Online Appendix to ”Learning from unrealized versus realized prices”

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1 Descriptive statistics and additional figures

Trading against private information. Table A1 shows the shares of buys when prices and signals reflect contrary information because they lie on opposite sides of their corresponding prior expectation. Trading decisions that conform rather with the information in the price than with the information in the signal indicate that participants gave thought to the price's informativeness. In all treatment variations, traders 2 in the sequential mechanisms traded more often against the information contained in their own signal: they sold (bought) more often than their peers in the simultaneous mechanism when the price was low (high). Differences between buys and sells in the two mechanisms are significant for the variations "Low Signal Quality" and "No Player 1".

Table A1: Acting against one's own signal: share of buys when signal and price move in opposite directions

	$p_2 \leq 130$ $s_2 > .5$	$p_2 > 130$ $s_2 \leq .5$
SEQ	.7834	.2357
	(.042)	(.044)
SIM	.8382	.1460
	(.036)	(.040)
Diff.	-.0498	.0877
N_{SEQ}/N_{SIM}	157/136	140/137
LSQ-SEQ	.5976	.4323
	(.059)	(.047)
LSQ-SIM	.7326	.1939
	(.049)	(.044)
Diff.	-.135*	.2383***
N_{SEQ}/N_{SIM}	164/187	155/165
NP1-SEQ	.6815	.3584
	(.049)	(.040)
NP1-SIM	.8446	.1198
	(.045)	(.035)
Diff.	-.1631**	.2386***
N_{SEQ}/N_{SIM}	148/179	173/167

Note: *p < 0.1,**p < 0.05,***p < 0.01 in two-sample t test with unequal variances. CRSE in parentheses. Numbers of observations N depend on the number of signal price combinations (s_2, p_2) within a category and therefore differ.

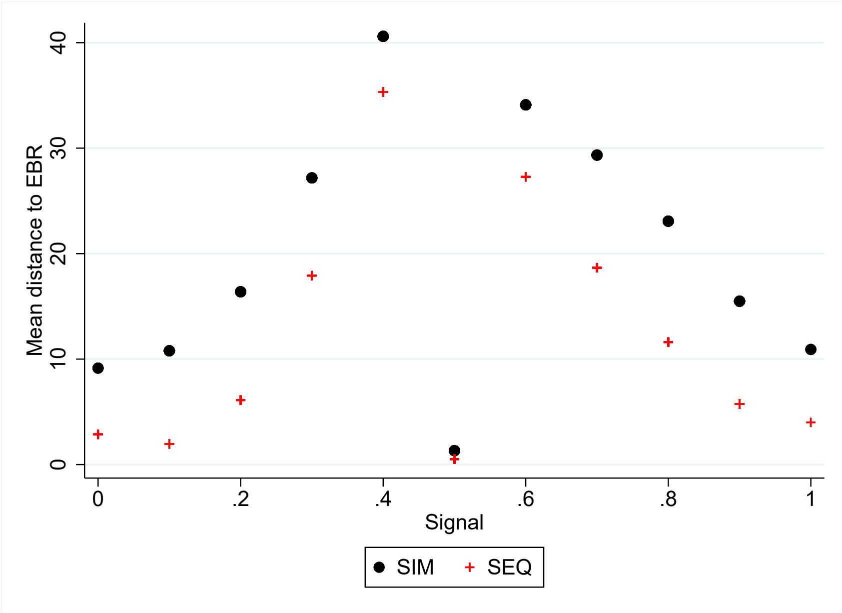


Figure A 1: Distance between bid function of trader 2 and EBR.

Figure A 1 shows the Euclidean distance between the estimated bid function of each treatment and the joint EBR function computed using the pooled sample of participants in the role of trader 1 in SIM and SEQ and signals grouped to bins of 0.1. As expected, the distance is smaller for extreme and uninformative signals ($s_i \approx 0, s_i \approx 0.5, s_i \approx 1$) than for other signals. More importantly, the distance is always smaller in treatment SEQ than in treatment SIM, showing that participants in SEQ bid closer to the EBR.

Figure A 2 also shows the estimated bid functions in direct comparison. The two functions differ significantly from each other in a Kolmogorov-Smirnov test ($p < 0.0001$).

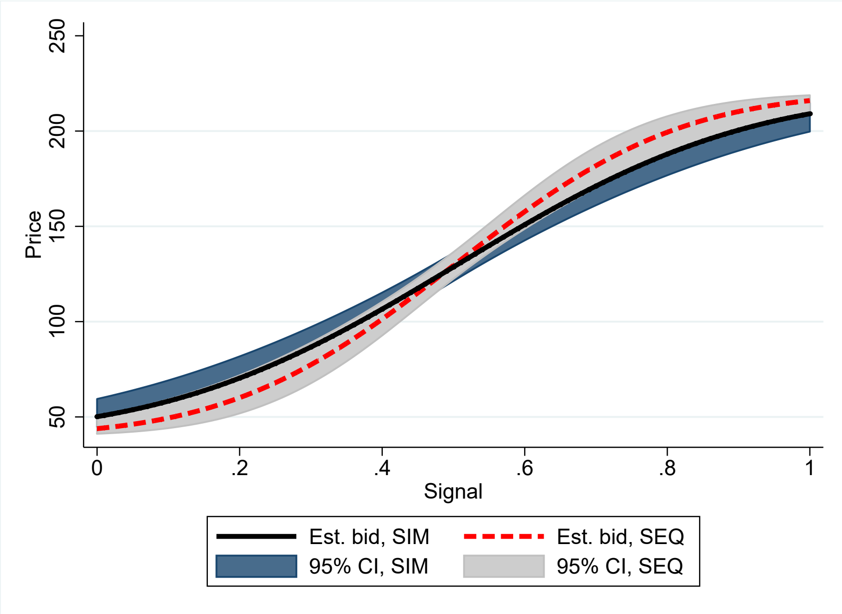


Figure A 2: Mean bids of trader 2 in treatments SIM and SEQ.

