21COE-GLOPE Working Paper Series

A Preliminary Experiment on the Role of A Large Speculator in Currency Crises

September 2005

Yasuhiro Arikawa

(Graduate School of Finance, Accounting and Law, Waseda University)

Kumi Suzuki-Loeffelholz

(Political Science and Economics, Waseda University)

Kenshi Taketa

(Institute for Monetary and Economic Studies, Bank of Japan)

Working Paper No.3

Please do not quote without permission.

A Preliminary Experiment on the Role of A Large Speculator in Currency Crises*

Yasuhiro Arikawa[†], Kumi Suzuki-Löffelholz[‡], and Kenshi Taketa[§]

September 2005

Abstract

Corsetti, Dasgupta, Morris, and Shin (2004) show that the presence of the large speculator makes all other traders more aggressive in speculative attacks in the foreign exchange market. We report the results of a preliminary experiment designed to test their theoretical findings. While the results only partially support the theoretical predictions of Corsetti, Dasgupta, Morris, and Shin (2004), the results indicate how we have to adjust our experimental design to test their theoretical findings more precisely.

JEL classifications: F31; E58; D82; C72; C91

Keywords: Currency Crises; Global Game; Experimental Economics

*Kumi Suzuki-Löffelholz thanks financial support provided by the Waseda University 21st Century Center of Excellence program "Constructing Open Political-Economics Systems". We thank the staff of the Bank of Japan for helpful suggestions. We also thank Yoshio Kamijo for his guidance of Z-tree. All possible remaining errors are ours. The views expressed in this paper are those of the authors and do not necessarily reflect the official views of the Bank of Japan or IMES.

[†]Graduate School of Finance, Accounting and Law, Waseda University, e-mail: arikawa@waseda.jp

[‡]Political Science and Economics, Waseda University, e-mail: suzukikumi@ruri.waseda.jp

[§]Institute for Monetary and Economic Studies, Bank of Japan, e-mail: kenshi.taketa@boj.or.jp

1 Introduction

Large speculators, like George Soros or Julian Robertson, have been blamed not only for destabilizing the market unnecessarily during currency crises, but also for triggering these crises. For instance, during the Asian financial crisis of 1997, the then prime minister of Malaysia, Mahathir Mohamad, accused George Soros and others of being "the anarchists, self-serving rogues and international brigandage".[1] Large speculators are often blamed because they are considered to be able to affect the whole market to some degree. As opposed to small traders, they can exercise a disproportionate influence on the likelihood and severity of a financial crisis by fomenting and orchestrating attacks against weakened currency pegs.

Corsetti, Dasgupta, Morris, and Shin (2004) show that the presence of the large speculator does indeed make all other speculators more aggressive: relative to the case where there is no large speculator, small speculators attack the currency when fundamentals are stronger. This paper reports the results of a preliminary experiment[2] designed to test the predictions of Corsetti, Dasgupta, Morris, and Shin (2004). In particular, the preliminary experiment tests (A) whether the large speculator makes other small speculators more aggressive in attacking the peg, and (B) whether the large speculator is more aggressive in attacking the peg than other small speculators. The preliminary results only partially support the theoretical predictions: we found that while the large speculator makes other small speculators more aggressive, the large speculator is *less* aggressive in attacking the peg than other small speculators.

This paper's interest is related to two papers: Heinemann, Nagel, and Ockenfels (2004) and Cheung and Friedman (2005). Heinemann, Nagel, and Ockenfels (2004) conduct an experiment to test the predictions of the theory of global games. Their experiment imitates the speculative-attack model by Morris and Shin (1998). They conclude that the global game solution (the so-called threshold strategy) is an important reference point and provides correct predictions for comparative statics with respect to parameters of the payoff function. Their experiment, however, is not designed to test the implications of the

[1] Financial Times, July 25, 1997.

