Endogenous Leverage and Default in the Laboratory. Appendix

Marco Cipriani Ana Fostel Daniel Houser

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Appendix I: Theory

Equilibrium Analysis in the FA-Economy

Equilibrium

Given the parameterization described in Table 1 of Section 2.1, we solve the equilibrium in the following way. First, we make an educated guess on the "equilibrium regime," that is, we make a guess on which constraints are binding, and hence on the level of some endogenous variables. Then, given this guess, we solve for the remaining endogenous variables using a set of equations derived from the agents' maximization and from market clearing conditions. Third, we show that the solution to the system of equations is a genuine equilibrium by checking that the assumed regime is consistent with agents' maximization and resource feasibility.

In this binomial economy the asset is financial, so by Fostel-Geanakoplos (2015) we can assert the existence of an equilibrium in which the only contract traded in equilibrium is $j = 100$. We further guess that Buyers buy all the assets in the economy ($y^B = 3$); use all their assets holding to sell contracts $j = 100$ ($\varphi^B_{j=100} = -3$) to Sellers; and hold no cash ($w^B = 0$).

Given this guess, the remaining endogenous variables $(p, b_{j=100}, y^S, w^S, \varphi^S_{j=100})$ can be obtained through the following system of equations:

$$-m^B + 3p = 3b_{j=100}, \tag{1}$$

$$b_{j=100} = q^S(100) + (1 - q^S)100, \tag{2}$$

$$y^S = a^B + a^S - 3, \tag{3}$$

$$\varphi^S_{j=100} + 3 = 0 \tag{4}$$

$$w^S = m^B + m^S \tag{5}$$

Equation (1) is the budget constraint for Buyers. Equation (2) is the Sellers' first order condition for lending through contract $j = 100$. Equations (3), (4) and (5) are the market clearing conditions for asset, debt contract $j = 100$, and cash markets. The solution to the system of equations is given by $(p, b_{j=100}, y^S, w^S, \varphi^S_{j=100}) = (200, 100, 0, 300, 3)$.

We need to check that the solution to the system is an equilibrium for the FA-economy (the regime assumed is the correct one). Clearly the Sellers do not want to hold the asset since $p = 200 > 180 = E^S Y$, hence it is optimal for Sellers to sell all their endowment of 3 assets. Buyers want to spend all their cash and borrow all they can through debt contract $j = 100$ to buy all the assets since $p = 200 < 420 = E^B Y$. By FG we don't need to investigate trading in any of the contracts $j \neq 100$. Hence, the solution is an equilibrium.

To complete the characterization of the equilibrium set $\varphi_j = 0, \forall j \neq 100$ and prices for the non traded contracts as $b_j = q^S min\{j, 500\} + (1 - q^S) min\{j, 100\}$, $\forall j \neq 100$. At these prices Buyers will not want to trade in these markets. In the terminology of Fostel-Geanakoplos the contract $j = 100$ is the one with the highest "Liquidity Value" for Buyers. The liquidity value of a debt contract j is the difference between the price of a debt contract (how much the borrower borrows) and the payoff value of the debt contract to borrowers (how much Buyers are expected to pay back at time 1, discounted by the marginal utility of money); it measures the efficiency of a debt contract as liquidity provider. In the equilibrium discussed in Section 2.2, the marginal utility of money (the maximum expected payoff of an extra unit of cash at time zero, given prices) for Buyers is given by $\mu^B = \frac{.8(500-100)}{200-100} = 3.2$. Hence, the payoff value of any debt contract j is given by $\frac{.8min\{500,j\}+.2min\{100,j\}}{3.2}$ (the expected delivery discounted by the marginal utility of money). As we discussed before, the price of all debt contracts are given by the Sellers' valuation, $b_j = .2min\{j, 500\} +$

$.8min\{j, 100\}$.[1]

Consider contracts $j \leq 100$. In this case the liquidity value for borrowers is given by $LV_j^B = j - j/3.2$. Clearly this expression is increasing in j and attains its maximum at $j = 100$. Now consider contracts $j > 100$. In this case the liquidity value for borrowers is given by $LV_j^B = .2min\{j, 500\} + .8min\{j, 100\} - \frac{.8min\{j,500\}+.2min\{j,100\}}{3.2}$. Both expressions are increasing in j, but because of the belief disagreement (Sellers think the state High will happen only with probability .2), the first term increases by less than the second one. Hence the liquidity value decreases as j increases. As a result, no contract with $j > 100$ is actively traded. All contracts have a positive liquidity value, reflecting the fact that Buyers are constrained (their marginal utility of money is bigger than 1). But the liquidity value attains its maximum when $j = 100$, so only this contract is actively traded in equilibrium.[2]

Uniqueness

The non-default equilibrium is unique. We cannot find an equilibrium with the same asset price, bond prices and payoffs for all investors which involves default. By FG, this would imply reshuffling portfolios so that Buyers would hold more risky assets as collateral to issue a higher promise. In this way they would still be buying the same amount of Arrow High securities. In equilibrium, per each leveraged asset, they are buying $500 - 100$ Arrow High securities, through contract $j = 100$. They could still buy the same amount of Arrow High securities by holding $3(\frac{500-100}{500-101})$ of the risky asset to issue $\frac{500-100}{500-101}$ units of contract $j = 101$ per unit of asset. But this is clearly unfeasible since $\frac{500-100}{500-101} > 1$ and there is no more available collateral in the economy, Hence, equilibrium is unique.

Equilibrium Analysis in NFA-Economy

Equilibrium

We solve for the parameter values of Table 4 in Section 2.2. This economy does not satisfy the assumptions in FG, and hence we cannot assert the existence of an

[1]Note that the the marginal utility of money for Sellers at time 0 is given by $\mu^S = 1$, because in equilibrium they only hold riskless assets.