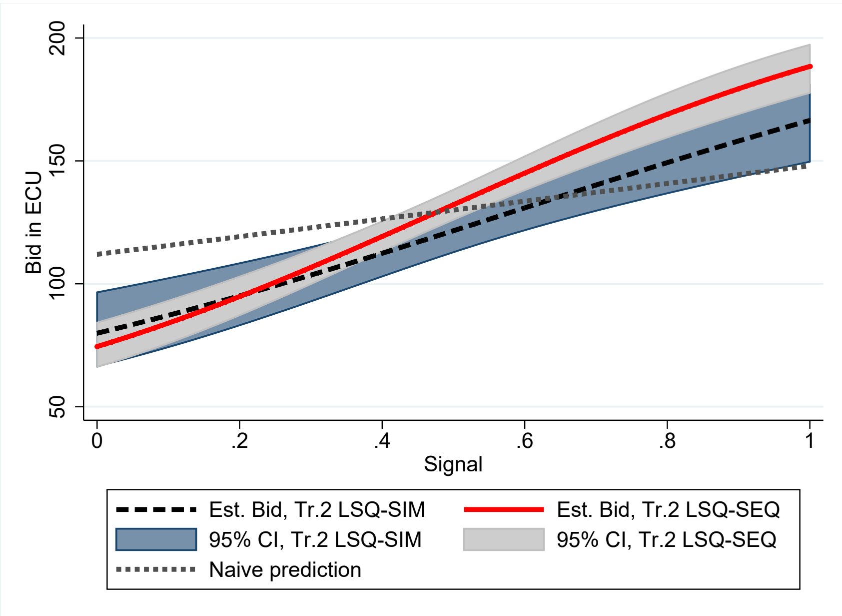


Figure A 3: Mean bids of trader 2 in treatments LSQ.

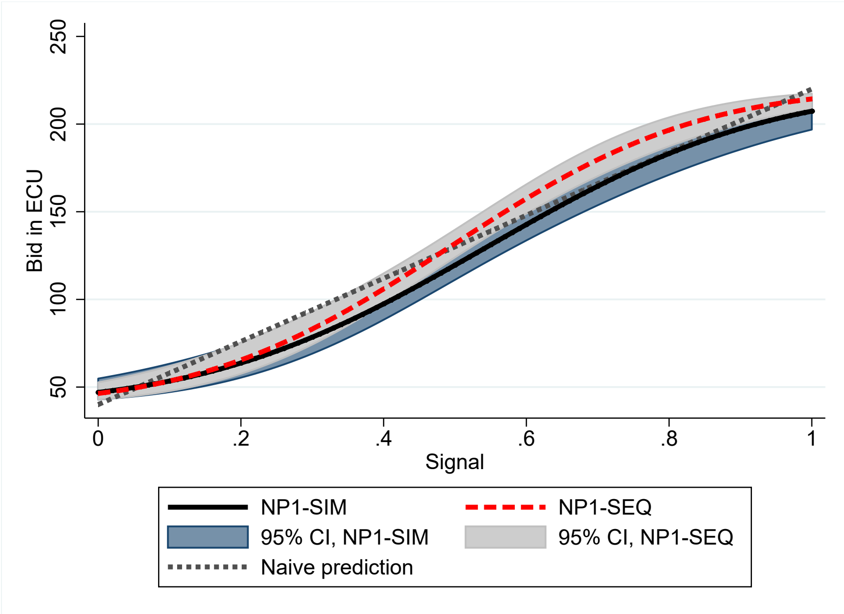
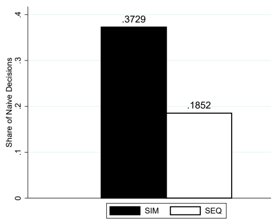
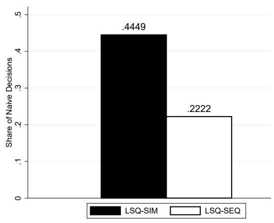


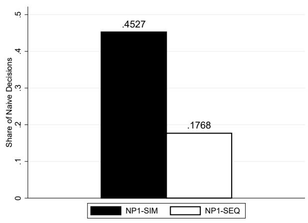
Figure A 4: Mean bids of trader 2 in treatments NP1.



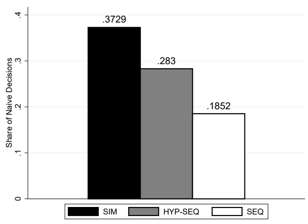
(a) Main



(b) Low Signal Quality



(c) No Player 1



(d) Main vs HYP-SEQ

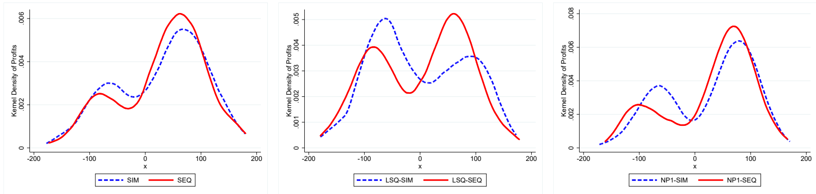
Figure A 5: Share of naive decisions across treatment variations

Table A2: Share of naive decisions (η) for all, high and low signals

	All s_2	$s_2 \leq 0.5$	$s_2 > 0.5$
SIM	0.373	0.300	0.448
	(0.047)	(0.073)	(0.065)
SEQ	0.185	0.137	0.228
	(0.052)	(0.045)	(0.064)
Difference	0.188***	0.163**	0.220***
N_{SIM}/N_{SEQ}	118/108	60/51	58/57
LSQ-SIM	0.445	0.35	0.545
	(0.045)	(0.049)	(0.066)
LSQ-SEQ	0.222	0.254	0.187
	(0.033)	(0.051)	(0.038)
Difference	0.223***	0.096*	0.358***
$N_{LSQ-SIM}/N_{LSQ-SEQ}$	227/261	117/138	123/110
NP1-SIM	0.453	0.376	0.556
	(0.050)	(0.064)	(0.082)
NP1-SEQ	0.177	0.148	0.204
	(.033)	(0.041)	(0.052)
Difference	0.276***	0.228***	0.352***
$N_{NP1-SIM}/N_{NP1-SEQ}$	148/181	85/88	63/93
Hyp-SEQ	0.283	0.307	0.25
	(0.052)	(0. 072)	(0.057)
Difference to SEQ	-0.098*	-0.17**	-0.022
Difference to SIM	0.09*	-0.007	0.198***
$N_{Hyp-SEQ}$	106	62	44

Note: CRSE in parentheses. One-sided t tests with ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.10$. Numbers of observations N depend on the number of signal price combinations (s_2, p_2) within the relevant area and therefore vary.

Profits. The difference between simultaneous and sequential mechanisms also affects the distribution of profits of trader 2. A corresponding difference occurs in each of the relevant treatment comparisons, but it is economically small (our experiments were not designed to generate big payoff differences between treatments) and is statistically significant only in the comparison LSQ-SIM versus LSQ-SEQ, i.e., with asymmetry in the informativeness of signals. Less informed traders benefit from sequential information processing, where the employed updating is more rational. Tables A3 shows mean and median profits of each treatment. It is also noteworthy that the distribution of profits conditional on price p_2 in LSQ-SEQ is mirror-inverted to the one in LSQ-SIM (see Figure A 6b): the majority of traders in LSQ-SIM lose significant amounts, whereas the majority of traders in LSQ-SEQ make gains. This hints at the importance of pre-trade transparency to restrain insider trading in real-world markets. Naive later traders may suffer if they are poorly informed.