[2] The difference between a preliminary experiment and a "full" experiment will be explained below.

existence of the large speculator which is the central issue of our experiment. Cheung and Friedman (2005) deal with the issue of the large speculator in their experiments. They conclude that while the presence of a larger speculator increases the likelihood of successful attack, giving the large speculator increased size does not significantly strengthen his impact. However their experiment design is closer to the first generation models pioneered by Krugman (1979) and Flood and Garber (1984), rather than the global game model of Corsetti, Dasgupta, Morris, and Shin (2004), in the sense that the economic fundamentals are deteriorating in their experiments to see the timing of speculative attacks. A concern might be that the experimental design of deteriorating economic fundamentals could induce the global game solutions (threshold strategies). Morris and Shin (1998) and Corsetti, Dasgupta, Morris, and Shin (2004) show that threshold strategies are the only equilibrium strategies even in the absence of deteriorating economic fundamentals. Therefore, we need to be careful if we interpret the result of their experiments as supportive (or not supportive) to the global game solutions found by Corsetti, Dasgupta, Morris, and Shin (2004), because their experiment does not imitate the model by Corsetti, Dasgupta, Morris, and Shin (2004) very closely. In contrast, our experiment is designed to imitate the Corsetti, Dasgupta, Morris, and Shin (2004) model as closely as possible, in order to test the global game solutions. To check whether our experiment is correctly designed, first we conduct a "preliminary" experiment. In particular, the preliminary experiment checks whether experiment participants understand the rule of the game correctly (i.e., our instruction of the experiment is easily understood by participants) and whether the computer program used in the experiment works without any problem. Once we obtain the results of the preliminary experiment, we will think about whether we should adjust our experimental design to imitate the Corsetti, Dasgupta, Morris, and Shin (2004) model as precisely as possible. Incorporating such adjustment if necessary, we will proceed to conduct "full" experiments. This paper reports the results of the preliminary experiment and discuss how we have to adjust our experimental design to test the findings of Corsetti, Dasgupta, Morris, and Shin (2004) as precisely as possible in the full experiment.

This paper is organized as follows. Section 2 explains the speculative-attack model

	Success	Failure
Attack	$D - c$	$-c$
Not Attack	0	0

Table 1: Payoff Matrix

used in our preliminary experiment. Section 3 lays out the experimental design. In Section 4 we present the preliminary results and discuss issues to note when we conduct "full" experiments. Section 5 concludes the paper.

2 The Model

In our experiment, we employ a reduced game form based on Corsetti, Dasgupta, Morris, and Shin (2004) with a finite number of speculators who decide simultaneously whether to attack the currency peg or not.

Consider an economy where the central bank pegs the exchange rate. The economy is characterized by a state of underlying economic fundamentals, Y. A low value of Y refers to good fundamentals while a high value refers to bad fundamentals. We assume that Y is randomly drawn from the interval $[\underline{Y}, \bar{Y}]$, with each realization equally likely.

Now assume that there are two kinds of speculators: a single large speculator ("Soros") and m small speculators (m is some positive integer). Each small speculator can short-sell one unit of the domestic currency. The distinguishing feature of the large speculator is his access to a larger line of credit in the domestic currency to take a short position up to the limit of λ (≥ 1). Just for simplicity, we assume λ is an integer. We call it "Soros case". Later we will consider "No-Soros case" where there are $m + \lambda$ small speculators and there is no large speculator.

Receiving the possibly noisy private signal about economic fundamentals, a speculator decides whether to short sell the currency, i.e., to attack the currency peg. An attack is associated with opportunity costs c. If the currency devalues, each attacking speculator earns an amount D. To make the model more interesting, we assume that a successful attack is profitable: $D - c > 0$.

Whether the current exchange rate parity is viable depends on the strength of the economic fundamentals and the incidence of speculative attack against the peg. The incidence of speculative attack is measured by the mass of speculators attacking the peg as follows.