[2]Incidentally, as shown by Fostel and Geanakoplos (2008, 2014) the liquidity value of the active contract in equilibrium equals the collateral value of the asset, $LV_{j=100}^B = CV_Y^B = 68.75$. See Cipriani *et al.* (2018) for a study on the presence of collateral values in the lab.

equilibrium with only $j = 100$ as we did in the FA-economy. In order to calculate the equilibrium we will guess the following equilibrium regime: Buyers buy all the assets in the economy ($y^B = 3$); use all their assets holding to sell only one debt contract j ($\varphi_j^B = -3$); hold no cash ($w^B = 0$); and pay for the asset according to their valuation.

Given this guess, the remaining endogenous variables $(p, b_j, j, y^S, w^S, \varphi_j^S)$ can be obtained through the following system of equations:

$$-m^B + 3p = 3b_j, \tag{6}$$

$$b_j = qj + (1-q)100, \tag{7}$$

$$p = q500 + (1-q)100. \tag{8}$$

$$y^S = a^B + a^S - 3, \tag{9}$$

$$\varphi_j^S + 3 = 0 \tag{10}$$

$$w^S = m^B + m^S \tag{11}$$

Equation (6) is the budget constraint for Buyers. Equation (7) is the Sellers' first order condition for lending through contract j. Equation (8) is the Buyers' first order condition to hold the asset. Equations (9), (10) and (11) are the market clearing conditions for asset, debt contract j and cash market respectively. The solution to the system of equations is given by $(p, b_j, j, y^S, w^S, \varphi_j^S) = (420, 320, 375, 0, 300, 3)$.

We need to check that the solution to the system is an equilibrium for the NFA-economy. Clearly the Sellers do not want to hold the asset since $p = 420 > 180 = E^S Y$, hence it is optimal for Sellers to sell all their endowment of 3 assets. Buyers want to spend all their money and borrow to buy all the asset since $p = 420 = E^B Y$. They are interior (their marginal utility of money is 1) and hence the liquidity value of all contracts is zero. Buyers are indifferent and hence they are optimizing issuing the risky bond $j = 375$, which allows them to pay exactly their asset valuation. To complete the characterization of the equilibrium set $\varphi_j = 0, \forall j \neq 375$ and prices for the non traded contracts as $b_j = q^S min\{j, 500\} + (1 - q^S) min\{j, 100\}$, $\forall j \neq 375$.

Uniqueness

This equilibrium is also unique. Let's consider three cases:

1) Any regime in which Buyers hold cash is not going to be optimal given risk-neutrality. It is also obvious that no Buyer would borrow through contracts $j > 375$.

2) Consider all regimes with $j < 375$ and Buyers holding all the assets. For the sake of concreteness, consider the same regime assumed in the FA-economy with $j = 100$. As we saw before in this case $p = 200, b_{j=100} = 100$. But this would not be a genuine equilibrium, since Buyers would like to sell risky debt contracts: $\frac{.8(500-j)}{p-\pi} = 3.2$, for $j = 100$, whereas $\frac{.8(500-j)}{p-\pi} = 3.22$, for $j = 101$. By continuity this argument rules out all regimes with $j < 375$ and Buyers holding all the assets.

3) Consider all the regimes with $j < 375$ and Buyers share assets with the Sellers. Again for concreteness consider $j = 100$. In this case, $p = 180$, for the Sellers to hold it in equilibrium. From the Buyers budget constraint we have that $y^O = 3.75$, which clearly is not an equilibrium for any $j \geq 100$. Next, consider same portfolio regime but for a lower debt contract, say $j = 10$. In this case $y^O = 1.7$, which is a feasible number. But the expected return is given by $\frac{.8(500-10)}{180-10} = 2.3$, whereas a deviation to $j = 11$ would yield a higher return of $\frac{.8(500-11)}{180-11} = 2.31$.

Robustness

Default is a robust feature of the NFA-economy. As explained in Section 2 the parameter values in Tables 1 and 4 were chosen so as to keep agents' asset valuation constant across economies. However, provided that there is enough differences in asset payoffs across agents, default will always occur in equilibrium.

In particular, given the parameters $(D_H^S, D_L, q, m^B, m^S, a^B, a^S)$ there exists $\hat{D}_H^B > D_H^S$ such that for all $D_H^B > \hat{D}_H^B$ there is default in equilibrium, so that $j > 100$. This follows from the following function derived from (6), (7) and (8):

$$F(j, \hat{D}_H^B) = -m^B + (a^B + a^S)(q\hat{D}_H^B + (1-q)D_L) - (a^B + a^S)(qj + (1-q)100) = 0.$$

This expression defines an increasing function $\hat{D}_H^B(j)$. For the parameter values in Table 4, $\hat{D}_H^B = 225$. Hence for differences in payoffs in the state High of less or equal than 25, Buyers would be able to pay their whole valuation of the asset borrowing

through debt contracts that do not default. For higher differences, equilibrium will always involve default.

Market Segmentation Model

Note that, although the payoff of the contract depends on its seller, this is still a competitive general equilibrium model, albeit with market segmentation. In particular, we can think of a promise sold by a Buyer as a different contract—and one that only Buyers can sell—than a promise sold by a Seller. In such a model j is a function of the type i, $j(i)$. Given our parameterization in Table 4, only Buyers borrow in equilibrium and therefore only contracts $j(B)$, sold by Buyers and backed by assets held by Buyers, are traded. For this reason, for the sake of keeping the notation simple, we refer to these contracts as contract j (similarly to what we do in Section 2.3). The whole equilibrium would be $(p, b_{j(B)}, j(B), y^S, w^S, \varphi^S_{j(B)}) = (420, 320, 375, 0, 300, 3)$, $\varphi_{j(B)} = 0, \forall j(B) \neq 375$ and prices for the non traded contracts as $b_{j(B)} = q^S min\{j(B), 500\} + (1 - q^S) min\{j(B), 100\}$, $\forall j(B) \neq 375$ and $\varphi_{j(S)} = 0, \forall j(S)$ and prices for the non-traded contracts as $b_{j(S)} = q^S min\{j(S), 500\} + (1 - q^S) min\{j(S), 100\}$, $\forall j(S)$.

