An Experiment on Retail Payments Systems: Supplementary Information (not for publication)

Gabriele Camera
Chapman University
University of Basel

Marco Casari
University of Bologna
IZA

Stefania Bortolotti
University of Cologne

In this appendix we firs present some details of the theoretical derivations. Subsequently, we include additional Tables. Finally, we present the instructions for the Reward treatment.

A Deriving the symmetric equilibrium

We derive the symmetric equilibrium μ_b and μ_s for each treatment using a constructive method. Let x, y denote arbitrary numbers in the open unit interval.

A.1 No-Fee

Here $r = 0$, $\varepsilon = 1$, hence $\eta_0 = \eta_1$. Consequently $p_M = p_E$ and $q_M = q_E$. We have:

$$\begin{aligned} \mathcal{V}_M^b - \mathcal{V}_E^b &= [u(q_M) - p_M q_M](\mu_s + \sigma - 1), \\ \mathcal{V}_M^s - \mathcal{V}_E^s &= -(1 - \mu_b)[q_M(p_M - g) - F] \end{aligned}$$

- $(\mu_b, \mu_s) = (0, 0)$ is always an equilibrium.
  Conjecture $\mu_b = 0$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). Given $\mu_s' = \mu_s = 0$ (symmetry), we have $\mathcal{V}_M^b - \mathcal{V}_E^b \leq 0$. If $\sigma < 1$, then $\mathcal{V}_M^b - \mathcal{V}_E^b < 0$; here (7) implies $\mu_b' = 0$. If $\sigma = 1$, then $\mathcal{V}_M^b - \mathcal{V}_E^b = 0$—in which case (7) implies $\mu_b' = [0, 1]$. Hence $\mu_b' = 0$ is always a best response when $\mu_s = 0$, and $(\mu_b, \mu_s) = (0, 0)$ is always an equilibrium.

- $(\mu_b, \mu_s) = (0, x), (0, 1)$ are never equilibria.
  Conjecture $\mu_b = 0$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). This contradicts $\mu_s' = \mu_s \in (0, 1]$ is a symmetric equilibrium.

- $(\mu_b, \mu_s) = (y, 0)$, is an equilibrium if $\sigma = 1$ but not if $\sigma < 1$.
  Conjecture $\mu_b = y \in (0, 1)$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$ (for the parameters selected, see discussion in the paper); Hence, $\mu_s' = 0$ from (9). When $\mu_s' = \mu_s = 0$ (symmetry), we have $\mathcal{V}_M^b - \mathcal{V}_E^b \leq 0$. If $\sigma = 1$, then $\mathcal{V}_M^b - \mathcal{V}_E^b = 0$ (< 0 if $\sigma < 1$), in which case (7) implies $\mu_b' = [0, 1]$. Hence any $\mu_b' = y \in (0, 1)$ is a best response when $\mu_s = 0$. Consequently, $(\mu_b, \mu_s) = (y, 0)$ is an equilibrium only if $\sigma = 1$.

- $(\mu_b, \mu_s) = (y, x), (y, 1)$ are never equilibria.
Conjecture $\mu_b = y \in (0, 1)$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). This contradicts $\mu_s' = \mu_s \in (0, 1]$ is a symmetric equilibrium.

- $(\mu_b, \mu_s) = (1, 0)$, is an equilibrium if $\sigma = 1$ but not if $\sigma < 1$.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s = 0$; Hence, $\mu_s' = [0, 1]$ from (9). Given $\mu_s' = \mu_s = 0$ (symmetry), it is clear that $\mathcal{V}_M^b - \mathcal{V}_E^b = 0$ only if $\sigma = 1$ (otherwise, it is < 0). In this case (7) implies $\mu_b' = [0, 1]$. Hence any $\mu_b' = 1$ is a best response to $\mu_s = 0$; and $(\mu_b, \mu_s) = (1, 0)$ is an equilibrium only if $\sigma = 1$.

- $(\mu_b, \mu_s) = (1, x), (1, 1)$ are equilibria with $x \in (1 - \sigma, 1)$.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s = 0$; Hence, $\mu_s' = [0, 1]$ from (9). If $\mu_s' = \mu_s > 1 - \sigma$ (symmetry), then $\mathcal{V}_M^b - \mathcal{V}_E^b > 0$. In this case, (7) implies $\mu_b' = 1$. Consequently, $(\mu_b, \mu_s) = (1, x)$ is an equilibrium if $\sigma < 1$ for any $x \in (1 - \sigma, 1)$. It should be clear that this equilibrium is not robust to small trembles in the choice of buyers. In that case $\mu_b < 1$, hence $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$. So $\mu_s' = 0$. Finally, it is clear that $(\mu_b, \mu_s) = (1, 1)$ is always an equilibrium.

A.2 Baseline

Here $r = 0$, $\varepsilon < 1$, hence $\eta_0 < \eta_1$. Consequently $p_M < p_E$ and $q_M > q_E$ for all $\mu_b < 1$, while $p_M = p_E$ and $q_M = q_E$ for $\mu_b = 1$. We have:

$$\begin{aligned}
\mathcal{V}_M^b - \mathcal{V}_E^b &= \mu_s \sigma [u(q_M) - p_M q_M] - (1 - \mu_s)[u(q_E) - p_E q_E](1 - \sigma), \\
\mathcal{V}_M^s - \mathcal{V}_E^s &= \mu_b \sigma \{q_M(p_M - g) - [q_E(p_E - g)]\} - (1 - \mu_b)[q_E(\varepsilon p_E - g) - F].
\end{aligned}$$

- $(\mu_b, \mu_s) = (0, 0)$ is always an equilibrium.
Conjecture $\mu_b = 0$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). Given $\mu_s' = \mu_s = 0$ (symmetry), we claim that $\mathcal{V}_M^b - \mathcal{V}_E^b \leq 0$. If $\sigma < 1$, then $\mathcal{V}_M^b - \mathcal{V}_E^b < 0$; here (7) implies $\mu_b' = 0$. If $\sigma = 1$, then $\mathcal{V}_M^b - \mathcal{V}_E^b = 0$—in which case (7) implies $\mu_b' = [0, 1]$. Hence $\mu_b' = 0$ is a best response when $\mu_s = 0$, and $(\mu_b, \mu_s) = (0, 0)$ is always an equilibrium.