$$N = k + \lambda \cdot I[\text{Soros attacks}] \tag{1}$$

where k is the number of small speculators who attack the peg and $I[\text{Soros attacks}]$ is the indicator function which takes the value of unity if Soros attacks and zero otherwise. Therefore the possible maximum number of N is $m+\lambda$. An attack is successful if and only if a sufficient number of speculators decide to attack. The better the state of the economy, the higher the hurdle to success: the hurdle to success is modelled as a nonincreasing function of Y. Let $a(Y)$ be the size of speculative attacks that are needed to enforce a devaluation and assume $a' \leq 0$ and $a(\bar{Y}) < 0 < m + \lambda < a(\underline{Y})$. The currency peg fails if and only if

$$N \geq a(Y). \tag{2}$$

When the economic fundamentals are sufficiently strong (i.e., Y satisfies $a(Y) > m + \lambda$), the currency peg is maintained irrespective of the actions of the speculators. When the economic fundamentals are sufficiently weak (i.e., Y satisfies $a(Y) \leq 0$), the peg is abandoned even in the absence of a speculative attack. The most interesting range is the intermediate case when $0 < a(Y) \leq m + \lambda$. Here the government is forced to abandon the peg if a sufficient proportion of speculators attacks the currency, whereas the peg will be maintained if a sufficient proportion of speculators choose not to attack. This tripartite classification of fundamentals follows Obstfeld (1996). In what follows, we call it a crisis if the government abandons the peg and no crisis if the government defends the peg.

Although speculators do not observe the realization of Y, they receive informative private signals about it. When the true state is Y, a speculator i observes a signal $x_i = Y + \varepsilon_i$ that is drawn uniformly from the interval $[Y - \varepsilon, Y + \varepsilon]$ ($\varepsilon \geq 0$). Conditional on Y, the signals are i.i.d. across individuals. Note that there is no difference, at least in terms of precision, between Soros' private signal and small speculators' private signals.

In the model, the only difference between Soros and the small speculators is their size. In order to focus on the size effect as clearly as possible, we exclude the possibility that Soros has better information about economic fundamentals than the small speculators.

As regards speculators' preferences, the expected utility from attacking the currency conditional on her private signal is the following.

$$U = \text{Prob}\left[N \geq a(Y)|\, x_i\right] D - c$$

Here $\text{Prob}\left[N \geq a(Y)|\, x_i\right]$ is the probability that her attack is successful conditional on her private signal.

The timing of the game is structured as follows.

- Nature chooses the value of Y.
- Each speculator receives a *private* signal $x_i = Y + \varepsilon_i$.
- Each speculator decides whether or not to attack the currency peg.
- The central bank abandons the peg if $N \geq a(Y)$ and defends the peg otherwise.
- If the attack is successful, those who attacked get $D - c$. If the attack is not successful, their payoff is $-c$. The payoff of those who did not attack is zero.

2.1 Common Knowledge Case

Before investigating the case $\varepsilon > 0$, consider the case where there is no noise in the signal: $\varepsilon = 0$. In this case, the realization of Y is common knowledge among the speculators.

In this case there are multiple equilibria when $\lambda < a(Y) \leq m + \lambda$: the crisis is the equilibrium if all the speculators coordinate an attack, while no crisis is the equilibrium if no speculator attacks. In the multiple equilibria, there is no clear implication of the existence of Soros. To see this, suppose that there are $m + \lambda$ small speculators and there is no Soros in the market. We call it No-Soros case. Note that in this case the possible maximum number of N, which is $m + \lambda$, is the same as the one in Soros case. Notice also that there are multiple equilibria, the crisis and no crisis, in No-Soros case as in Soros case. Within multiple equilibria framework, there is no significant difference in terms of equilibrium selection between Soros-case and No-Soros-case when $\lambda < a(Y) \leq m + \lambda$: it is not very clear whether or not the existence of Soros affects equilibrium selection when $\lambda < a(Y) \leq m + \lambda$ and how. In order to consider implications of the existence of Soros, it would be useful to refine multiple equilibria to clarify how one particular equilibrium is selected over another.

2.2 Non-Common Knowledge Case

A feature already familiar from the discussion of global games in the literature is that when $\varepsilon > 0$, the realization of Y will not be common knowledge among the speculators. Applying the global game approach, Corsetti, Dasgupta, Morris, and Shin (2004) have shown that in this case there is a unique equilibrium in which the small speculators use the switching strategy around X^* while Soros use the switching strategy around X^{**}. X^* is a threshold signal such that small speculators attack if and only if they receive a signal above this threshold. X^{**} is a threshold signal such that Soros attacks if and only if he receives a signal above this threshold. Moreover, Corsetti, Dasgupta, Morris, and Shin (2004) have shown that the presence of Soros does indeed make all other speculators more aggressive in their attacking.