Borrowing while holding positive cash under non-recourse contracts

As discussed in Section 4.4 of the paper, in the NFA-treatment, not only Buyers borrow more than in the FA-treatment, but they maintain significantly larger cash balances at the end of the round. This puzzling behavior can be explained by the coexistence of non-recourse debt with Buyers' desire to protect themselves in case state Low is realized. We now present a formal argument to show that this behavior can be optimal.

Consider the FA and NFA economies with the same parameter values as in Tables 1 and 4 of Section 2, but with risk-averse agents. Suppose agents have a CRRA payoff function for state $s = High, Low$ given by:

$$u^i(x_s) = \begin{cases} \frac{x_s^{\beta_i}}{\beta_i}, & \beta_i \neq 0, \\ log(x_s), & \beta_i = 0, \end{cases} \tag{12}$$

We solve for equilibrium for different parameters of risk aversion corresponding to mild levels of risk-aversion a(see Holt and Laury, 2002). Tables 1 and 2 present the

equilibrium values in both the FA and the NFA-economy.

Table 1: FA-equilibrium.

β	j	p	b_j	w^B	y^B
0.70	100	200	100	0.3	3
0.6	100	199	100	2	3
0.5	100	197	100	8	3

This table shows the equilibrium in the FA-economy for different parameters of risk aversion.

Table 2: NFA-equilibrium.

β	j	p	b_j	w^B	y^B
0.70	420	397	337	120	3
0.6	418	388	329	123	3
0.5	416	379	321	125	3

This table shows the equilibrium in the NFA-economy for different parameters of risk aversion.

In the FA-economy, Buyers hold (almost) no cash and borrow using the maxmin contract (as in the risk-neutral case). On the other hand, as discussed in Section 4.4, the behavior in the NFA-economy is very different to the one in the risk-neutral equilibrium of Section 2 of the paper. Buyers, while still buying all the asset supply on margin through risky bonds, hold cash in equilibrium. They do so by spending less than their overall cash endowment on downpayment.

Appendix II: Empirical Analysis

Results across Paid and Non-Paid Rounds

Table 3: Final Asset Allocations.

	FA		NFA	
Session	Buyers	Sellers	Buyers	Sellers
1	2.60	0.40	2.85	0.15
2	2.57	0.43	2.78	0.22
3	2.78	0.22	3.00	0.00
4	2.86	0.14	2.93	0.07
5	2.79	0.21	2.95	0.05
All	2.73	0.27	2.90	0.10

This table shows average final asset holdings of Buyers and Sellers in each session across both paid and unpaid rounds of all sessions and by session.

Table 4: Number of Trades per Round.

Session	FA	NFA
1	15.60	17.08
2	15.40	16.67
3	16.67	18.00
4	17.17	17.60
5	16.75	17.70
All	16.38	17.37

This table shows the mean number of trades per round in each session across both paid and unpaid rounds of all sessions and by session.

Table 5: Proportion of Transactions that Default.

	Low State		High State	
Session	FA	NFA	FA	NFA
1	0.06	0.94	0.00	0.00
2	0.13	0.83	0.00	0.00
3	0.65	0.85	0.00	0.00
4	0.35	0.71	0.00	0.00
5	0.68	0.97	0.00	0.01
All	0.46	0.86	0.00	0.00
Predicted	0	1	0	0
FA vs. NFA	0.06			

This table shows the proportion of transactions that default in each treatment across paid and unpaid Low rounds of all sessions and by session. The last rows report p-values from Wilcoxon signed-rank tests on the nulls that FA proportions equal NFA proportions.

Table 6: Default Distributions in the Low State.

	Round		Buyer	
Statistic	FA	NFA	FA	NFA
P10	1	13	0	1
P25	5	14	0	2
Median	8	15	2	5
P75	12	17	5	9
P90	12	18	14	15

This table shows the distribution of defaults per Low round and the distribution of defaults per Buyer for the FA and NFA-treatments across both paid and unpaid rounds of all sessions and by session.

Table 7: Average Default Loss.

	Low State	
Session	FA	NFA
1	21	214
2	17	99
3	79	123
4	29	134
5	87	257
All	54	155
Predicted	0	275
FA vs. NFA	0.06	

This table shows the average loss from default in paid and unpaid Low rounds of all sessions and by session. The last rows reports the p-value from a Wilcoxon signed-rank test on the nulls that average losses in the FA-treatment equal those in the NFA-treatment.

Table 8: Mean and Median Promise.

	FA		NFA	
Session	Mean	Median	Mean	Median
1	116	100	283	250
2	152	100	191	181.5
3	166	170	275	280
4	108	100	198	162.5
5	169	150	360	400
All	143	100	260	236
Predicted	100	100	375	375
Actual vs. Theory	0.06		0.06	
FA vs. NFA	0.06			

This table shows the mean and median promise across paid and unpaid Low rounds of all sessions and by session. The last two rows report p-values from Wilcoxon signed-rank tests on the nulls that means equal their theoretical values and that FA means equal NFA means.

Table 9: Distribution of Average Promises.

	Round		Buyer	
Statistic	FA	NFA	FA	NFA
P10	97	171	51	94
P25	109	186	90	130
Median	142	234	130	223
P75	173	324	176	296
P90	186	388	201	371

This table shows the distribution of average promises per round and per Buyer across paid and unpaid Low rounds of all sessions and by session.

Table 10: Descriptive Statistics for Promises Greater than 100.