(a) SIM vs. SEQ　(b) LSQ　(c) NP1

Figure A 6: Kernel density of profits of traders 2

Table A3: Profits of traders 2

	Mean	S.E.	Median
SIM	27.63	2.98	44
SEQ	30.65	2.86	43.25
LSQ-SIM	-1.24	3.19	-18.25
LSQ-SEQ	.85	3.21	21
HYP-SEQ*	27.48	4.30	43.25
NP1-SIM	25.30	2.78	50.5
NP1-SEQ	28.36	2.65	52.5

Note: S.E. refers to standard errors of mean. *Excluding rounds that generated zero profit in Hyp-SEQ because no trade occurred.

2 Random utility model by treatment

Table shows the results of the maximum likelihood estimation by treatment variation.

Table A4: Results of MSL estimation

	SIM	SEQ	LSQ-SIM†	LSQ-SEQ	NP1-SIM	NP1-SEQ	Hyp-SEQ
β	1.487	1.267	21.388*	5.406*	2.335	0.482**	6.856
	(0.82)	(0.44)	(12.41)	(3.31)	(1.42)	(0.26)	(7.16)
α	0.839	1.692**	≈ 0	2.273**	0.261*	1.726**	0.615
	(0.43)	(0.34)	(0.002)	(0.76)	(0.56)	(0.32)	(1.52)
λ	0.0293***	0.0422***	0.0089***	0.0238**	0.0245***	0.727**	0.012***
	(0.01)	(0.01)	(0.001)	(0.01)	(0.007)	(0.03)	(0.003)
σ_u	0.0142	0.0067	56.67***	0.0011	0.0112	0.004	0.016
	(6.13)	(4.20)	(15.88)	(1.94)	(7.13)	(2.47)	(17.03)
N	720	720	700	680	800	860	620

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Std. Err. in parentheses. Hypothesis testing for β and α refers to one-sided tests of deviations from 1. †The coefficients for LSQ-SIM are obtained using a constrained optimization with $\alpha, \beta \geq 0$ since an unconstrained optimization results in technically invalid values of $\alpha = -6.10$ (and $\beta = 82.49$).

Across all treatments, α, the weight given to price information, is always considerably lower in the simultaneous than in the sequential mechanism: In the sequential markets participants put too much weight on the price (α is significantly larger than 1) whereas in the simultaneous treatments subjects underweight the informational content of prices. Differences are larger in the robustness treatments LSQ & NP1; in particular in treatment LSQ-SIM where subjects assign extremely high and zero weights to the signal and price, respectively. Treatment SIM exhibits reasonable estimates that do not differ from 1. However, we add for completeness that these estimates change substantially if we estimate the model without the reversed limit orders ($\hat{\alpha} \approx 0$ (0.00009), $\hat{\beta} = 2.22$ (0.311), std. err. in parentheses).

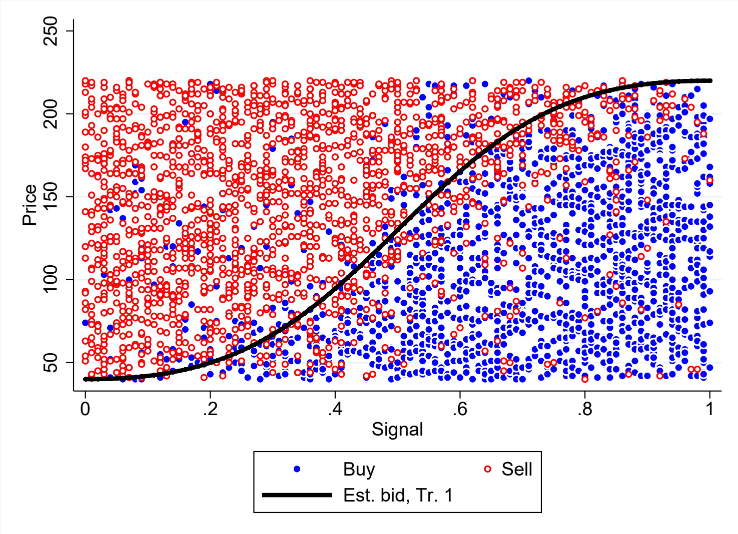


Figure A 7: Bid function for trader 1 given MSL estimates.

3 Learning

To investigate whether participants learn over time, we divide observations into two time subsections: an early time interval for the rounds one to ten and a late interval for later rounds. We first checked that there are no significant differences in trader 1 trading behavior over time, which implies that the empirical best response of trader 2 is stable. For trader 2, we find only mild evidence that the sequential variant of the game facilitates learning about the other agents' private information. In the subset of price-signal realizations where naive and Bayesian predictions differ, the proportion of naive decisions does not change significantly over time in all treatments except treatment LSQ-SEQ, as shown in Table A5. Furthermore, plotting the share or number of naive decisions across rounds does not display any systematic pattern of decay. Even pooling treatments into simultaneous and sequential variants does not reveal significant learning. A random-effects probit regression with reciprocal time trend detects some experience effects in treatment SIM where subjects bid less naively over time. Another type of experience effect can be detected in treatment NP1-SEQ where subjects trade less aggressively after incurring a loss.

Another dynamic that provides some information about subject's sophistication over time is the use of reversed limit orders. While reversing the limit order is a strictly suboptimal strategy for trader 1, the Bayes-Nash best response of trader 2 can also be sustained with extreme reversed limit orders. Most empirical best responses cannot be made with reversed limit orders, but their use may hint at trader 2's partial sophistication. In line with this, subjects in the role of trader 2 reverse their limit order more often than those in the role of trader 1 (15% for trader 2 vs. 3% for trader 1 in treatment SIM). Dynamics shed additional light on whether these reversed limit orders might be due to confusion or partial sophistication: subjects in the role of trader 1 use fewer reversed limit orders over time, suggesting that they recognize reversing as a dominated strategy, whereas those in the role of trader 2 significantly increase their use of reversed limit orders over time (e.g. an increase of 11% to 19% in SIM between early versus late rounds). Although these reversed limit orders do not generate more Bayes-rational trades, their increased use could be an indicator that subjects recognize the price's informational content.

