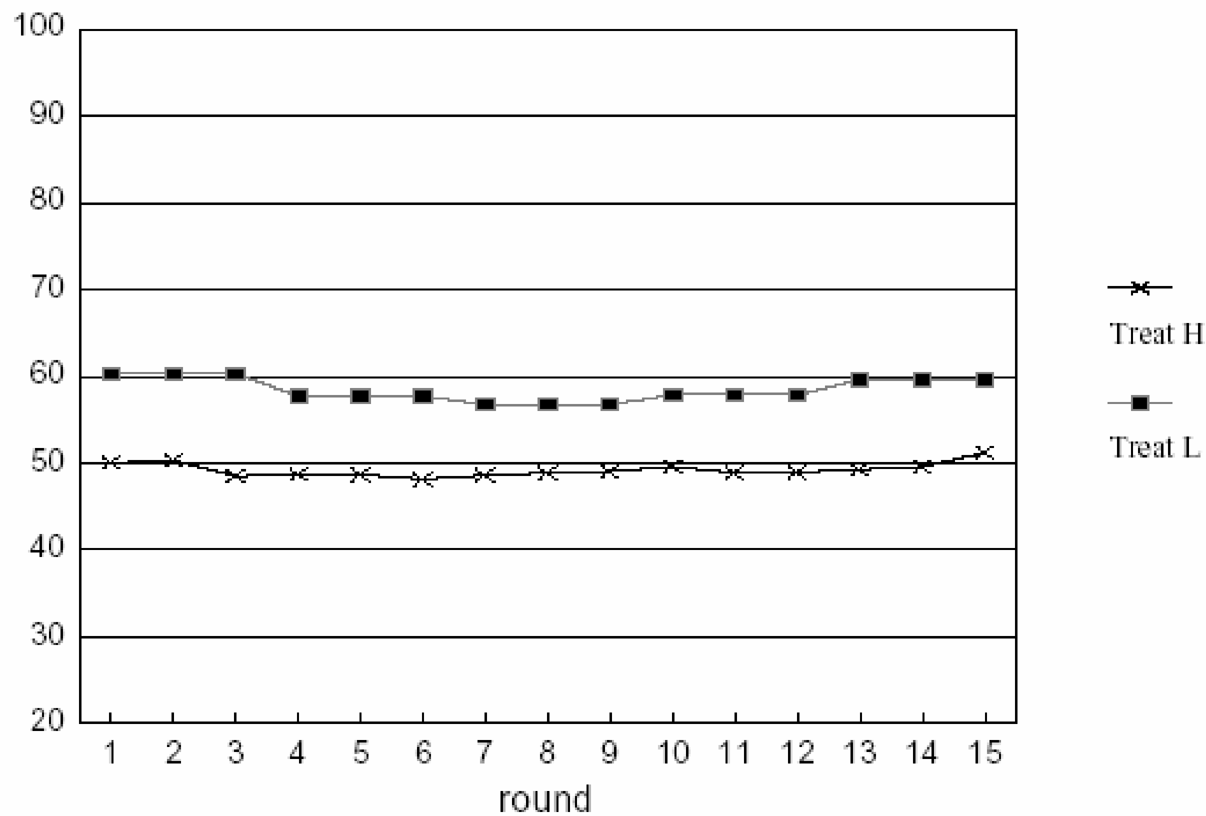


Figure 3. Average prices per round for each treatment

Table 2: Asset value, Number of traders, and Allocations

	Treatment H	Treatment L	Mann-Whitney p[a]
Asset value	58.0	48.0	0.55
Trades per round per trader	2.23	2.18	1.00
Standard deviation of allocations	2.54	2.31	0.22
Range of allocations	6.33	5.88	0.10

Speculative Trade, Bubbles, and inexperienced and inexperienced players.

Smith, Suchanek and Williams: "Bubbles, Crashes and Endogenous Expectations in Experimental Spot Asset Markets" 1988 Econometrica.
and
Dufwenberg, Lindqvist and Moore, "Bubbles and Experience: An Experiment on Speculation".

6 subjects trade in the following market.
There are assets that generate stochastic streams of dividends are bought and sold. An asset has a finite life-span of ten periods. In each period it pays a dividend of 0 or 20 cents, with equal probability. Trade takes place in each period, before dividends are determined. The dividend process coupled with a backward inductive argument defines time-dependent theoretical asset values.