	Pr(j > 100)		Mean | j > 100	
Session	FA	NFA	FA	NFA
1	0.212	0.859	279	318
2	0.312	0.830	295	215
3	0.680	0.939	202	288
4	0.330	0.619	189	277
5	0.687	0.938	227	381
All	0.461	0.838	225	297
FA vs. NFA	0.06		0.19	

This table shows descriptive statistics for promises greater than 100 computed across paid and unpaid Low rounds of all sessions and by session. The last row reports p-values from Wilcoxon signed-rank tests on the null FA values equal NFA values.

Table 11: Mean and Median Downpayment.

	FA		NFA	
Session	Mean	Median	Mean	Median
1	112	100	76	50
2	98	100	71	50
3	94	90	63	50
4	75	75	66	50
5	93	100	43	35
All	93	100	64	50
Predicted	100	100	100	100
Actual vs. Theory	0.44		0.06	
FA vs. NFA	0.06			

This table shows the mean and median downpayment in each session across paid and unpaid Low rounds of all sessions and by session. The last rows report p-values from Wilcoxon signed-rank tests on the null that median in the FA and NFA-treatment are the same.

Table 12: Average Final Cash.

	FA		NFA	
Session	Buyers	Sellers	Buyers	Sellers
1	10	290	82	218
2	49	251	103	197
3	39	261	110	190
4	85	215	107	193
5	40	261	174	126
All	46	254	113	187
Buyers vs. Sellers	0.06		0.13	
FA vs. NFA	0.06	0.06		

This table shows the average final cash holdings for Buyers and Sellers in each session, across both paid and unpaid rounds. The last two rows report p-values from Wilcoxon signed-rank tests on the nulls that FA means equal NFA means for a subject type and that buyer means equal seller means for a treatment.

Table 13: Proportion of Cash-constrained Buyers.

	Proportion Constrained	
Session	FA	NFA
1	0.98	0.54
2	0.77	0.43
3	0.86	0.40
4	0.51	0.48
5	0.83	0.22
All	0.79	0.42
FA vs. NFA	0.06	
Rounds per Median Buyer	5	2
Buyers per Median Round	10	4.5

This table shows the proportion of cash-constrained buyers, the number of rounds in which the median buyer is constrained, and the number of buyers that are cash-constrained in the median round computed across paid and unpaid Low rounds of all sessions and by session. The last row reports p-values from Wilcoxon signed-rank tests on the null that FA statistics equal their NFA counterparts. A buyer is defined to be cash-constrained if at the end of a round, the buyer's final cash holdings are strictly smaller than the average downpayment during the round.

Default Results for Sellers' Low State of the World

Table 14: Proportion of Transactions that Default according to Sellers' State of the World.

	Low State		High State	
Session	FA	NFA	FA	NFA
1	0.01	0.94		0.00
2	0.04	0.83	0.00	0.00
3	0.11	1.00	0.00	0.00
4	0.17	0.71	0.00	0.00
5	0.53	1.00	0.00	0.01
All	0.17	0.86	0.00	0.00

This table shows the proportion of transactions that default across all paid Low rounds according to Sellers' state of the world for all sessions and by session.

Non-parametric tests

This table summarizes all significance tests that are referred to in the paper.

	FA vs. NFA	Buyers vs. Sellers	Actual vs. Theory	Early vs. Rounds 7-8	$j < 100$ vs. $j = 100$	$j \leq 100$ vs. $j > 100$
Low-Round Default	0.06					
Low-Round Default Loss	0.06					
Constrained Buyer	0.06					
$j > 100$	0.06					
Cash						
Buyers	0.06					
Sellers	0.06					
FA		0.06				
NFA		0.19				
Promise	0.06					
$j > 100$	0.19					
FA			0.06			
FA, Practice			0.06	0.13		
FA, Rounds 1-2			0.06	0.06		
FA, Rounds 3-6			0.13	0.06		
FA, Rounds 7-8			0.31			
NFA			0.13			
NFA, Practice			0.06	0.06		
NFA, Rounds 1-2			0.06	0.06		
NFA, Rounds 3-6			0.13	0.06		
NFA, Rounds 7-8			0.44			
Downpayment	0.06					
$j < 100$	0.13					
$j = 100$	0.38					
$j > 100$	0.63					
FA			0.44			
FA, Practice			0.44	0.19		
FA, Rounds 1-2			1.00	0.13		
FA, Rounds 3-6			0.63	0.31		
FA, Rounds 7-8			0.06			
FA, $j < 100$					0.06	0.06
FA, $j = 100$						0.06
NFA			0.06			
NFA, Practice			0.06	0.06		
NFA, Rounds 1-2			0.06	0.13		
NFA, Rounds 3-6			0.06	0.19		
NFA, Rounds 7-8			0.06			
NFA, $j < 100$					0.25	0.06
NFA, $j = 100$						0.13

Appendix III: Instructions and Screenshots

Instructions

Thank you for participating in today's experiment. You have earned $5 for arriving on time. What you earn in this experiment will be added to this $5. If you read these instructions carefully, you have the potential to earn significantly more.

In the experiment, you will earn Experimental Dollars (E$), which will be converted into cash at the end. For every E$35 you have at the end of the experiment, you will be paid $1 in cash.

You will participate in the experiment along with 11 other students. We will never reveal your identity to other participants, and you will never receive any information about the identity of other participants. During the experiment, you are not allowed to talk to other participants or to use cell phones. If you have any questions, please raise your hand, and an experimenter will assist you.

The experiment consists of two parts: Parts A and B. First, read the instructions for Part A. After reading these instructions, you will answer a brief questionnaire, and then play Part A. After you finish playing Part A, we will distribute the instructions for Part B, and you will play Part B.

Instructions for Part A

This part of the experiment consists of 12 rounds.

- The first 4 rounds are for practice only and will not affect how much you will be paid.
- The following 8 rounds will be used to determine how much you will be paid at the end of the experiment.
- In each round of the experiment, you will buy or sell "widgets" by trading with other participants.