Table A5: Proportion of naive decisions

	SIM	SEQ	LSQ-SIM	LSQ-SEQ	Hyp-SEQ	NP1-SIM	NP1-SEQ
First 10	.3971	.2127	.4741	.2810	.3077	.5128	.1596
	(.060)	(.074)	(.052)	(.046)	(.065)	(.070)	(.044)
Last 10	.34	.1639	.4144	.1714	.2593	.3857	.1954
	(.079)	(.058)	(.068)	(.038)	(.073)	(.061)	(.044)
Diff.	.0571	.0488	.0597	.1096**	.0484	.1271	-.0358
N	118	108	227	261	106	148	181

Note:* $p < 0.1$,** $p < 0.05$,*** $p < 0.01$. CRSE in parentheses. Number of observation N depends on the number of signal price combinations (s_2, p_2) that realize within the relevant area where predictions differ, and therefore varies.

Table A6: Use of reversed limit orders over time, trader 1

Trader 1	SIM	SEQ	LSQ-SIM	LSQ-SEQ	HYP-SEQ
Round 1 - 10	0.047	0.089	0.089	0.038	0.119
	(0.018)	(0.024)	(0.032)	(0.017)	(0.033)
Round 11 - 20	0.017	0.064	0.06	0.024	0.094
	(0.010)	(0.026)	(0.030)	(0.013)	(0.036)
Difference	0.030*	0.025	0.029	0.014	0.025

Note: ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.10$. Clustered Robust Standard Errors in parentheses.

Table A7: Use of reversed limit orders over time, trader 2

Trader 2	SIM	LSQ-SIM	NP1-SIM
Round 1 - 10	0.114	0.134	0.078
	(0.032)	(0.033)	(0.025)
Round 11 - 20	0.189	0.194	0.115
	(0.052)	(0.047)	(0.038)
Difference	-0.075*	-0.060*	-0.037**

Note: ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.10$. Clustered Robust Standard Errors in parentheses.

4 Trading volume

Naive beliefs may not only affect prices and profits, but may also trigger speculative trade (Eyster, Rabin and Vayanos, 2019). Naive traders who receive differential information develop different beliefs as they neglect information revealed by trades. When beliefs are sufficiently divergent, they agree to speculate against each other and thus generate excessive trade.

We calculate the number of trades that would occur within one treatment if traders 2 were allowed to trade with each other (as price-takers). To this end, we compare the actual buys and sells that took place at each price values, rounding the latter to the nearest ten. The number of potential transactions that could have been observed at a given price is given by the minimum of buys or sells at this price. The number of potential trades is then normalized by the maximum number of trades. Since every trade requires two trading parties, the maximum number of possible trades at a price equals the frequency of this price value divided by two. Table A8 shows the share of potential trades, which corresponds to the ratio of potential trades to the maximum possible trading volume. The simultaneous mechanisms entail significantly more potential trades, except for the treatment variation with "Low Signal Quality" that displays similar shares of trades in each mechanism. This simulation, albeit simplistic, supports the conjecture that naive traders who neglect disagreement in beliefs spawn additional trade.

Table A8: Simulated trading volume

	SIM	SEQ
Main treatments	.8611	.7806***
	(.004)	(.004)
Low Signal Quality	.7629	.7735
	(.007)	(.006)
No Player 1	.87	.6977***
	(.003)	(.005)

Note: Average simulated trading volume with random matching of trader 2 participants. ***Share is significantly smaller than in the alternative treatment in a one-sided t-test with $p < .01$.

5 Instructions

The instructions for treatments SIM and SEQ are identical except for the section describing the task in group 2. The instructions for treatments LSQ, NP1 and Hyp-SEQ are overall very similar, but the wording differs slightly in several sections. We therefore omit the instructions for these treatments at this point, but provide them upon request. The instructions were divided into two parts, with a short simulation quiz in between. The first part of the instructions was the same for the simultaneous and sequential treatments. Note, class A and class B correspond to group of trader 1 and trader 2, respectively.

Welcome!

General information

The experiment in which you will take part is a module of the research project financed by different institutions, such as Humboldt University of Berlin, Technical University of Berlin, German Institute for Economic Research, Berlin Social Science Center, European Research Council. Its aim is to analyse financial decision-making behaviour.
Read attentively the following instructions and make your choice carefully. You have the chance to earn a significant profit, which will be paid in cash to you at the end of the experiment. We kindly ask you to devote your full attention to the experiment. During the experiment mobile phones or other electronic devices as well as any interactions with other participants are forbidden. Please use only the programs and functions assigned for the experiments. Please do not talk with other participants. If you have any questions, please raise your hand. We will come to you and answer your question privately. Please by no means ask your question aloud. In case your question is relevant for the other participants, we will repeat it and answer openly. Breach of this rule will result in your exclusion from the experiment and the payment.

Instructions – Part 1

The experiment

The following experiment consists of 20 rounds. You are an investor and you want to optimize your portfolio with respect to a specific company's shares. In each round you will have to decide, whether to buy or to sell one single share.
At the end of a round the share can have only two possible values: 40 or 220 currency units (experimental currency units are subsequently referred to as ECU). There is a 50% chance that the share value will be 220 ECU; with

the remaining probability of 50%, it will be 40 ECU. At the moment when you make your decision, you will not know this value, or at least you will not know it for sure.

$$\begin{tikzcd}[column sep=small] & \text{Share value} \arrow[dl, "50\%"'] \arrow[dr, "50\%"] & \\ 40 \text{ ECU} & & 220 \text{ ECU} \end{tikzcd}$$

Your task is to make an investment decision. At a given market price you can either buy or sell a share. Which decision you will finally have to make and how the market price is being calculated, will be explained to you later.

The tip

You and all other participants in the experiment will each receive a tip from the computer that should make it easier to estimate the value of the share and should help you with the decision-making. The tip is related to the share value because it tends to be high when the share value is 220. The tip will be obtained in the following way: the computer determines the share value at 40 or 220, with equal probabilities. Then it draws your tip. The tip is a value between 0 and 1 from one of two possible distributions.
If the share value is 40 ECU, then the tip will be drawn from the red distribution (see Figure 1). In this case, it is more likely to get a lower tip (close to 0).

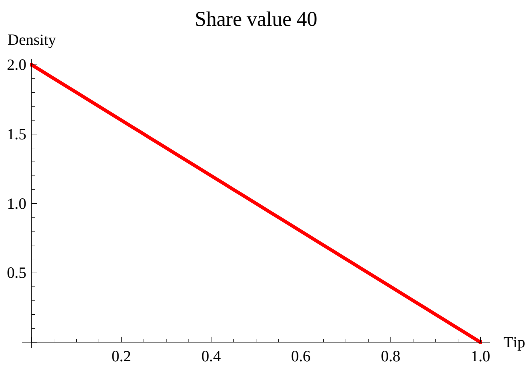


Figure 1: Tip distribution when share value is 40 ECU.