- $(\mu_b, \mu_s) = (0, x), (0, 1)$ are never equilibria.
Conjecture $\mu_b = 0$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$. This contradicts $\mu_s' = \mu_s \in (0, 1]$ is a symmetric equilibrium.

- $(\mu_b, \mu_s) = (y, 0)$, is an equilibrium if $\sigma = 1$ but not if $\sigma < 1$.
Conjecture $\mu_b = y \in (0, 1)$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). Given $\mu_s' = \mu_s = 0$ (symmetry), $\mathcal{V}_M^b - \mathcal{V}_E^b \leq 0$. If $\sigma = 1$, then $\mathcal{V}_M^b - \mathcal{V}_E^b = 0$ (< 0 if $\sigma < 1$), in which case (7) implies $\mu_b' = [0, 1]$. Hence $\mu_b' = y$ is a best response when $\mu_s = 0$. Consequently, $(\mu_b, \mu_s) = (y, 0)$ is an equilibrium only if $\sigma = 1$.

- $(\mu_b, \mu_s) = (y, x), (y, 1)$ are never equilibria.
Conjecture $\mu_b = y \in (0, 1)$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). This contradicts $\mu_s' = \mu_s \in (0, 1]$ is a symmetric equilibrium.

- $(\mu_b, \mu_s) = (1, 0)$ is not an equilibrium if $\sigma < 1$, and it is an equilibrium otherwise.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s = 0$ because $p_E = p_M$, hence $q_M(p_M - g) = q_E(p_E - g)$. It follows that $\mu_s' = [0, 1]$ from (9). If $\mu_s' = \mu_s = 0$ (symmetry), then $\mathcal{V}_M^b - \mathcal{V}_E^b < 0$, as long as $\sigma < 1$, hence $\mu_b' = 0$, from (7), which is a contradiction. Otherwise, if $sigma = 1$ then $\mathcal{V}_M^b - \mathcal{V}_E^b = 0$; hence $\mu_b' = [0, 1]$, from (7), and $(\mu_b, \mu_s) = (1, 0)$ is an equilibrium.

- $(\mu_b, \mu_s) = (1, x)$ is an equilibrium if $\sigma < 1$ and $x > 1 - \sigma$.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s = 0$ because $p_E = p_M$, hence $q_M(p_M - g) = q_E(p_E - g)$. It follows that $\mu_s' = [0, 1]$ from (9). If $\mu_s' = \mu_s = x \in (0, 1)$ (symmetry), then $\mathcal{V}_M^b - \mathcal{V}_E^b = [u(q_M) - p_M q_M](\mu_s + \sigma - 1)$. If $\mu_s > 1 - \sigma$ we have $\mathcal{V}_M^b - \mathcal{V}_E^b > 0$. Hence, $\mu_b' = 1$ (from (7)). Consequently, $(\mu_b, \mu_s) = (1, x)$ is an equilibrium if $\sigma < 1$ for any $x \in (1 - \sigma, 1)$. This equilibrium is not robust to small trembles in the choice of buyers. In that case $\mu_b < 1$, hence $p_E > p_M$ and $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$. So $\mu_s' = 0$.

- $(\mu_b, \mu_s) = (1, 1)$ is always an equilibrium.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s = 0$ because $p_E = p_M$, hence $q_M(p_M - g) = q_E(p_E - g)$. It follows that $\mu_s' = [0, 1]$ from (9). If $\mu_s' = \mu_s = 1$ (symmetry), then $\mathcal{V}_M^b - \mathcal{V}_E^b > 0$. Hence, $\mu_b' = 1$, from (7) and $(\mu_b, \mu_s) = (1, 1)$ is an equilibrium.

A.3 Reward

Here $r = 0.05$, $\varepsilon < 1$, hence $\eta_0 < \eta_1$. We have $p_M < p_E$ and $q_M > q_E$ for all $\mu_b < 1$, while $p_M = p_E$ and $q_M = q_E$ for $\mu_b = 1$, with

$$\begin{aligned}
\mathcal{V}_M^b - \mathcal{V}_E^b &= \mu_s \sigma [u(q_M) - p_M q_M] - (1 - \mu_s)[u(q_E) - p_E q_E]\left(\frac{1}{1-r} - \sigma\right), \\
\mathcal{V}_M^s - \mathcal{V}_E^s &= \mu_b \sigma \{q_M(p_M - g) - [q_E(p_E - g)]\} - (1 - \mu_b)\left\{\frac{q_E}{(1-r)^2}(\varepsilon p_E - g) - F\right\}.
\end{aligned}$$

- $(\mu_b, \mu_s) = (0, 0)$ is always an equilibrium.
Conjecture $\mu_b = 0$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). Given $\mu_s' = \mu_s = 0$ (symmetry), $\mathcal{V}_M^b - \mathcal{V}_E^b < 0$ for any $\sigma \leq 1$; here (7) implies $\mu_b' = 0$. Hence $(\mu_b, \mu_s) = (0, 0)$ is always an equilibrium.

- $(\mu_b, \mu_s) = (0, x), (0, 1)$ are never equilibria.
Conjecture $\mu_b = 0$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$. This contradicts $\mu_s' = \mu_s \in (0, 1]$ is a symmetric equilibrium.

- $(\mu_b, \mu_s) = (y, 0)$, is never an equilibrium.
Conjecture $\mu_b = y \in (0, 1)$. In this case $\mathcal{V}_M^s - \mathcal{V}_E^s < 0$; Hence, $\mu_s' = 0$ from (9). Given $\mu_s' = \mu_s = 0$ (symmetry), $\mathcal{V}_M^b - \mathcal{V}_E^b < 0$ for all $\sigma \leq 1$. Hence, (7) implies $\mu_b' = 0$, which contradicts the conjecture $\mu_b = y \in (0, 1)$.