Buyers and Sellers

At the beginning of the experiment

- You are randomly assigned to be a Buyer or a Seller (this information is on the left corner of your computer screen).
- 6 of you will be Buyers, 6 of you will be Sellers.
- You keep the same role throughout the experiment.

Description of each round

In each round, Buyers can buy widgets from Sellers and Sellers can sell widgets to Buyers.

At the beginning of each round, Buyers are given an endowment of E$300 and Sellers are given an endowment of 3 widgets. You can find this information in the left column of the screen, where your ***Widgets*** and ***Cash*** are indicated.

Widgets

At the end of each round, the value of the widgets will be either

High: E$**500.**

Low: E$**100.**

At the end of each round, after trading has ended, we will pick a ball from a bag with five numbered balls, from 1 to 5:

- For Buyers: if the number of the ball is 1, the final value of all widgets is Low (E$100). If the number is 2 or higher, the final value of all widgets is High (E$500). Hence, the chance of the final value being High is 80% for Buyers.
- For Sellers: if the number on the ball is 4 or lower, the final value of all widgets is Low (E$100). If the number is 5, the final value of all widgets is High (E$500). Hence, the chance of the final value being High is 20% for Sellers.

This is summarized in the following table:

Ball Number	**1**	**2**	**3**	**4**	**5**
Buyers	Low (100)	High (500)	High (500)	High (500)	High (500)
Sellers	Low (100)	Low (100)	Low (100)	Low (100)	High (500)

Note that if the number on the ball is 1, the final value of the widgets is Low (E$100) for both Buyers and Sellers. If the number on the ball is 5, the final value of the widgets is High (E$500)

for both Buyers and Sellers. If the number on the ball is between 2 and 4, the final value of each widget is High (E$500) for Buyers, but Low (E$100) for Sellers.

In each round, we pick the ball from a new bag. This means that the chance of the value being High or Low does not depend on the value in previous rounds.

Trading

In each round, trading takes place for 200 seconds. During trading, Buyers submit *Buy Offers* and Sellers submit *Sell Offers*. A Buy or Sell Offer is for 1 widget. A Buyer can accept any Sell Offer and a Seller can accept any Buy Offer. Both buyers and sellers can also cancel their own offers.

When a Buyer and a Seller make a trade, they agree on a **Downpayment** and a **Promise.**

- The **Downpayment** is what the Buyer pays immediately at the time of the trade.
- The **Promise** is what the Buyer promises to pay at the end of the round.

Buying and selling happen in two ways: either a Seller accepts a Buy Offer or a Buyer accepts a Sell Offer.

Only Buyers can make Buy offers and only Sellers can make Sell Offers. Once a Buyer has a widget, (s)he cannot sell it, and once a Seller has cash, (s)he cannot use it to buy widgets.

Buy Offers

In a Buy Offer, a Buyer indicates the Downpayment that (s)he is willing to pay immediately and a Promise of payment at the end of the round. For example, a buyer may post a Buy Offer with a Downpayment of E$50, and a Promise of E$200 to be paid at the end.

If you are a Buyer, you can post a Buy Offer by filling in:

1) The Downpayment.
2) The Promise.

After reviewing the information, you can complete the offer by clicking ***Place Offer.***

You can submit as many Buy Offers as you like. However, you will not be able to post Buy Offers with Downpayment greater than the cash available to you. For example, if you have E$100 in cash, you can post as many Buy Offers as you want as long as the Downpayment of each Buy Offer is no more than E$100.

On the top left corner of the screen, you can see the ***Open Buy Offers***, where your outstanding Buy Offers are displayed along with those of the other Buyers (you can see all the offers by scrolling through them; your own offers are indicated by an asterisk in the left column). For each offer, you can see the Downpayment and the Promise. By clicking ***Cancel***, you can cancel any offer you posted that has not been executed.

Sell Offers

Similarly, in a Sell Offer a Seller indicates the Downpayment (s)he wants to receive at the time of the trade and the Promise for future payment (s)he is willing to accept. For example, a Seller may ask a Downpayment of E$50, and a Promise of future payment of E$300.

If you are a Seller, you can post a Sell Offer by indicating:

1) The Downpayment
2) The Promise

After reviewing the information, you can complete the offer by clicking ***Place Offer.*** On the top right of the screen, you can see the ***Open Sell Offers,*** where your outstanding Sell Offers are displayed along with those of the other Sellers (you can see all the offers by scrolling through them; your own offers are indicated by an asterisk in the left column). For each offer, you can see the Downpayment and the Promise. By clicking ***Cancel,*** you can cancel any offer you posted that has not been executed.

As a Seller, you can submit as many Sell Offers as you want as long as you have widgets left to sell (otherwise you will receive a warning message).

Exchange

A trade takes place whenever a Buyer accepts a Sell Offer, or a Seller accepts a Buy Offer. If you want to accept a Sell Offer, you can click on the offer you like and then click ***Buy***. If you want to accept a Buy Offer, you can click on the offer you like and then click ***Sell***.

When the trade takes place, the widget is transferred from the Seller to the Buyer, and the Downpayment is transferred from the Buyer to the Seller.

If you are a Buyer, when you buy a widget, your Cash is reduced by the amount of the Downpayment, and your Widget account is increased by one. If you are a Seller, when you sell a widget, your Cash is increased by the amount of the Downpayment, and your Widget account is decreased by one. This information is reflected in ***Cash*** and ***Number of Widgets*** in the left column. You can see all the information about past trades on the bottom of the screen under ***Past Trades*** (your own trades are market with an asterisk).

Finally, after a trade takes place the computer automatically deletes your outstanding Buy Offers that you can no longer afford with the remaining cash. And it deletes all your outstanding Sell Offers if you have no widgets left to sell.

The Final Payment

- At the end of the round, the Buyer must pay the Promise to the Seller.
- **BUT:** the Buyer will never pay more than the final value of the widget to Buyers and the Seller will never receive more than the final value of the widget to Sellers.

