

Experimental Markets with Frictions:

Supplementary Materials

Gabriele Camera, Marco Casari, and Maria Bigoni

27 December 2012

This document contains supplementary material relative to Section 4, in particular tables S1, S2, and S3 with econometric regressions on the experimental data about communication in a market with frictions.

Table S1 shows linear regressions explaining cooperation rates at the economy level in period 1 and in all periods, which are regressed against treatment dummies and other variables, including the duration of the previous supergame. Table S1 provides support for Result 2 and Result 3 as it fails to find evidence that structured communication increases cooperation relative to *No-communication*.

The (mean) cooperation rate for economy $k=1,...,n$ is measured by coding a cooperative action as 1, and a defection as 0. Define the action $a_{it}^k \in \{0,1\}$ of subject $i=1,...,4$ in period $t=1,...,T^k$ of the economy k ; average cooperation in economy k is $c_k = \frac{1}{4T^k} \sum \sum a_{it}^k$ between zero and one, and across economies is $c = \frac{1}{n} \sum_{k=1}^n c_k$. Thus, although economies have different length T^k , they are given equal weight in our measure c of average cooperation. Similarly, in economy k the coordination on cooperation rate is $cc_k = \frac{1}{T^k} \sum_{t=1}^{T^k} \prod_{i=1}^4 a_{it}^k$, and the average across economies is $cc = \frac{1}{n} \sum_{k=1}^n cc_k$.

<i>Dependent variable:</i> <i>Cooperation rate</i>	<i>All treatments, All periods (1)</i>	<i>All treatments except Chat, Periods 1 only (2)</i>	<i>All treatments except Chat, All periods (3)</i>
<i>Treatment dummies</i>			
Messages	0.049 (0.143)	0.085 (0.056)	-0.488*** (0.091)
Multiple Messages	0.105* (0.053)	0.081 (0.056)	-0.466** (0.163)
Chat	0.397*** (0.044)		
<i>N. of others signaling a cooperative intention X treatment dummy</i>			
Messages			0.270*** (0.010)
Multiple Messages			0.236*** (0.051)
<i>Supergame dummies</i>			
supergame 2	-0.075 (0.082)	-0.068 (0.047)	-0.055 (0.091)
supergame 3	-0.015 (0.049)	-0.063 (0.038)	0.033 (0.070)
supergame 4	-0.002 (0.058)	0.001 (0.016)	0.050 (0.055)
supergame 5	0.033 (0.079)	0.035 (0.033)	0.064 (0.085)
<i>Duration of previous supergame</i>	0.001 (0.002)	0.002 (0.002)	0.003 (0.003)
<i>Constant</i>	0.579*** (0.089)	0.687*** (0.081)	0.507*** (0.110)
<i>R²</i>	0.199	0.080	0.191
<i>Observations</i>	175	150	150

Table S1: Treatment and communication effects

Notes: Linear regressions. For model (2) the dependent variable takes values 0, 0.25, 0.50, 0.75, and 1. We obtain qualitatively similar results by running an ordered probit regression. Standard errors robust for clustering at the session level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table S2 illustrates two probit regressions, where we explain the cooperation actions (0=defect, 1=cooperate) using as independent variables the messages made public in the economy, controlling for period effects, supergame order and duration. This evidence supports Result 4. Subjects were not always more likely to cooperate when they observed several cooperative messages. A subject who sent a cooperative message was more likely to cooperate when two or three others signaled

their intention to cooperate, and the effect was highly significant in all three treatments. This supports the view that communication was used to foster coordination on a social norm of cooperation. On the other hand, subjects who *did not* send a cooperative message, and also observed at least two cooperative messages were *less* likely to cooperate in the *Messages* and *Multiple Messages* treatments. This is evidence that some subjects used communication in an opportunistic way.

Dependent variable: cooperation marginal effects from probit regressions	<i>Messages</i>	<i>Multiple Messages</i>
msg_sent (=1 if the subject signaled the intention to cooperate)	0.071 (0.170)	-0.398*** (0.091)
msg_observed (=1 if the subject observed 2 or 3 cooperative messages)	-0.093*** (0.031)	-0.365*** (0.064)
(msg_sent.) x (msg_observed)	0.333*** (0.067)	0.704*** (0.134)
supergame 2	-0.308*** (0.003)	-0.106 (0.166)
supergame 3	0.047** (0.021)	-0.115* (0.062)
supergame 4	0.045 (0.053)	-0.125** (0.050)
supergame 5	-0.044 (0.040)	-0.156*** (0.017)
<i>Duration of previous supergame</i>	-0.018* (0.010)	0.004 (0.003)
communication (1 in periods 1, 5, 9,...)		0.078* (0.042)
Pseudo R-squared	0.292	0.112
Observations	2820	1280

Table S2: Effect of signaling cooperative intentions on cooperation

Notes: We regress the binary choice of cooperation/defection on three main regressors, as well as standard control variables (duration of the previous supergame, supergame and period dummies, individual fixed effects, and a dummy for periods in which communication was possible). The first regressor is a dummy that takes value 1 when the subject signaled her intention to cooperate (i.e., sent a message Y “for herself”) and 0 otherwise. The second regressor is also a dummy, which takes value 1 in periods when communication was possible and the subject observed at least two cooperative messages from others. The third regressor is an interaction term between the first two. Standard errors

robust for clustering at the session level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Individual fixed effects.