The market used is a double auction.

Before a market opened, half of the subjects, i.e. three subjects, each started with a cash endowment of 200 cents and six assets; the other half each started with 600 cents and 2 assets. Each asset held at the end of a trading period paid a dividend of either 0 or 20 cents, with equal probability for each of these two outcomes.

Since the expected dividend in each period is 10 cents (= ½ × 0 cents + ½ × 20 cents), the expected monetary value of holding an asset is 10 cents for each of the remaining periods. Assuming risk-neutrality, one may calculate a theoretical value of the asset by backward induction. We shall refer to this value as the fundamental value. In the last period, the fundamental value is 10 cents. If traders anticipate that this will be the trading price in the last period, then with two periods remaining the price should be 20 cents (2 periods × 10 cents per period). If traders anticipate this, then with three periods remaining the price should be 30 cents, etc. Using this logic it is evident that the fundamental value of an asset with k periods remaining is k × 10 cents. A bubble obtains if prices in some period are considerably higher than the fundamental value.

The 6 subjects play together 3 of those markets.

In the 4th market, either 2 or 4 of those inexperienced traders will be replaced by inexperienced traders.

At the start of each session we read through the instructions (reproduced in the Appendix) for all of the subjects, and then let them play one two-minute practice period. The subjects then made a draw from a box of chips; six chips implied that the subject was seated at a computer, while the other chips (two or four of them, depending on treatment) implied that the subject was sent to another room. The subjects who went to the other room would participate in the fourth round as inexperienced traders, and they had to wait (approximately one hour) until the others had completed their three rounds of trading.

We faced the problem of what to do with the waiting subjects. Our objective was that they should be reimbursed, not be bored, not be allowed to communicate, not interact in some other market, in fact not even strategically interact at all. We instructed them to complete as much as possible of a crossword puzzle, without communicating to any other subjects. For this task they were paid a fixed amount of $10.