Example: Suppose a Buyer and a Seller trade a widget with a Downpayment of E$100 at the time of the trade, and a Promise of E$300.

How much does the Buyer pay? When the trade takes place, the Buyer pays the Downpayment of E$100. Remember that the Promise is E$300. However, depending on the widget's value at the end of the round, the Buyer might not need to pay the entire Promise to the Seller. If, at the end of the round, the widget is worth E$500 to the Buyer (High Value), (s)he pays the entire Promise (E$300) to the Seller. If, however, the widget is only worth E$100 to the Buyer (Low value), (s)he only pay E$100.

Hence, Buyers may not have to pay the full agreed-upon Promise if the value of the widget to Buyers is Low.

How much does the Seller gets paid? The Seller receives the Downpayment of E$100 at the time of the trade. If, at the end of the round, the widget is worth E$500 to him/her, (s)he receives the entire Promise E$300. If, at the end of the round, the widget is only worth E$100 to him/her, (s)he only receives E$100.

Hence, Sellers may not receive the full agreed-upon Promise, when the value of the widget to Sellers is Low.

Note that in some rounds the value of the widget may be High (E$500) for Buyers, but Low (E$100) for Sellers. In this case, it is possible that a Buyer pays the entire Promise (because it is less than E$500), but a Seller only receives E$100 (in which case, the experimenter pockets the difference).

To summarize, for Buyers, the final payment is the minimum of the value of the widget to Buyers and the Promise. For Sellers, the final payment received is the minimum of the value of the widget to Sellers and the Promise.

The Profit from each Trade

For a Buyer, the Per-Trade Profit from buying one widget is:

Per-Trade Profit = Final Value to Buyer – Downpayment – Final Payment =

Final Value to Buyer – Downpayment – Minimum of Promise and Final Value to Buyer

For a Seller, the Per-Trade Profit from selling a widget is:

Per-Trade Profit = (Downpayment + Final Payment) – Final Value to Seller =

(Downpayment + Minimum of Promise and Final Value to Sellers) – Final Value to Seller

So, a Buyer's Per-Trade Profit is the difference between the value of the widget to him/her and the total amount (s)he paid for the widget (Downpayment + Final Payment). A Seller's Per-Trade Profit is the difference between the total amount (s)he was paid for the widget (Downpayment + Final Payment) and the final value of the widget to him/her.

Example: Suppose a Buyer and a Seller trade a widget with a Downpayment of E$50 and a Promise of E$300.

The Buyer pays the Seller E$50 at the time of the trade. At the end of the round, (s)he pays the minimum of the Promise (E$300) and the value of the widget to Buyers:

- If the widget is worth E$500 to Buyers, (s)he repays the entire Promise (E$300), and the overall cost of the widget to the Buyer is E$50 + E$300 = E$350. The Buyer's Per-Trade Profit is E$500 - E$50 - E$300 = E$150.

- If the widget is worth only E$100 to Buyers, (s)he only pays E$100 at the end of the round, and the overall cost of the widget is E$50 + E$100 = E$150, which is less than the sum of Downpayment and Promise. In this case, his/her Per-Trade Profit is E$100 – E$150 = - E$50 (negative E$50). Note that, as in this example, the Per-Trade Profit can be negative (that is, it can be a Per-Trade Loss).

The Seller receives the Downpayment of E$50 from the Buyer at the time of the trade. At the end of the round, (s)he gets back the minimum of the Promise (E$300) and the value of the widget to Sellers:

- If the widget is worth E$500 to Sellers, (s)he receives the entire promise (E$300) and the overall amount the Seller receives from selling the widget is E$50 + E$300 = E$350, which equals the sum of Downpayment and Promise. The Per-Trade Profit to the Seller is E$350 minus the final value of the widget to the Seller, that is, E$350 – E$500 = -E$150 (negative 150), a Per-Trade Loss.

- But if the widget is worth only E$100 to Sellers, (s)he receives only E$100 at the end of the round and the overall amount the Seller receives from selling the widget is only E$50 + E$100 = E$150, which is less than the agreed-upon sum of Dowpayment and Promise. The Per-Trade Profit to the Seller is E$150 minus the final value of the widget to the Seller, that is, E$150 – E$100 = E$50.

The Per-Round Profit

As we said, in each round we give Buyers an initial endowment of E$300, and Sellers an initial endowment of 3 widgets, so that Sellers can sell the widgets and Buyers can buy them. At the end of the round, we will take these initial endowments back, so that the Per-Round Profit only depends on the profits or losses made while trading and not on the initial endowment.

As a result, your Per-Round Profit is ***the sum of the Per-Trade Profits from each of your trades*.**

At the end of the round, your screen will show the Final Value of the widget, the Per-Trade Profits of each trade, and the Per-Round Profit for that round. Note that the Per-Round Profit can be positive or negative depending on whether you made or lost money in the round.

Other Rounds

After the first round ends, you will move to the next round, until round 12. At the beginning of each round, you will be given cash (if you are a Buyer) or widgets (if you are a Seller) to be able

to trade in the round. Each round is separate: **you will not be able to use the widgets or cash from previous rounds**.

Part B of the Experiment

After Part A ends, you will read the Instructions for Part B and then play Part B, which only consists of 10 rounds. When Part B ends, we will discard the first 2 rounds, which are for practice only.

Final Payoff

At the end of the experiment, we will randomly select ONE round in order to calculate your final payoff. This round is chosen out of 16 rounds: the last 8 rounds of Part A, and the last 8 rounds of Part B.

Your Final Payoff will be

The Chosen Per-Round Profit +1,200

We add E$1,200 to the chosen Per-Round Profit to ensure that you never end up with a negative Final Payoff.

Finally, we will convert your Final Payoff from E$ into US Dollars at the exchange rate of E$35 per $1. To this amount we will add the $5 participation fee, and pay you.

This is the end of the instructions for Part A. If you have any questions, please raise your hand and an experimenter will assist you privately.