Table S3 presents an OLS regression of the average profit in each economy on the average number of public statements that were explicit about the sender's intended play (Y or Z messages "for oneself"), controlling for supergame order and length. None of these coefficients is significant in the *Messages* and *Multiple Messages* treatments.

Dependent variable:	<i>Messages</i>	<i>Multiple Messages</i>
Average profit per economy	(1)	(2)
Number of explicit messages regarding the subject's intended play	3.514 (1.560)	0.689 (0.885)
Number of explicit messages regarding play suggested to others (match and everyone else)	-2.165 (2.205)	1.111 (2.470)
Supergame 2	-2.927 (0.689)	-0.295 (1.632)
Supergame 3	1.537 (3.408)	-0.831 (0.176)
Supergame 4	0.675 (1.839)	-0.615 (0.946)
Supergame 5	-0.536 (1.450)	-1.326* (0.105)
<i>Duration of current supergame</i>	-0.145** (0.007)	-0.262* (0.037)
Constant	17.577* (2.185)	16.494 (5.257)
Observations	50	50
R ²	0.317	0.142

Table S3: Structured communication and profits

Notes: OLS regression where the dependent variable is profits. Standard errors robust for clustering at the session level are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix: Instructions for treatment Messages (not for publication)

Overview

This is an experiment in decision-making. Purdue University has provided funds for this research. The instructions are simple. If you follow them carefully and make good decisions, you can earn an appreciable amount of money. These earnings will be paid to you in cash at the end of the experiment.

We ask that you not talk with one another for the duration of the experiment. Please turn off your cell-phones. Do not use e-mail.

During the course of this experiment, you will be called upon to make decisions in several periods. The experiment is divided into **five** sequences of periods and each sequence is referred to as a **cycle**.

- At the beginning of a cycle, each participant in this room will be randomly assigned to a **set**.
- In each set there will be **four** persons.
- For the whole duration of a cycle, you will interact exclusively with the three other participants in that set and nobody else.
- You will never meet again these participants in the following cycles.

In each **period** of a cycle:

- In each period you will be matched to one other participant selected at random from the set you are assigned to. We will refer to this person as “**your match**.”
- You will not be informed of the identity of your match. Hence, you do not know when you have already interacted with that person in previous periods of the same cycle.
- You and your match will interact according to the rules described in the upper portion of your screen. The rules will be explained in a moment.
- After each period you will be re-matched to a participant chosen at random from the set you are assigned to. There is one chance out of three that you will be matched with any given person in your set.

Period

Action stage: you don't know the ID of your match

Your set

History of choices of your previous matches

Period: 1 Your ID: 1

Choice of your match

	Y	Z
Y	You get 25, your match gets 25	You get 5, your match gets 30
Z	You get 30, your match gets 5	You get 10, your match gets 10

Please enter your choice

Y
Z

Suggestions for this Period

You	Your match	Everyone else
		Z
Y	Y	Y
	Z	

Summary of Results in cycle 1

Period	ID1	Your match	Other person	Other person	Your match ID	Your earnings
1					unknown	

Interaction rules

Each period is divided into two stages. In the suggestion stage everyone will have an opportunity to exchange information with others in their set. In the suggestion stage, you do not earn any points. In the action stage you interact only with your match and you can earn points. We now explain the action stage and later will explain suggestion stage.

Action stage. You and your match can make either of two choices, Y or Z. The points you earn in the action stage depend upon both the choice you make and the choice made by your match in that stage. As the payoff table on your screen (above) indicates, there are four possible outcomes for the action stage:

1. If both of you choose Y then: you both earn **25** points.
2. If you choose Y and your match chooses Z then: you earn **5** points and your match earns **30** points.
3. If you choose Z and your match chooses Y then: you earn **30** points and your match earns **5** points.

4. If you both choose Z then: you both earn **10** points.

To make your choice, click the button next to either Y or Z. You may change your mind at any time prior to clicking the “Submit” button by simply clicking on the button next to Y or Z. You are free to choose Y or Z in every period. When you are satisfied with your choice, click the “Submit” button.

Period: 1 Your ID: 1

Choice of your match

	Y	Z
Y	You get 25, your match gets 25	You get 5, your match gets 30
Z	You get 30, your match gets 5	You get 10, your match gets 10

Your choice

Your Suggestion for this Period

You	Your match	Everyone Else
☐ Y ☐ Z ☒ Not Sure	☐ Y ☐ Z ☒ Not Sure	☐ Y ☐ Z ☒ Not Sure

No Suggestion

Submit Suggestion

Summary of Results in cycle 1

Persons in your set: ID1 (you), ID15, ID12, ID18

Period	ID1	Your match	Other person	Other person	Your match ID	Your earnings

Suggestion stage. At the beginning of every period, you will have an opportunity to exchange suggestions about choices with everyone in your set. You are free to skip the suggestion stage entirely by clicking the “No Suggestion” button. The suggestion stage gives you the opportunity to suggest choice Y or Z for any person in your set. Your suggestion is shared with all people in your set.