FIGURE 1: Example of a ⅔-EXPERIENCED treatment

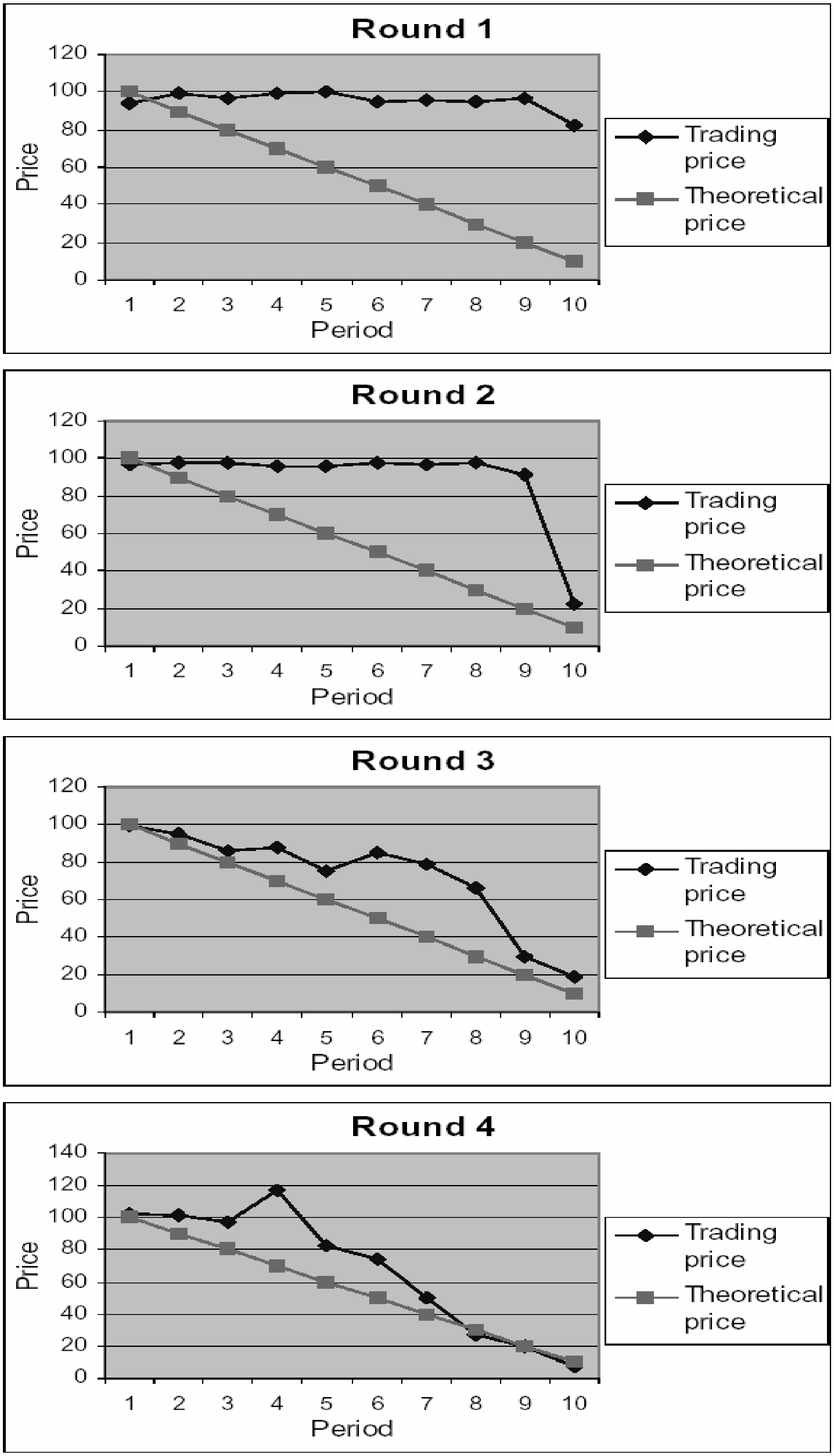


TABLE 2: Goodness-of-fit in ⅔-EXPERIENCED treatment

Session	Round 1	Round 2	Round 3	Round 4
1	0.014	0.290	0.239	0.001
2	0.082	0.256	0.806	0.924
3	0.822	0.856	0.903	0.925
4	0.268	0.311	0.772	0.868
5	0.582	0.270	0.541	0.954

TABLE 3: Goodness-of-fit in ⅓-EXPERIENCED treatment

Session	Round 1	Round 2	Round 3	Round 4
1	0.895	0.948	0.986	0.978
2	0.834	0.976	0.969	0.951
3	0.065	0.395	0.296	0.027
4	0.002	0.134	0.123	0.118
5	0.112	0.217	0.773	0.799

Price Volatility: standard deviation of prices for each session

TABLE 4: Market Volatility

	⅔- EXPERIENCED TREATMENT				⅓-EXPERIENCED TREATMENT			
SESSION	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**
1	19.3	8.1	10.5	8.8	32.3	28.7	30.6	34.5
2	31.0	53.7	59.1	45.7	38.8	42.8	46.9	22.4
3	14.3	16.4	19.1	19.1	17.4	6.2	5.5	11.9
4	8.2	20.3	30.8	39.6	9.8	9.5	9.7	18.1
5	12.6	6.1	14.3	26.8	23.7	31.6	28.1	14.2
Average	*17.1*	*20.9*	*26.8*	*28.0*	*24.3*	*23.8*	*24.2*	*20.2*
p-value: **R1=R4**	0.937				0.188			
p-value: **R3=R4**	0.813				0.500			

Trade Volume:

TABLE 5: Volume of Trade

	⅔-EXPERIENCED TREATMENT				⅓-EXPERIENCED TREATMENT			
SESSION	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**
1	170	189	130	162	74	63	61	87
2	93	68	47	82	82	48	45	151
3	120	169	137	165	185	124	124	86
4	107	66	64	38	155	90	63	102
5	133	105	50	81	171	132	125	248
Average	*124.6*	*119.4*	*85.6*	*105.6*	*133.4*	*91.4*	*83.6*	*134.8*
p-value: **R1=R4**	0.125				0.438			
p-value: **R3=R4**	0.063				0.094			

It turns out, that experienced traders are the ones that open the market.

Do differences in experience generate differences in earnings?

TABLE 6: Earnings

Subject type	Average Earnings for One Subject	
	⅔- EXPERIENCED treatment	⅓- EXPERIENCED treatment
Inexperienced	\$6.45	\$6.97
Experienced	\$8.53	\$9.10
p-value: *same earnings*	0.048	0.075