If, however, the share has a value of 220 ECU, the tip will be drawn from the blue distribution (see figure 2). In this case the computer is more likely to display a higher tip (close to 1).

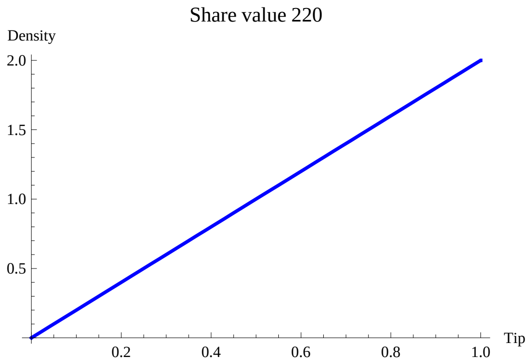


Figure 2: Tip distribution when share value is 220 ECU.

Therefore, extreme values of the tip, i.e. tips that are close to 0 or 1, reveal the real share value better. That is, if the tip is closer to 0, the probability that the share value is 40 ECU is higher. On the other hand, if the share value is 220, it is more likely that the tip will be closer to 1. With a tip of 0.50 both share values (40 and 220 ECU) are equally likely.

The box on page 4 describes in detail how the computer determines the tip.

Tip distribution

The drawn line (red/blue) is a so called density of the distribution. The area below the drawn line represents a probability. The total area below the line corresponds to the probability of 100% : You will get a tip between 0 and 1 for sure, i.e. with a probability of 100%.

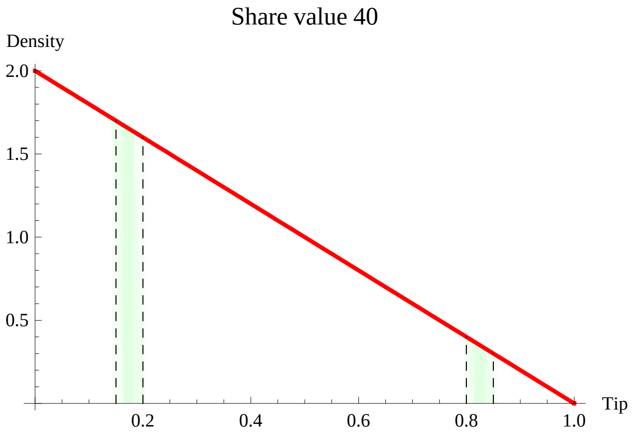


Figure 3: Tip distribution when share value is 40 ECU.

If the share value is 40 ECU, the computer will draw a tip from the red distribution (see Figure 3). The larger portion of the area below this red line is towards the left. This means that smaller values are more probable than larger ones. For example, the left area in light green corresponds to the probability of getting a tip between 0.15 and 0.20. As you can see, the green area decreases in size the further its location lies to the right since the height of the line decreases. Consequently, the probability of getting a higher tip decreases if the share value is 40.

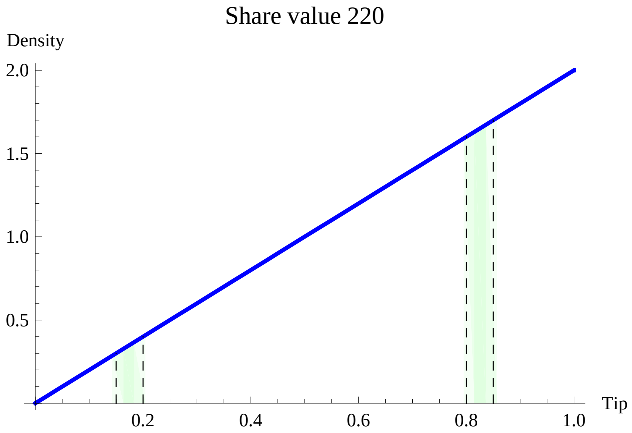


Figure 4: Tip distribution when share value is 220 ECU.

If the share value is 220 ECU, the computer will draw a tip from the blue distribution (see Figure 4). The higher the tip, the higher is the probability that it will be drawn. Considering the green area in the graph, you can for example see that a tip between 0.80 and 0.85 is more likely than a tip between 0.15 and 0.20.

For both possible share values (40/220) any tips with any conceivable value ranging from 0 to 1 (rounded to two decimals) are theoretically possible.

In order to illustrate the relation between the tip and the share, a short simulation will be displayed on the screen.

The simulation consists of 10 rounds. In each round the computer will determine a share value, as described above, and it will give you a tip between 0 and 1. At the beginning of each round you will receive the tip. Afterwards you can make two assessments based on the tip:

- First, you guess which of the two share values (40 or 220) is most likely.
- Second, from a scale ranging from 1 [“very uncertain”] to 5 [“very certain”], you state how sure you are about your guess on the share value.

After you have input your data, you will learn the real share value in that specific round.

Please note that the simulation can proceed to the next round only when each participant has completed the task and pressed the “OK”button.

When all participants have completed the simulation, including all 10 rounds, you will receive the second part of the instructions.

Treatment SIM
Instructions - Part 2

Subdivision into classes

For the experiment, all participants will be evenly split in two classes - class A and class B. The class you belong to (A or B) will be displayed on the computer screen shortly before the experiment. Throughout the whole experiment, you will remain in the same class. At the beginning of each of the 20 rounds, you will be randomly assigned to a participant from the other class. Throughout the whole experiment, it will remain secret which two people in the room are in the same group in which round. A group of two participants from different classes (in the following investor A and investor B) forms a market, together with an observer, who sets the price. The observer is not a participant in the experiment.
In every round the computer randomly determines whether the share value is 40 or 220 ECU. Afterwards investors A and B each receive their own tip. The two investors receive separate tips, which therefore will most likely differ. However, both tips are drawn from the same distribution (red / blue), depending on whether the true value of the share is 40 or 220 ECU.

Please read carefully the following instructions for both classes of investors A and B.

Tasks of a class A participant

After been given your tip, you will state a maximum buy limit order, i.e. the price up to which you would be willing to buy a share. Your maximum buy limit order must lie between 40 and 220. At the point of making your decision, you will not know the market price. Should the market price later turn out to be lower than your maximum buy limit, you will buy a share. In contrast, you will sell a share if the market price lies above your maximum buy limit.

Your maximum buy limit should reflect your estimation of the share value. For example: If you are sure that the share value is 220 ECU, you should indicate a maximum buy limit of 220 ECU. If you expect the share value to be 40 ECU for sure, you should set a maximum buy limit of 40 ECU. If you are uncertain, i.e. your estimation lies between these two values, then your maximum buy limit should be in-between, too.