- $(\mu_b, \mu_s) = (y, x), (y, 1)$ are never equilibria.
Conjecture $\mu_b = y \in (0,1)$. In this case $\mathcal{V}^s_M - \mathcal{V}^s_E < 0$; Hence, $\mu'_s = 0$ from (9). This contradicts $\mu'_s = \mu_s \in (0,1]$ is a symmetric equilibrium.

- $(\mu_b, \mu_s) = (1, 0)$ is never an equilibrium.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}^s_M - \mathcal{V}^s_E = 0$ because $p_E = p_M$, hence $q_M(p_M - g) = q_E(p_E - g)$. It follows that $\mu'_s = [0,1]$ from (9). If $\mu'_s = \mu_s = 0$ (symmetry), then $\mathcal{V}^b_M - \mathcal{V}^b_E = [u(q_M) - p_M q_M](\frac{\mu_s - 1}{1-r} + \sigma) < 0$ always, hence $\mu'_b = 0$, from (7), which is a contradiction.

- $(\mu_b, \mu_s) = (1, x)$ is an equilibrium for $x \in (1 - \sigma(1-r), 1)$.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}^s_M - \mathcal{V}^s_E = 0$ because $p_E = p_M$, hence $q_M(p_M - g) = q_E(p_E - g)$. It follows that $\mu'_s = [0,1]$ from (9). If $\mu'_s = \mu_s = x > 1 - \sigma(1-r)$ (symmetry), then $\mathcal{V}^b_M - \mathcal{V}^b_E = [u(q_M) - p_M q_M](\frac{\mu_s - 1}{1-r} + \sigma) > 0$. Hence, $\mu'_b = 1$ (from (7)). Consequently, $(\mu_b, \mu_s) = (1, x)$ is an equilibrium for all σ for any $x \in (1 - \sigma(1-r), 1)$. This equilibrium is not robust to small trembles in the choice of buyers. In that case $\mu_b < 1$, hence $p_E > p_M$ and $\mathcal{V}^s_M - \mathcal{V}^s_E < 0$. So $\mu'_s = 0$.

- $(\mu_b, \mu_s) = (1, 1)$ is always an equilibrium.
Conjecture $\mu_b = 1$. In this case $\mathcal{V}^s_M - \mathcal{V}^s_E = 0$ because $p_E = p_M$, hence $q_M(p_M - g) = q_E(p_E - g)$. It follows that $\mu'_s = [0,1]$ from (9). If $\mu'_s = \mu_s = 1$ (symmetry), then $\mathcal{V}^b_M - \mathcal{V}^b_E > 0$. Hence, $\mu'_b = 1$, from (7) and $(\mu_b, \mu_s) = (1,1)$ is an equilibrium.

A.4 The interiority of equilibrium

The experimental parameters are given by

$$F = 15, g = 60, \theta = 169.5, \sigma = 1, \varepsilon = 0.9, r = 0.05, m \in [250, 350].$$

Buyers' payment constraint never binds in equilibrium, so q is interior for any value of μ_b that is consistent with equilibrium. To verify this note that

$$p_M q(p_M) = \frac{\theta^2}{2g}, \qquad p_E q(p_E(1-r)) = p_E k(r) q(p_E) = \frac{\theta^2}{2g} \times \frac{\eta_0}{\eta_1(1-r)^2}.$$

Given the parameters, we have $\frac{\theta^2}{2g} = 239.5 < m$; this implies that the equilibrium is always interior in the No-Fee treatment, whether or not sellers accept cash. We also have $\frac{\eta_0}{\eta_1} < 1$ when $r = 0$, which implies that if in the Baseline treatment sellers accept electronic payments, then buyers are never constrained in equilibrium. This is also true in the Baseline & Reward treatment since if sellers accept electronic payments, then $\mu_b = 0$; hence, $\frac{\eta_0}{\eta_1} = 0.9$, which implies $\frac{\eta_0}{\eta_1(1-r)^2} = 0.99$ because

$$\frac{1}{(1-r)^2} = 1.1.$$

It is also immediate that given the parameters, sellers who accept electronic payments make a positive profit also when a buyer pays cash, i.e., $F < q(p_E)(\varepsilon p_E - g)$ holds.

B Additional tables

Dep. var.: Payment method in comparison to the previous period				
1=switch; 0= no switch	Model 1		Model 2	
Failure t-1	0.808	***		
	(0.098)			
Electronic (median)	0.049		0.049	
	(0.244)		(0.244)	
Period	-0.025	***	-0.025	***
	(0.004)		(0.004)	
No-Fee treatment	-0.654	**	-0.654	**
	(0.271)		(0.271)	
Reward treatment	0.089		0.089	
	(0.248)		(0.248)	
Failure cash t-1			0.809	***
			(0.133)	
Failure electronic t-1			0.807	***
			(0.130)	
Constant	-0.905	***	-0.905	***
	(0.232)		(0.232)	
N.obs.	3168		3168	

Table B-1: Dynamics in adoption of payment methods by buyers

Notes: probit regression with individual random effects. Data for period 7-40. Symbols $***$, $**$, and $*$ indicate significance at the 1%, 5% and 10% level, respectively.

	Failed transactions (%)						
	Cash			Electronic			
	Time	Underpay	Total	Time	Underpay	Declined	Total
Baseline	52.1	47.9	100	3.9	13.7	82.4	100
No-Fee	55.6	44.4	100	8.1	29.7	62.2	100
Reward	64.7	35.3	100	15.4	9.2	75.4	100

Table B-2: Why transactions failed

Notes: Time= the transaction was not completed within the time limit. Underpay= the transaction was not completed because the buyer did not transfer a sufficient number of tokens to the seller. Declined= the seller did not accept electronic payments. Data for periods 7-40.