You can make a suggestion for the current period. Suggestions concern choices for you, for your match, and for everyone else in your set. To share your suggestion with others, click the “Submit suggestion” button.

After the suggestion stage, all suggestions from people in your set will be displayed in a table in the middle of the screen. In the action stage, you are always free to choose Y or Z regardless of suggestions made by you or others. After all persons have made suggestions and choices, the results of the period will appear on your screen.

Your results

Random number

Period 1 Results
 Your choice: Z
 Choice of your match: Y
 Your period earnings: 30

15

The cycle: will continue

Suggestions for this Period

Yours -->

You	Your match	Everyone else
		Z
Y	Y	Y
	Z	

Summary of Results in cycle 1
 Persons in your set: ID1 (you), ID15, ID12, ID18

Period	ID1	Your match	Other person	Other person		Your match ID	Your earnings
1	Z	Y	Y	Z		unknown	30

The result screen (above) will display the number of points you have earned for the period as well as **the choices of all four persons in your set**. The first column of the ‘Summary of Results’ table contains your past choices. The second column concerns the choices of your previous matches. The third and fourth columns list the choices of the other two persons in your set. Notice that **choices in the column labeled “Your match” were most likely made by different persons in different periods. The same can be said for the two columns labeled “Other person”**. Please record your results for the period on your RECORD SHEET under the appropriate headings.

At this stage a ball will be drawn from an urn containing one hundred balls numbered from 1 to 100. Each ball is equally likely to be selected. The computer program will randomly draw a ball and show the number on the result screen (above). If this random number is less than or equal to 95, then the cycle will continue into the next period. If this number is greater than 95, then the cycle ends. Therefore, **after each period there is a 95% chance that there will be another period of interactions in the cycle and a 5% chance that the cycle will end**.

Suppose that a number less than or equal to 95 has been drawn. Then you press the “Continue” button to proceed. You will face the same decisional situation as in the previous period, **but with a person selected at random from the set of participants you were assigned to**. Remember that there are four participants in each set.

Before making your choice, you may review all the outcomes in previous periods of the cycle by scrolling down the “Summary of Results” table. The table shows your past choices and the past choices of all persons in your set. You then choose either Y or Z. All choices for this period are recorded and added to the Summary of Results table in the lower portion of your screen. You then record the outcome and your point earnings for the period.

If the number drawn is greater than 95 then the cycle ends. When a cycle ends, you will be notified in a new screen. There will be a total of five cycles. The rules in the following cycles are the same as in the first, but you will interact with different persons. More precisely, after each cycle, new sets of persons will be formed. This assignment does not depend on actual choices. **A participant will never interact with a person for more than one cycle.**

Earnings

The points you earned in each period are added up. For every 10 points that you earn you will receive 13 cents (\$.13). Therefore, the more points you earn the more money you earn. You will be paid your earnings in cash and in private at the end of today’s session.

Final Comments

First, do not discuss your choices or your results with anyone at any time during the experiment.

Second, your ID# is private. Do not reveal it to anyone.

Third, since there is a 95% chance that at the end of a period the cycle will continue, you can expect, on average, to interact for 20 periods in a given cycle. However, since the stopping decision is made randomly, some cycles may be much longer than 20 periods and some others may be much shorter.

Fourth, remember that after each period you will be matched randomly to someone in the set you were assigned to. As there are four people in the set, the probability of you being matched with the same person in two consecutive periods of a cycle is $1/3$. You are not told the identity of your match.

Fifth, in the suggestion stage of every period you have an opportunity to suggest choices to people in your set. In the action stage everyone is free to choose Y or Z independently from any suggestion.

Sixth, the rules are the same in all five cycles. After a cycle, you will never meet again the same participants.

Questions?

Now is the time for questions. Does anyone have any questions before we begin?

Quiz

QUIZ

1. The total number of **cycles** is _____
2. You are at the beginning of the cycle. How many **periods** do you expect the cycle will last, on average? _____
3. You are in period 15 of the cycle. How many additional **periods** do you expect, on average? _____
4. The number of **participants** in the experiment (total in the room) is _____
5. In a given **cycle** with how many participants could you interact with (i.e. number of people in a set)? _____
6. In a given **period** with how many participants do you interact with? _____
7. Other than your match, will you know at the end of the period the actions taken by people **in your set**? _____
8. Will you know at the end of the period the actions taken by participants **outside your set**? _____
9. Before choosing an action, will you know the **ID** of your match? _____
10. If ID 5 is in your set this cycle, is there any chance that ID 5 will be your match in future cycles? _____
11. How many points do you earn if both you and your match choose **Y**? _____
12. If the experiment lasts 100 periods and everybody always chooses **Y**, how many dollars are you going to earn? _____
13. How many points do you earn if you and your match choose **Z**? _____
14. If the experiment lasts 100 periods and everybody always chooses **Z**, how many dollars are you