Instead of a *maximum* buy limit, you can also state a *minimum* buy limit. A minimum buy limit is the lowest price at which you are willing to buy a share. In this case, you *buy* a share if the market price is *above* your minimum buy limit. You *sell* a share if the market price is *below* your minimum buy limit. Should the market price correspond exactly to your buy limit, you will buy a share in both cases of maximum or minimum buy limit.
In each round you initially set a maximum buy limit. Once this is done, you will have the opportunity to convert your maximum buy limit into a minimum buy limit, by ticking a box. Please note that a minimum and a maximum buy limit can lead to opposite buying-selling decisions (please see Figure 1). You should indicate a minimum buy limit if you prefer to sell at low prices and buy at high prices. Also keep in mind that, in the most extreme case, with a minimum buy limit you could buy a share even at the highest price of 220 ECU or sell a share at the lowest price of 40 ECU. If you rather want to sell at high prices and buy at low prices, you should choose a *maximum* buy limit.

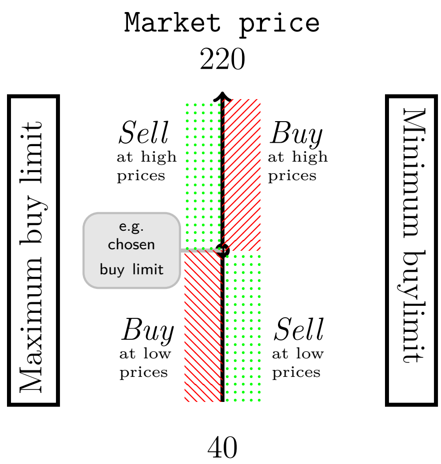


Figure 1: Maximum vs minimum buy limit

The market price that is relevant to you as an investor in class A, is called

Price A. Price A is a random number between 40 and 220, that is determined by the computer. The computer only draws integers (thus 40,41,42,43 ... 219 or 220) whereby all possible 181 numbers can be selected with the same probability (i.e. 1/181).

Trade will occur at this Price A. At the end of the round, all relevant information will be displayed to you, i.e. Price A, the true value of the share and your profit in the corresponding round.

Tasks of a class B participant

If you belong to class B, one essential difference is the fact that investor A affects the market price that is relevant to you.

You will receive a tip and will state a buy limit between 40 and 220 ECU as well. Like investor A you can indicate your buy limit in two different ways: You can either set a maximum or minimum buy limit. With a maximum buy limit you will buy a share if the market price falls below the maximum buy limit, otherwise you will sell a share. With a minimum buy limit you will buy a share if the market price lies above the minimum buy limit, and sell otherwise (see Figure 1).

Once you have set your buy limit, a so-called Price B is determined. Price B is calculated by means of a fixed formula, which simulates the behavior of an outside observer. The observer sees the buying and selling decisions of investor A at Price A and calculates on that basis an estimate of investor A's tip. Price A, at which investor A buys or sells, enables the observer to estimate the tip. For example: The higher Price A at which investor A buys, the more likely it is for the observer that investor A has received a high tip. Conversely, a low tip is more likely if investor A sells at low prices. Using his estimate of investor A's tip, the observer then calculates the likelihood with which the share has taken the high or the low value. To this end, he uses the laws of probability. The observer then sets Price B, accordingly. Price B reflects therefore the observer's estimate of the share value. As a result, Price B will lie above Price A if investor A buys. In contrast, if investor A sells, Price B will lie below Price A. More precisely, Price B is the result of the following formula:

$$
\text{Price B} = \begin{cases} \dfrac{220 + \text{Price A}}{2}, & \text{if investor A buys} \\ \\ \dfrac{40 + \text{Price A}}{2}, & \text{if investor A sells} \end{cases}
$$

Before you set your buy limit, you will observe Price A. However, at this point, you will not know whether investor A has bought or sold. Therefore, at the point of making your decision, you will not know the Price B that is relevant to you.

Trade takes place once Price B is determined. After this all relevant information will be displayed to you, i.e. Price B, the true value of the share and your profit in the respective round.

A main difference between investors A and B is therefore the price. A participant in class A pays or receives a random Price A; in contrast, for a participant in class B, Price B reflects the observer's estimate of the share value, after the observer has seen the decision of investor A.

Your profit

Your profit depends on the share value as well as on whether you buy or sell. If you buy a share, you will receive the difference between the share value and the market price:

$$
\text{profit after a buy} = (\text{share value}) - \text{market price}
$$

In contrast, if you sell a share, you will receive the market price, but lose the share value. In this case, your profit is the difference between the market price and the share value.

$$
\text{profit after a sell} = \text{market price} - (\text{share value})
$$

In both cases (buy/ sell), your profit can be positive or negative. Neither buying nor selling can completely protect you from losses.

You repeat the whole decision game in 20 rounds.

Figure 2 summarizes the experiment.

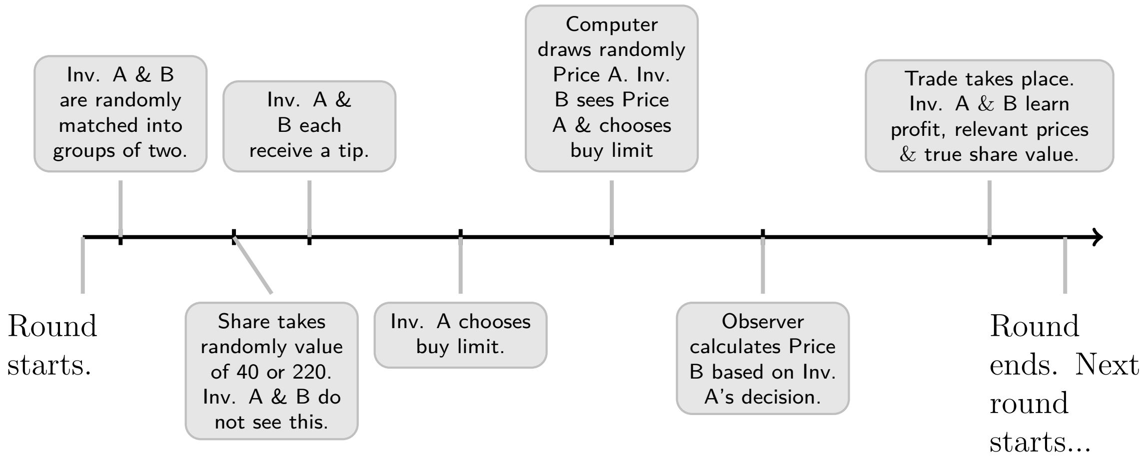


Figure 2: Experimental Procedure

Payoff

At the end of the experiment, your payoff consists of a show-up fee of 5 EUR, a fixed endowment of 15 EUR and the profit in one randomly chosen round. Each of the 20 rounds has the same probability to be chosen, i.e. 1/20. In the chosen round, you will receive 0.08 Euro per ECU. Thus, the payoff in Euros is calculated as follows:

$$\begin{aligned}\text{payoff [in EUR]} = {} & (\text{payoff from } \textit{one} \text{ randomly chosen} \\ & \ \text{round [in ECU]}) * 0,08\,[EUR/ECU] \\ & + \ 15 \text{ fixed endowment [in EUR]} \\ & + \ 5 \text{ show} - \text{up fee [in EUR]}\end{aligned}$$

If you incur a loss in the randomly chosen round, the fixed endowment will be reduced by the amount of loss.