Dependent var.: Posted prices	Baseline Model 1	No-Fee Model 2	Reward Model 3	Switch Model 4	Electronic Declined Model 5
Accept electronic	18.260 **	-15.096	7.815	12.316 ***	
	(7.600)	(10.533)	(7.686)	(4.515)	
No-Fee treatment					29.258
					(24.275)
Rebate treatment					11.517
					(19.895)
Switch treatment					12.027
					(22.073)
Period	-0.295	-0.787 ***	-0.556 ***	-0.383 **	0.269
	(0.180)	(0.161)	(0.184)	(0.175)	(0.289)
Purdue	24.602 **	-20.561	-12.072		-11.884
	(11.516)	(18.108)	(12.466)		(17.876)
Constant	170.075 ***	233.780 ***	214.349 ***	216.204 ***	185.855 ***
	(11.481)	(16.528)	(11.736)	(14.569)	(19.561)
N.obs.	1088	1088	1088	1088	569
R squared	0.040	0.033	0.016	0.008	0.016

Table B-3: Treatment effect on prices

Notes: OLS regression with individual random effect. Symbols $***$, $**$, and $*$ indicate significance at the 1%, 5% and 10% level, respectively.

B.1 Bivariate probit model

Consider a bivariate probit model for a pair composed of a buyer i and a seller j for transaction t:

$$E^B_{it} = \beta^B X^B_{it} + \delta^B Z + \varepsilon^B_{it},$$
$$E^S_{jt} = \beta^S X^S_j + \delta^S Z + \varepsilon^S_{jt},$$

where E^B_{it} and E^S_{jt} take value 1 if electronic payments are adopted and 0 otherwise.

For the buyer's equation, the regressors are the treatment effects (No Fee, Reward) and individual characteristics in terms of the random endowment for the round t (Endowment), session location (Purdue), and a proxy for the reliability of cash payments (Low ability). This proxy is based on the number of cash transactions initiated but not completed in trial rounds 4, 5, and 6 where by design all subjects had to pay cash. "Low ability" takes value 1 for subjects who were not able to complete one or more cash transactions.

For the seller's equation, the regressors are the treatment effects (No Fee, Reward) and individual characteristics in terms of session location (Purdue).

Below, we report results from the joint estimation through a bivariate probit regression (Table B-4, Model 1).

Magnitude and significance of the coefficients are similar in the independent and in the joint probit regressions. As suggested by a Referee, we carried out a test of possible network externalities using the correlations of the residuals in the bivariate probit regressions. The estimated correlation coefficient for the two error terms, denoted by ρ, is positive; this suggests the possible presence of unobservable factors that are positively related to buyers' decisions and are also positively related to sellers' decisions. However, ρ is small and statistically not significant (p = 0.269).

We also estimate an additional specification of the bivariate probit. This augmented model includes two lag regressors that capture a subject experience in terms of the payment method adopted by her previous trading partners. For a buyer at time t, "Seller Electronic $t-1$" takes value 1 if she met a seller in round $t-1$ who accepted electronic payments, and 0 otherwise. Similarly, "Seller Electronic $t-2$" takes value 1 if she met a seller in round $t-2$ who accepted electronic payments, and 0 otherwise. For a seller, the two regressors are built in a similar manner with respect to buyers' adoption choices. In Model 2 (Table B-4), we present the estimates of this alternative specification.

Trade histories of buyer and seller seem to matter because of the state dependence generated by the randomized pairwise trades. In the above estimates, the lag regressors are statistically significant for both buyers and sellers. In addition, we can reassess the role of network externalities using the correlations of the residuals ρ. By adding the lag regressors, ρ remains positive, but becomes even smaller and stays insignificant (p = 0.388).

Dependent var.: 1=Electronic 0=Cash	**Adoption** Model (1)		Model (2)	
Buyers				
No-Fee	1.230	***	1.169	***
	(0.308)		(0.292)	
Reward	0.721	***	0.683	***
	(0.185)		(0.178)	
Purdue location	-0.474	**	-0.387	**
	(0.193)		(0.193)	
Endowment	0.000		0.000	
	(0.001)		(0.001)	
Low ability	0.376	*	0.365	*
	(0.198)		(0.220)	
Seller Electronic t-1			0.588	***
			(0.107)	
Seller Electronic t-2			0.474	***
			(0.131)	
Constant	-0.223		-1.187	***
	(0.259)		(0.275)	
Sellers				
No-Fee	0.893	***	0.731	***
	(0.285)		(0.200)	
Reward	0.456	*	0.370	*
	(0.257)		(0.214)	
Purdue	-0.654	***	-0.612	***
	(0.234)		(0.194)	
Buyer Electronic t-1			0.206	**
			(0.082)	
Buyer Electronic t-2			0.179	
			(0.116)	
Constant	1.466	***	1.315	***
	(0.217)		(0.234)	
N.obs.	3264		3072	
ρ	0.063		0.032	
Prob > chi2	0.269		0.388	

Table B-4: Bivariate probit regressions: buyers and sellers' joint adoption

Notes: Bivariate probit regression with clusters at the session level. Data for main treatments and period 7-40. Symbols $***$, $**$, and $*$ indicate significance at the 1%, 5% and 10% level, respectively.

C Experimental Instructions (Reward treatment)

This is an experiment in decision-making. The National Science Foundation and Purdue University have provided funds for this research. You can earn money based on the decisions you and the other participants make in the experiment. Please turn off your cell-phones, do not talk to others and do not look at their screens. These instructions are a detailed description of the procedures we will follow. You will benefit from understanding them well.

How do you earn money?

In the experiment you will either be a seller or a buyer of a good. The experimental currency for trading is called "tokens" and will be converted into dollars. For every 100 tokens you earn, you will receive 7 cents ($.07). You will also be paid a $5 show up fee. All earnings will be paid to you in cash at the end of the experiment.

In each period, you make some choices:

- You must choose a method of payment, i.e., how to settle trades.
- You must make trading decisions:
  - If you are a **seller**, then you choose a price for the good you sell. You earn tokens depending on the price at which you sell and on the quantity sold. The "seller's table" (see later) reports earnings for different combinations of quantities and prices.
  - If you are a **buyer**, you receive an endowment of tokens and then you choose a quantity to buy. You can earn tokens if you buy at a price lower than your utility value. The "buyer's table" (see later) reports utility values in tokens for different quantities bought.

How long will the experiment last?

This session will last **40 periods**.

In the room there are 8 sellers and 8 buyers. The computer assigns you a role through a coin flip and you keep the same role for whole duration of the experiment.