Instructions for Part B

The experiment in Part B is like the experiment in Part A except for four differences:

1) The value of the widget when it is High.

2) How the value of the widget is determined.

3) How the profit from each trade is computed.

4) Number of rounds

1) The Final Value of the Widget.

In Part B, when the final value of the widget is High, it is worth E$500 for Buyers but only E$200 for Sellers (in contrast, in Part A the widget was worth E$500 for both Buyers and Sellers when it was High). So, at the end of each round, the final value of the widgets will be either

High: E$**500** for Buyers and E$**200** for Sellers

or

Low: E$**100** for both Buyers and Sellers

Note that when the final value of the widget is High, it is worth E$500 for Buyers but only E$200 for Sellers.

2) How we determine the Final Value of the Widget.

In Part B, the widget will either be High for everyone or Low for everyone (in contrast, in Part A the widget final value could be High for Buyers but Low for Sellers).

As in Part A, at the end of each round, we pick a ball from a bag with five numbered balls, from 1 to 5. If the number of the ball is 1, the final value of all widgets is Low (E$100). If the number is 2 or higher, the final value of all widgets is High (E$500 for Buyers and E$200 for Sellers).

The following table summarizes this information:

Ball Number	**1**	**2**	**3**	**4**	**5**
Value of the Widgets	Low	High	High	High	High
Value for Buyers	100	500	500	500	500
Value for Sellers	100	200	200	200	200

To summarize: in Part B: 1) the final value of the widget is either High for both Buyers and Sellers, or Low for both Buyers and Sellers and 2) when the final value of the widget is High, it is worth E$500 to Buyers but only E$200 to sellers.

3) The Final Payment and the Profit from each Round

Similarly to Part A, at the end of the round, the Buyer must pay the Promise to the Seller. However, the Buyer will never pay more and the Seller will never receive more than the final value of the widget to Buyers. That is, in order to determine how much Buyers pay Sellers only the value of the widget to Buyers is what matters.

Note that this is different to what happened in Part A. In Part A, the Seller never received more than the final value of the widget to Sellers. As a result, in Part A, it was possible that a Buyer paid the entire Promise (e.g., when the Buyer's final value was 500 and the promise was smaller), but a Seller only received E$100 (because the Seller's final value was 100). This never happens in Part B. If the Promise is lower than the Buyer's final value, the Buyer pays it in its entirety, and the Seller receives the amount that the Buyer pays (even if the payment is higher than the value of the widget to Sellers).

As a result, for Buyers the Per-Trade Profit from buying one widget is:

Per-Trade Profit = Final Value to Buyer – Downpayment – Final Payment =

Final Value to Buyer – Downpayment – Minimum of Promise and Final Value to Buyers

For a Seller, the Per-Trade Profit from selling a widget is:

Per-Trade Profit = (Downpayment + Final Payment) – Final Value to Seller =

(Downpayment + Minimum of Promise and Final Value **to Buyers**) – Final Value to Sellers

Example: Suppose a Buyer and a Seller trade a widget with a Downpayment of E$50 and a Promise of E$300.

The Buyer pays the Seller E$50 at the time of the trade. At the end of the round, (s)he pays the Seller the minimum of the Promise (E$300) and the value of the widget to Buyers:

- If the state is High, *the widget is worth E$500 to Buyers and E$200 to Sellers*.
    - The Buyer repays the entire Promise (E$300). The overall cost of the widget to the Buyer is E$300 + E$50 = E$350. The Buyer's Per-Trade Profit is E$500 - E$300 - E$50 = E$150.
    - The Seller receives the entire Promise (E$300). The overall amount the Seller receives from selling the widget is E$300 + E$50 = E$350, which equals the sum of Downpayment and Promise. The Per-Trade Profit to the Seller is E$350 minus the final value of the widget to the Seller, that is, E$350 – E$200 = E$150.

- If the state is Low, *the widget is worth only E$100 to Buyers and Sellers*.
    - The Buyer only pays E$100 at the end of the round. The overall cost of the widget is E$50 + E$100 = E$150, which is less than the sum of Downpayment and Promise. In this case, his/her Per-Trade Profit is E$100 – E$150 = - E$50 (negative E$50). Note that, as in this example, the Per-Trade Profit can be negative (that is, can be a Per-Trade Loss).
    - The Seller receives only E$100 at the end of the round. The overall amount the Seller receives from selling the widget is only E$50 + E$100 = E$150, which is less than the agreed-upon sum of Dowpayment and Promise. The Per-Trade Profit to the Seller is E$150 minus the final value of the widget to the Seller, that is, E$150 – E$100 = E$50.

The Rounds of the Experiment

Unlike Part A, you will only play for 10 rounds. In particular, you will only have two practice rounds. The profit for these first 2 rounds will not be considered to calculate your Final Payoff, since they are just for practice.

At the end of the experiment, we will randomly select ONE round in order to calculate your Final Payoff. This round is chosen from the last 8 rounds of Part A, and the last 8 rounds of Part B.