The following examples illustrate the payoff-rules. Please consider that the examples are chosen arbitrarily and do not allow for any inferences, which price limits/market prices/profits are to be expected later in the experiment.

Example 1:
From the 20 rounds, round 8 is chosen randomly. In the eighth round the price was 160 ECU and the share's value was 220. Through a maximum buy limit of 110, you sold the share and made a loss of 60 ($= 160 - 220$*) ECU.*
Consequently, your payoff is:

$$\textit{Payoff}\ [\textit{in EUR}] = -60 \cdot 0.08\ +\ 15\ +\ 5\ = 15.2\ [\textit{EUR}]$$

Example 2:
From the 20 rounds, round 14 is drawn randomly. In the fourteenth round, the price was 180 ECU and it was above your maximum buy limit of 80 ECU while the share's value was 40 ECU. You sold the share and made a profit of 140 ($= 180 - 40$*) ECU.*
Consequently, your payoff is:

$$\textit{Payoff}\ [\textit{in EUR}] = 140 \cdot 0.08\ +\ 15\ +\ 5\ = 31.2\ [\textit{EUR}]$$

Example3:
From the 20 rounds, round 3 is chosen randomly. In the third round, the price was 200 ECU, being above your minimum buy limit of 170 ECU; the share's value was only 40 ECU. You bought the share and made a loss of 160 ($= 40 - 200$*) ECU.*
Consequently, your payoff is:

$$\textit{Payoff}\ [\textit{in EUR}] = -160 \cdot 0.08\ +\ 15\ +\ 5\ = 7.2\ [\textit{EUR}]$$

Please keep in mind that participants are newly matched into groups of two after each round. The experiment can only be continued once all participants have made a choice and pressed the "finish "-button.

The experimenters will now hand out a questionnaire to check your understanding. Please raise your hand when you have filled out the questionnaire. The experimenters will then come to you.

Good Luck!

Treatment SEQ
Instructions - Part 2

Subdivision into classes

For the experiment, all participants will be evenly split in two classes - class A and class B. The class you belong to (A or B) will be displayed on the computer screen shortly before the start of the experiment. Throughout the whole experiment, you will remain in the same class. At the beginning of each of the 20 rounds, you will be randomly assigned to a participant from the other class. A group of two participants from different classes (investor A and investor B) forms a market. Throughout the whole experiment, it will remain secret, which two people in the room are in the same group in which round.

In every round, the computer randomly chooses whether the value of the share is 40 or 220 ECU. Afterwards investors A and B each receive their own tip. The two investors receive separate tips, which therefore will most likely differ. However, both tips are drawn from the same distribution (red/blue), depending on whether the true value of the share is 40 or 220 ECU.
Please read carefully the following instructions for <u>both</u> classes of investors A and B.

Tasks of class A participant

After been given your tip, you need to set a maximum buy limit order, i.e. the price up to which you would be willing to buy a share. Your maximum buy limit order must lie between 40 and 220. At the point of making your decision, you will not know the market price. Should the market price later turn out to be lower than your maximum buy limit, you will buy a share. In contrast, you will sell a share if the market price lies above your maximum buy limit.

Your maximum buy limit should reflect your estimation of the share value. For example: If you are sure that the share value is 220 ECU, you should indicate a maximum buy limit of 220 ECU. If you expect the share value to be 40 ECU for sure, you should set a maximum buy limit of 40 ECU. If you are uncertain, i.e. your estimation lies between these two values, then your maximum buy limit should be in-between, too.

Instead of a *maximum* buy limit, you can also state a *minimum* buy limit. A minimum buy limit is the lowest price at which you are willing to buy a share. In this case, you *buy* a share if the market price is *above* your minimum buy limit. You *sell* a share if the market price is *below* your minimum buy limit. Should the market price correspond exactly to your buy limit, you will buy a share in both cases of maximum or minimum buy limit.
In each round you initially set a maximum buy limit. Once this is done, you will have the opportunity to convert your maximum buy limit into a minimum buy limit, by ticking a box. Please note that a minimum and a maximum buy limit can lead to opposite buying-selling decisions (please see Figure 1). You should indicate a minimum buy limit if you prefer to sell at low prices and buy at high prices. Also keep in mind that, in the most extreme case, with a minimum buy limit you could buy a share even at the highest price of 220 ECU or sell a share at the lowest price of 40 ECU. If you rather want to sell at high prices and buy at low prices, you should choose a *maximum* buy limit.

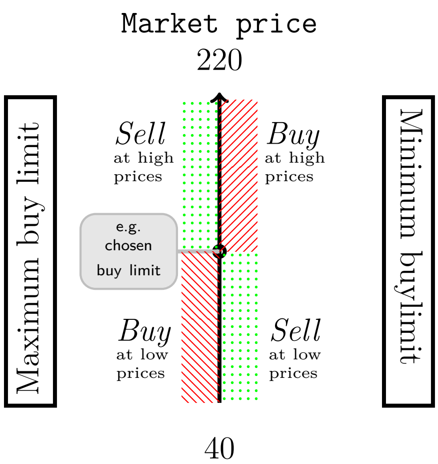


Figure 1: Maximum vs minimum buy limit

The market price that is relevant to you as an investor in class A, is called Price A. Price A is a random number between 40 and 220, that is determined by the computer. The computer only draws integers (thus 40,41,42,43

. . . 219 or 220) whereby all possible 181 numbers can be selected with the same probability (i.e. 1/181).

Trade will occur at this Price A. At the end of the round, all relevant information will be displayed to you, i.e. Price A, the true value of the share and your profit in the corresponding round.

Tasks of a class B participant

If you belong to class B, one essential difference is the fact that investor A affects the market price that is relevant to you. Furthermore, you will observe this market price.