At the beginning of each period, every seller meets a buyer who is selected at random. Therefore, most likely you will interact with different participants in different periods because there is only one chance out of eight to have the same trading partner in two consecutive periods.
No matter what participants choose to do, every seller is always equally likely to meet any buyer. Moreover, you will not be able to tell whether you have met before your trading partner, because you will not see her identity.

What exactly do you need to do in each period?

Each **period** has the following timeline:

(1) Buyers receive an endowment of tokens
(2) Everyone chooses a payment method for trading in the period
THEN A TRADING CLOCK STARTS
(3) Each seller meets a buyer and chooses the price for the good
(4) Each buyer decides how much to buy at the given price
(5) Buyers carry out payments
THEN THE TRADING CLOCK STOPS
(6) Everyone sees their outcome

We now discuss each of the above items in detail:

(1) At the beginning of each period, each buyer receives a random amount between 250 and 350 tokens. This endowment can be used to buy goods or can be simply kept.

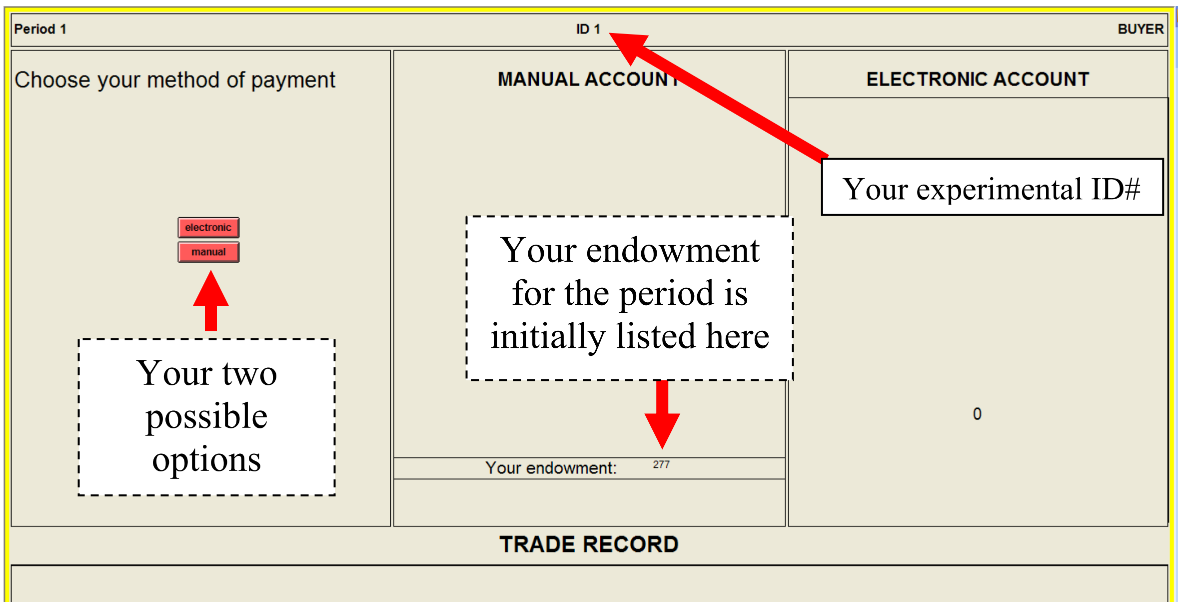

Figure 1: Choice of payment method for a buyer

(2) At this point, buyers and sellers independently choose a payment method for their trades, which is either a **manual** or an **electronic** transfer of tokens. How these methods work will be explained in a moment.
Sellers always accept manual payments and can choose to accept electronic payments, **also**. Buyers must choose to make either a manual or an electronic payment, **but not both** (Figure 1). You will be asked to choose a payment method each period.

There is a **fee** charged for electronic transfers and no fee for manual transfers. The fee is always paid by the seller and never by the buyer. The seller pays a proportional fee for each electronic payment received: the fee is 10 tokens for every 100 tokens received.

Buyers receive a proportional **rebate** for each electronic payment made. A buyer receives 5 tokens for every 100 tokens paid using an electronic transfer.

As soon as methods of payments are chosen, a **trading clock** starts. The clock displays the remaining seconds to complete a trade in a large red font on your screen (Figure 2). Initially the available time is 120 seconds; from period 7 it will be reduced to 60 seconds.

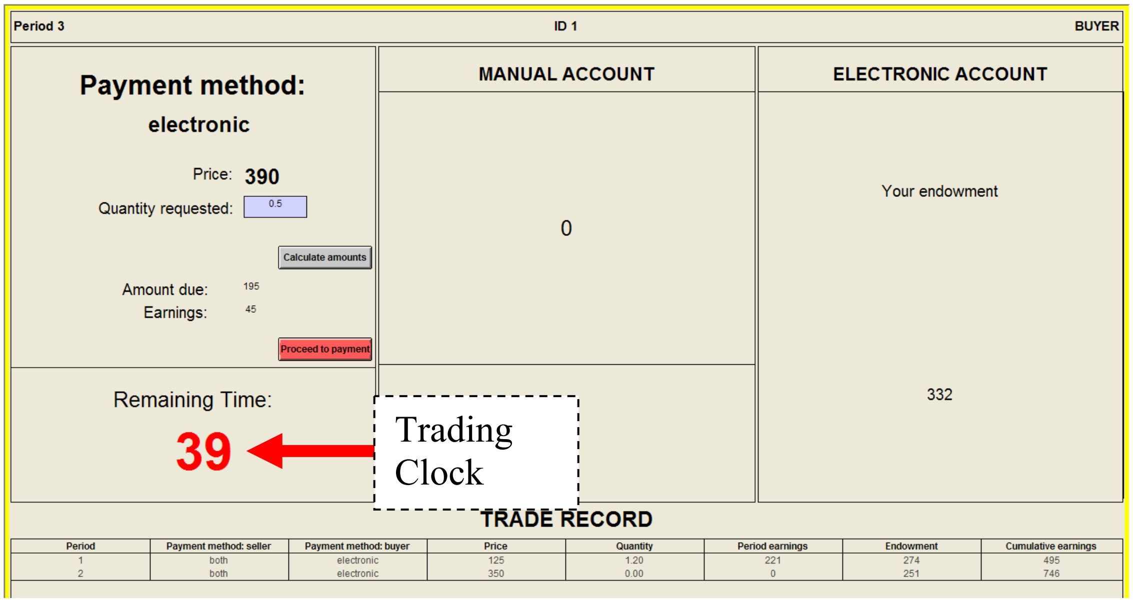

Figure 2: Buyers choose a quantity to buy

(3) When the trading clock starts, each seller must choose the unit price for the goods. The price must be an integer number between 0 and 400. Then, sellers must click the button "**Confirm**."