Your Final Payoff will be:

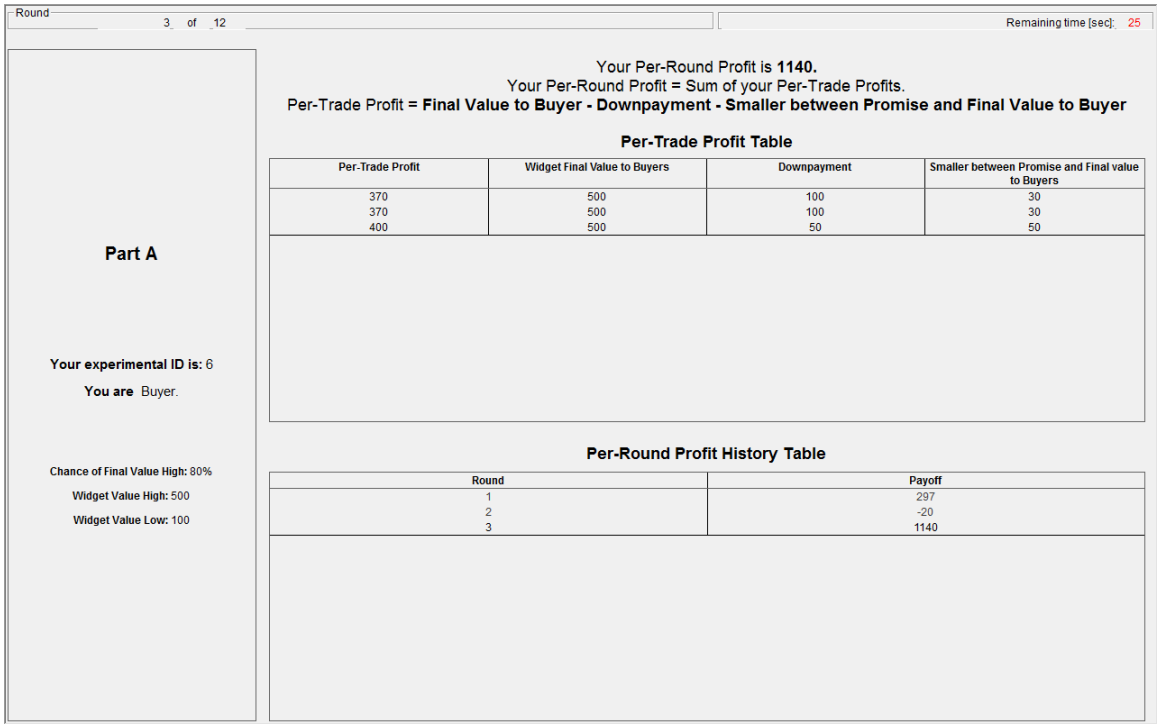
The Chosen Per-Round Profit +1,200

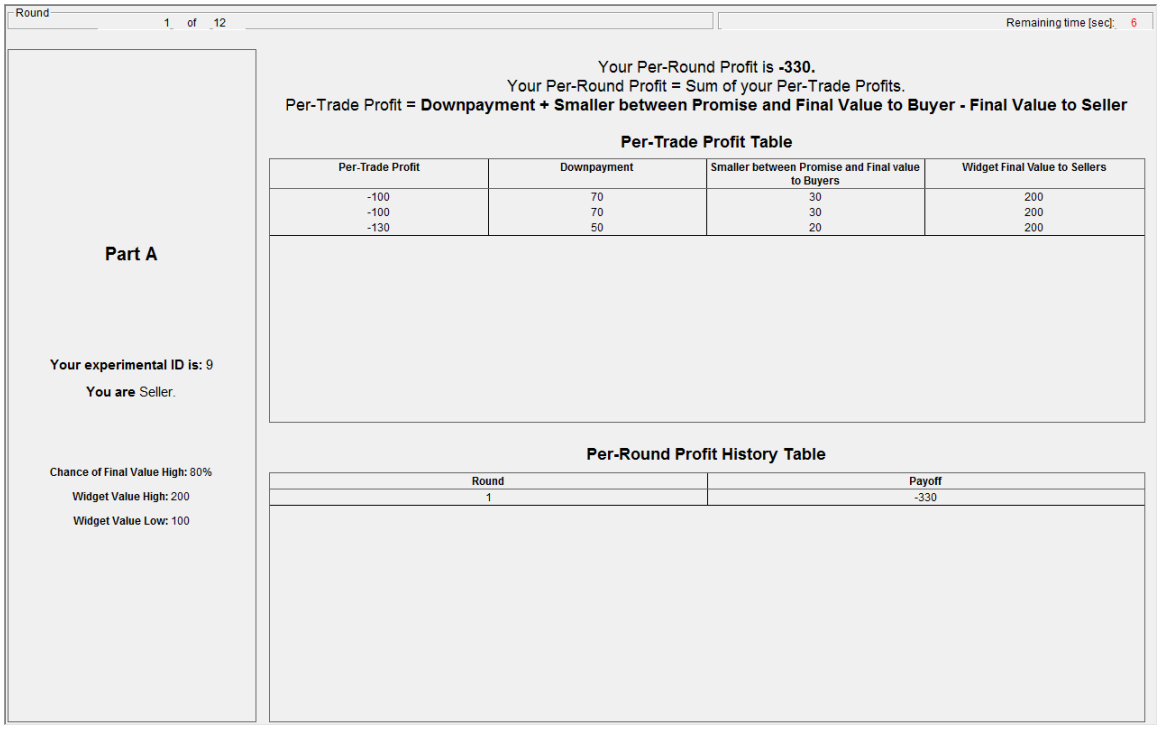
We add E$1,200 to the chosen Per-Round Profit to ensure that you never end up with a negative Final Payoff.

Finally, we will convert your Final Payoff from E$ into US Dollars at the exchange rate of E$35 per $1. To this amount we will add the $5 participation fee, and pay you.

This is the end of the Instructions for Part B. If you have any questions, please raise your hand and an experimenter will assist you privately.

Screenshots




Round
1 of 12
Remaining time [sec]: 6
Part A
Your experimental ID is: 9
You are Seller.
Chance of Final Value High: 80%
Widget Value High: 200
Widget Value Low: 100
Your Per-Round Profit is -330.
Your Per-Round Profit = Sum of your Per-Trade Profits.
Per-Trade Profit = Downpayment + Smaller between Promise and Final Value to Buyer - Final Value to Seller
Per-Trade Profit Table
Per-Trade Profit
Downpayment
Smaller between Promise and Final value to Buyers
Widget Final Value to Sellers
-100 70 30 200
-100 70 30 200
-130 50 20 200
Per-Round Profit History Table
Round
Payoff
1 -330