The market price that is relevant to you - the so-called Price B - is calculated by means of a fixed formula, which simulates the behavior of an outside observer. The observer sees the buying and selling decisions of investor A at Price A and calculates on that basis an estimate of investor A's tip. Price A, at which investor A buys or sells, enables the observer to estimate the tip. For example: The higher Price A at which investor A buys, the more likely it is for the observer that investor A has received a high tip. Conversely, a low tip is more likely if investor A sells at low prices. Using his estimate of investor A's tip, the observer then calculates the likelihood with which the share has taken the high or the low value. To this end, he uses the laws of probability. The observer then sets Price B, accordingly. Price B reflects therefore the observer's estimate of the share value. As a result, Price B will lie above Price A if investor A buys. In contrast, if investor A sells, Price B will lie below Price A. More precisely, Price B is the result of the following formula:

$$\text{Price B} = \begin{cases} \dfrac{220 + \text{Price A}}{2}, & \text{if investor A buys} \\[2ex] \dfrac{40 + \text{Price A}}{2}, & \text{if investor A sells} \end{cases} \tag{1}$$

You will first receive your tip, you will then see Price A and Price B, and finally, you will choose between buying or selling the share at the listed Price B. The more you expect the share value to be high (220 ECU), the more you should buy.

Once you have made your buying or selling decision, trade takes place. At the end of the round, all relevant information will be displayed to you, i.e. the true value of the share and your profit in the corresponding round.

The main differences between investors A and B are therefore the type of decision (buy limit (maximum or minimum) vs. buy/sell) and the market price. A participant in class A pays or receives a random Price A; in contrast, for a participant in class B, Price B reflects the observer's estimate of the share value, after the observer has seen the decision of investor A.

Your profit

Your profit depends on the share value as well as on whether you buy or sell. If you buy a share, you will receive the difference between the share value and the market price:

$$\text{profit after a buy} = (\text{share value}) - \text{market price}$$

In contrast, if you sell a share, you will receive the market price, but lose the share value. In this case, your profit is the difference between the market price and the share value.

$$\text{profit after a sell} = \text{market price} - (\text{share value})$$

In both cases (buy/ sell), your profit can be positive or negative. Neither buying nor selling can completely protect you from losses.

You repeat the whole decision game in 20 rounds.

Figure 2 summarizes the experiment:

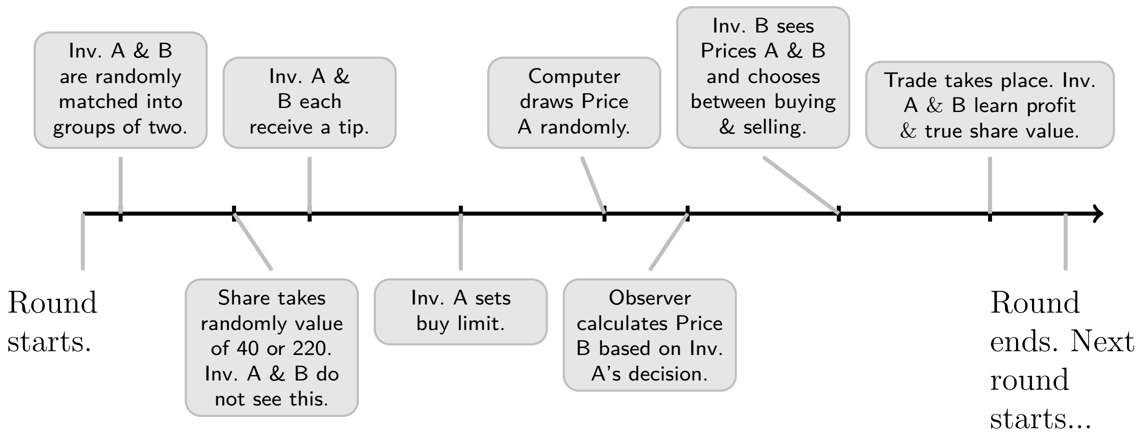


Figure 2: Experimental procedure

Payoff

At the end of the experiment, your payoff consists of a show-up fee of 5 EUR, a fixed endowment of 15 EUR and the profit in one randomly chosen round. Each of the 20 rounds has the same probability to be chosen, i.e. 1/20. In the chosen round, you will receive 0.08 Euro per ECU. Thus, the payoff in Euros is calculated as follows:

$$\begin{aligned} \text{payoff [in EUR]} = &(\text{payoff from } \textit{one} \text{ randomly chosen} \\ &\ \text{round [in ECU]}) * 0,08\,[EUR/ECU] \\ &+\ 15 \text{ fixed endowment [in EUR]} \\ &+\ 5 \text{ show} - \text{up fee [in EUR]} \end{aligned}$$

If you incur a loss in the randomly chosen round, the fixed endowment will be reduced by the amount of loss.

The following examples illustrate the payoff-rules. Please consider that the examples are chosen arbitrarily and do not allow for any inferences, which purchase limits/ market prices/ profits are to be expected later in the experiment. As for all the following examples of the payoff illustration, we assume that you are a participant in class A.

Example 1:
From the 20 rounds, round 8 is chosen randomly. In the eighth round the price was 160 ECU and the share's value was 220. Through a maximum buy limit of 110, you sold the share and made a loss of 60 ($= 160 - 220$*) ECU. Consequently, your payoff is:*

$$\textit{Payoff } [\textit{in EUR}] = -60 \cdot 0.08 \ + \ 15 \ + \ 5 \ = 15.2 \ [\textit{EUR}]$$

Example 2:
From the 20 rounds, round 14 is drawn randomly. In the fourteenth round, the price was 180 ECU and it was above your maximum buy limit of 80 ECU while the share's value was 40 ECU. You sold the share and made a profit of 140 ($= 180 - 40$*) ECU.*
Consequently, your payoff is:

$$\textit{Payoff } [\textit{in EUR}] = 140 \cdot 0.08 \ + \ 15 \ + \ 5 \ = 31.2 \ [\textit{EUR}]$$

Example3:
From the 20 rounds, round 3 is chosen randomly. In the third round, the price was 200 ECU, being above your minimum buy limit of 170 ECU; the share's value was only 40 ECU. You bought the share and made a loss of 160 ($= 40 - 200$*) ECU.*
Consequently, your payoff is:

$$\textit{Payoff } [\textit{in EUR}] = -160 \cdot 0.08 \ + \ 15 \ + \ 5 \ = 7.2 \ [\textit{EUR}]$$

In each of the described examples, a participant in class B would have received the same payoff provided that his decisions at the same market prices had resulted in the same actions (sell of a share in examples 1 and 2 and buy in example 3).

Please keep in mind that participants are newly matched into groups of two after each round. The experiment can only be continued once all participants have made a choice and pressed the "finish "-button.

The experimenters will now hand out a questionnaire to check your understanding. Please raise your hand when you have filled out the questionnaire. The experimenters will then come to you.

Good luck!