Seller's earnings vary according to the price and quantity sold, as illustrated in the "Seller's table." Each row of the table lists earnings for a given price of 0, 10, 20, ..., 400. Sellers can use the table to guide their choice of price. Let's see an example.

Example: Find the row with a price of 390. As you can see, the seller's earnings change depending on the quantity sold. The seller picks the price but it is the buyer who picks the quantity. If nothing is sold, then the seller's earnings are fixed at 350 tokens. If a quantity = 1 is sold, then earnings are 665 tokens. If a quantity = 2 is sold, then earnings are 995 tokens. And so on. For quantities and prices not listed in the table you can approximate earnings by looking at the nearby cells. Note that for some prices the seller has a loss.

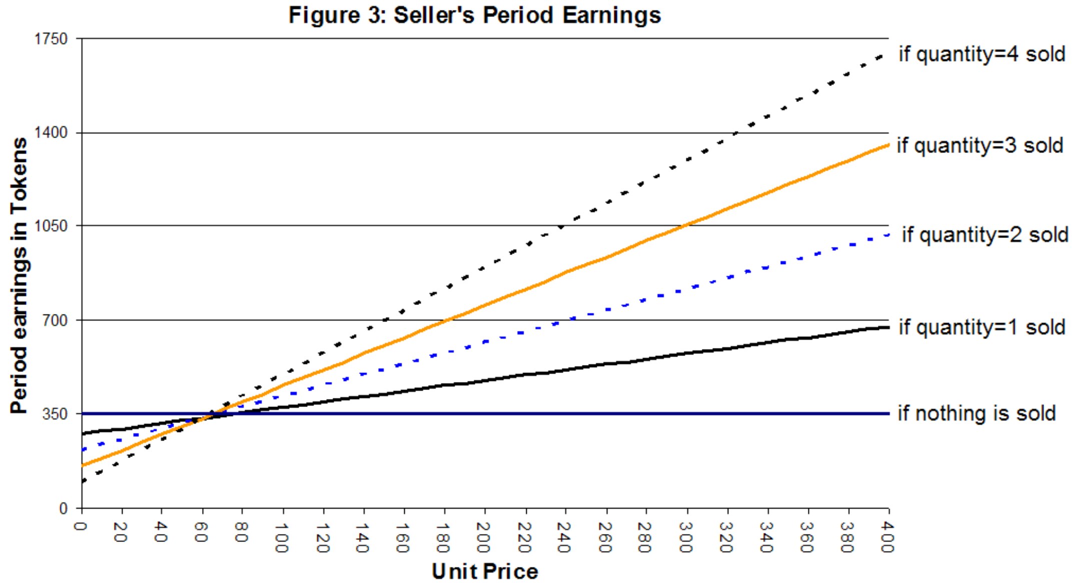

Figure 3 displays the same information contained in the seller's table. In the horizontal axis find the price 390. The corresponding earnings are on the curve labeled "quantity = 1" and "quantity = 2."

Now take a moment to find the seller's earning if a quantity=3 is sold at a price of 390 tokens. Any question at this point?

(4) After the seller has chosen a price, the buyer must decide how many units of the good to purchase, by typing any number between 0 and 4 (Figure 2).
--The **amount due** is the price multiplied by the quantity requested. Buyers are never endowed with more than 350 tokens to spend in a period. This endowment is placed in the account selected at the beginning of the period (manual or electronic). The endowment leftover after purchases will be redeemed for dollars.
--Goods generate a utility value in tokens for the buyer, as shown in the "buyer's table." **Earnings** are equal to the **utility value** minus the **amount due** plus any **rebate** earned. Buyers can use the table to guide their purchases.

Example: if you buy a quantity of 0.5 at a price of 390 tokens, the amount due is 195 tokens, which is 0.5 times 390. If you use manual payments, the earnings are 44.7 tokens. If you use electronic payments, the earnings are instead 54.5 tokens, i.e., 44.7 tokens plus a rebate of 195×0.05=9.8 tokens. The computer calculates this for you: type in the quantity requested, then click the "**Calculate amounts**" button. You can repeat this process as many times as you wish. To finalize your purchase, you must click on the "**Proceed to payment**" button.

How can a buyer calculate period earnings without the computer? Just look at the buyer's table. Each row indicates a quantity of goods: 0, 0.10, 0.20, ... up to 4. For each quantity the table shows the utility value of those goods. Now, find the row for a quantity of 0.5. The corresponding utility value is 239.7 tokens. Did everyone find it? Suppose the buyer uses manual payments. If the price is 390, as in the example above, then the buyer earns 44.7 tokens, i.e., a utility of 239.7 minus an amount due of 390 × 0.5. Consider instead a price of 111 tokens per unit: then the buyer's earnings are 184.2 tokens, i.e., a utility of 239.7 minus an amount due of (111 × 0.5). If the buyer uses electronic payments you have to add a 5% rebate: 9.8 tokens when the price is 390, and 2.8 tokens when the price is 111.

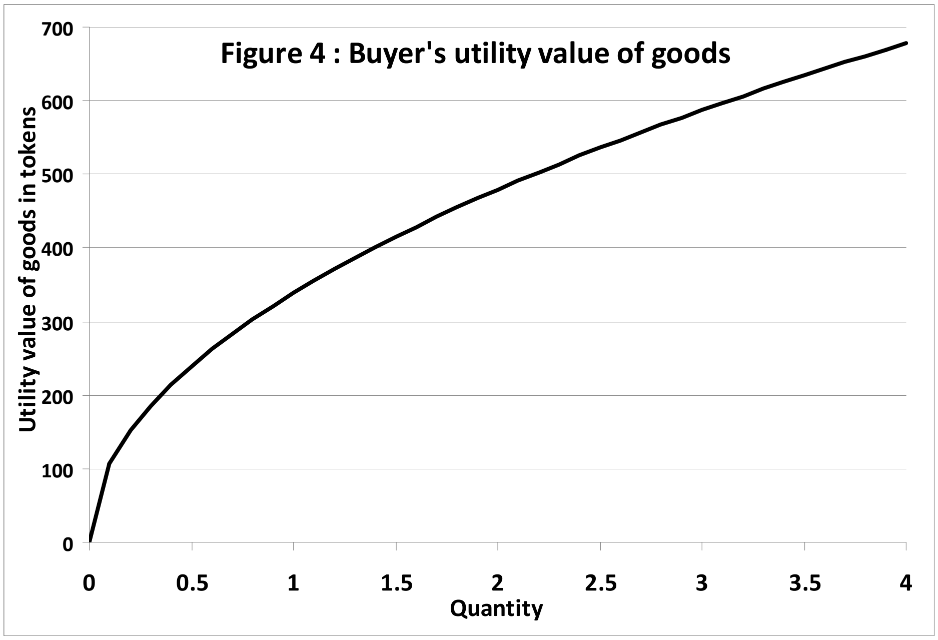

Figure 4 displays the same information as in the buyer's table. Now, please find a quantity = 0.5 on the horizontal axis. The corresponding utility value on the curve is 239.7 tokens, which can be read with some approximation on the vertical axis. Recall that to obtain the buyer's earnings you need to take this utility value and then subtract the amount paid.

Any question at this point?

Once a purchasing decision is made, the payment can be carried out. The buyer had already decided earlier in the period whether to pay electronically or manually.

- **Electronic payment**: the buyer must click the "Proceed to payment" button and tokens are automatically taken from the buyer's electronic account.
- **Manual payment**: the buyer must select a proper combination of tokens from the manual account (Figure 5).

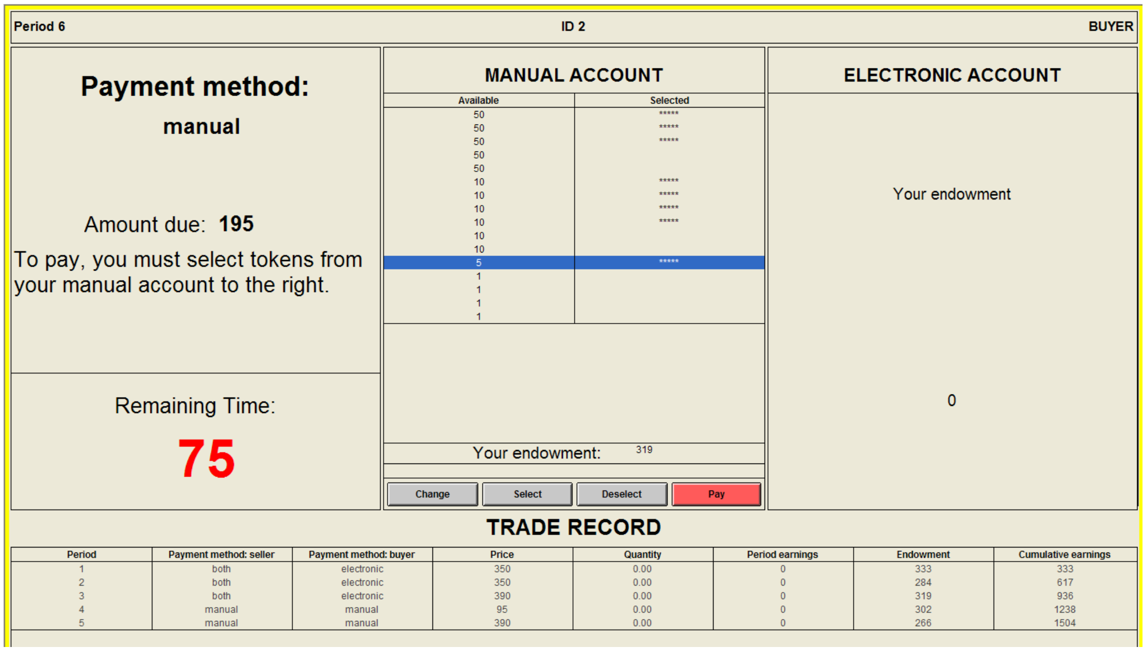

Figure 5: How to pay a seller from the manual account

The manual account contains tokens of various sizes. To break a large-size token into a smaller size, select a token and then click the button "**Change**." To select the tokens, click on any "Available" tokens and then press the button "**Select**." Selected tokens are indicated with *****. Press "Deselect" to undo the selection. To transfer the selected tokens to the seller, a buyer must click the button "**Pay**." A trade is completed when a buyer transfers enough tokens, i.e., equal or more than the amount due. It is not completed if the transfer is less than the amount due.

The choices described in items (3) to (5) above must be completed within the available time.

(6) At the end of the period, you will see whether trade took place. Trade **cannot** take place:
(a) if a buyer pays electronically but the seller does not accept electronic payments;
(b) if the buyer has insufficient tokens available in the relevant account;
(c) if the buyer manually selects to transfer less than the amount due;
(d) if the clock runs out before trade is settled.

If trade does not take place within the available time, then **cumulative earnings** for the buyer increase by the received endowment (between 250 and 350 tokens), and increase by 350 tokens for the seller.

The results screen (Figure 6) displays details of the trade, for 30 seconds. Seller's earnings reflect the table values minus any applicable payment fee, plus possible excess payments. Buyer's earnings reflect the utility values in the table minus the payment, plus any applicable payment rebate. ID is your experimental ID.

The lower part of the screen will always display your "trade record" for previous periods. This includes the **payment method** selected by you and by the person you encountered, **price** and **quantity** traded, your **period earnings** in tokens, your **endowment** in tokens (only for buyers), and your **cumulative earnings** in tokens. Cumulative earnings will be redeemed for dollars at the end of the experiment. Use the record sheet to record your earnings.

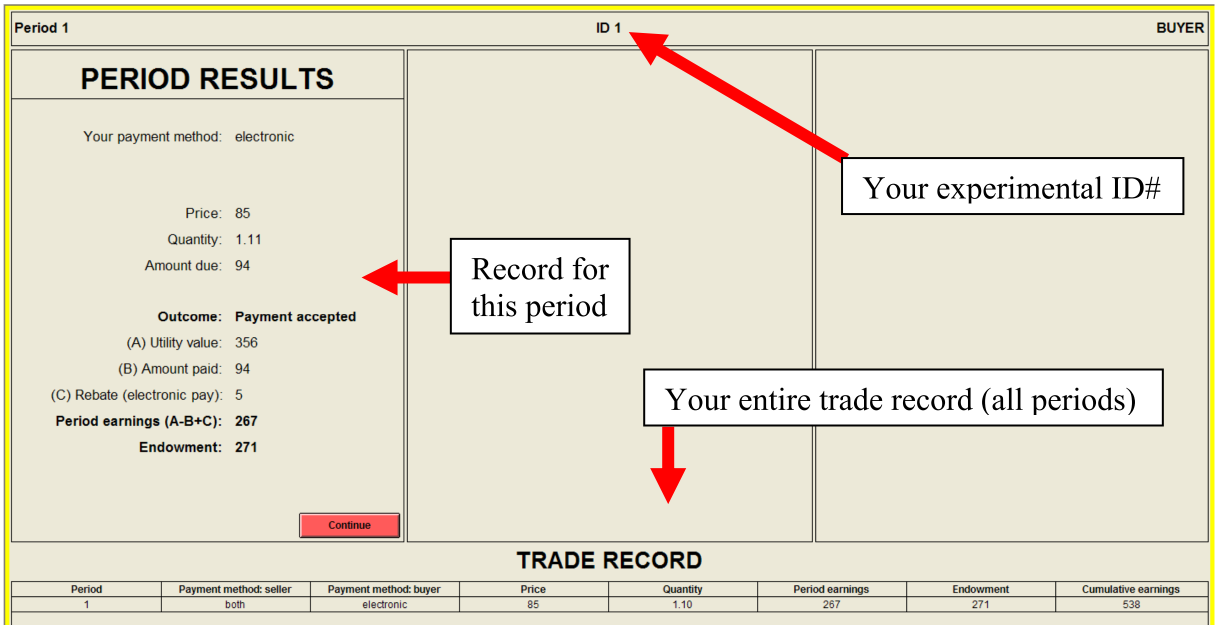

Figure 6: Results screen for a buyer

<u>Questions?</u>

Now is time for questions. Do you have any questions before we begin the experiment?

SELLER'S TABLE: earnings in tokens if a quantity of the good is sold at the price indicated

Quantity sold:	**0**	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**
Price									
0	350	305	275	245	215	185	155	125	95
10	350	310	285	260	235	210	185	160	135
20	350	315	295	275	255	235	215	195	175
30	350	320	305	290	275	260	245	230	215
40	350	325	315	305	295	285	275	265	255
50	350	330	325	320	315	310	305	300	295
60	350	335	335	335	335	335	335	335	335
70	350	340	345	350	355	360	365	370	375
80	350	345	355	365	375	385	395	405	415
90	350	350	365	380	395	410	425	440	455
100	350	355	375	395	415	435	455	475	495
110	350	360	385	410	435	460	485	510	535
120	350	365	395	425	455	485	515	545	575
130	350	370	405	440	475	510	545	580	615
140	350	375	415	455	495	535	575	615	655
150	350	380	425	470	515	560	605	650	695
160	350	385	435	485	535	585	635	685	735
170	350	390	445	500	555	610	665	720	775
180	350	395	455	515	575	635	695	755	815
190	350	400	465	530	595	660	725	790	855
200	350	405	475	545	615	685	755	825	895
210	350	410	485	560	635	710	785	860	935
220	350	415	495	575	655	735	815	895	975
230	350	420	505	590	675	760	845	930	1015
240	350	425	515	605	695	785	875	965	1055
250	350	430	525	620	715	810	905	1000	1095
260	350	435	535	635	735	835	935	1035	1135
270	350	440	545	650	755	860	965	1070	1175
280	350	445	555	665	775	885	995	1105	1215
290	350	450	565	680	795	910	1025	1140	1255
300	350	455	575	695	815	935	1055	1175	1295
310	350	460	585	710	835	960	1085	1210	1335
320	350	465	595	725	855	985	1115	1245	1375
330	350	470	605	740	875	1010	1145	1280	1415
340	350	475	615	755	895	1035	1175	1315	1455
350	350	480	625	770	915	1060	1205	1350	1495
360	350	485	635	785	935	1085	1235	1385	1535
370	350	490	645	800	955	1110	1265	1420	1575
380	350	495	655	815	975	1135	1295	1455	1615
390	350	500	665	830	995	1160	1325	1490	1655

400	350	505	675	845	1015	1185	1355	1525	1695

BUYER’S TABLE: buyer's utility values in tokens for each quantity purchased of the good

quantity bought	utility value in tokens	quantity bought	utility value in tokens
0	0.0	**2.1**	491.3
0.1	107.2	**2.2**	502.8
0.2	151.6	**2.3**	514.1
0.3	185.7	**2.4**	525.2
0.4	214.4	**2.5**	536.0
0.5	239.7	**2.6**	546.6
0.6	262.6	**2.7**	557.0
0.7	283.6	**2.8**	567.3
0.8	303.2	**2.9**	577.3
0.9	321.6	**3**	587.2
1	339.0	**3.1**	596.9
1.1	355.5	**3.2**	606.4
1.2	371.4	**3.3**	615.8
1.3	386.5	**3.4**	625.1
1.4	401.1	**3.5**	634.2
1.5	415.2	**3.6**	643.2
1.6	428.8	**3.7**	652.1
1.7	442.0	**3.8**	660.8
1.8	454.8	**3.9**	669.5
1.9	467.3	**4**	678.0
2	479.4		