A risk neutral speculator who receives the threshold signal is indifferent between attacking and not attacking provided that all other speculators attack if and only if they receive signals above their threshold signal. At state Y the probability that Soros' attack is successful is given by the probability that at least $a(Y) - \lambda$ out of m small speculators get signals above X^* and attack. This can be described by the binomial distribution. The probability that a single speculator gets a signal above X^* at state Y is $(Y - X^* + \varepsilon)/(2\varepsilon)$. Denoting the round-up of $a(Y)$ by $\hat{a}(Y)$, the expected payoff of attacking Soros with the threshold signal is

$$
\begin{aligned}
& EU(X^{**}) \\
= \; & \frac{1}{2\varepsilon}\int_{X^{**}-\varepsilon}^{X^{**}+\varepsilon} D\cdot \text{Prob}\left[k \geq \hat{a}(Y)-\lambda\right] dY \\
= \; & \frac{1}{2\varepsilon}\int_{X^{**}-\varepsilon}^{X^{**}+\varepsilon} D\cdot \left(1-\text{Prob}\left[k \leq \hat{a}(Y)-\lambda-1\right]\right) dY \\
= \; & \frac{1}{2\varepsilon}\int_{X^{**}-\varepsilon}^{X^{**}+\varepsilon} D\cdot \left(1-\sum_{k=0}^{\hat{a}(Y)-\lambda-1}\binom{m}{k}\left(\frac{Y-X^{*}+\varepsilon}{2\varepsilon}\right)^{k}\left(1-\frac{Y-X^{*}+\varepsilon}{2\varepsilon}\right)^{m-k}\right) dY \\
= \; & \frac{1}{2\varepsilon}\int_{X^{**}-\varepsilon}^{X^{**}+\varepsilon} D\cdot \left(1-\text{Bin}\left[\hat{a}(Y)-\lambda-1, m, \frac{Y-X^{*}+\varepsilon}{2\varepsilon}\right]\right) dY, \qquad (3)
\end{aligned}
$$

where Bin is the cumulative binomial distribution. The equilibrium threshold signal X^{**} is defined by

$$EU(X^{**}) = c. \qquad (4)$$

At state Y the probability that a small speculator's attack is successful is given by the sum of the following: (1) the probability that at least $a(Y)-\lambda-1$ out of $m-1$ small speculators receive private signals above X^{*} and Soros receive private signal above X^{**} and then they attack, and (2) the probability that at least $a(Y)-1$ out of $m-1$ small speculators receive private signals above X^{*} and attack but Soros receives private signal below X^{**} so he does not attack. Let the former be $P_1(Y)$ and the latter be $P_2(Y)$. Notice that private signals are independent across speculators (and hence between Soros and small speculators) conditional on Y. Therefore, these two probabilities can be written as follows.

$$\begin{aligned}
P_1(Y) &= \text{Prob}\left[\text{Soros attacks at state } Y\right] \cdot \text{Prob}\left[k \geq \hat{a}(Y) - \lambda - 1\right] \\
&= \text{Prob}\left[x_i \geq X^{**}\right] \cdot \Big(1 - \text{Prob}\left[k \leq \hat{a}(Y) - \lambda - 2\right]\Big) \\
&= \frac{Y - X^{**} + \varepsilon}{2\varepsilon} \cdot \left(1 - \text{Bin}\left[\hat{a}(Y) - \lambda - 2, m - 1, \frac{Y - X^{*} + \varepsilon}{2\varepsilon}\right]\right) \qquad (5)
\end{aligned}$$

$$\begin{aligned}
P_2(Y) &= \text{Prob}\left[\text{Soros does not attack at state } Y\right] \cdot \text{Prob}\left[k \geq \hat{a}(Y) - 1\right] \\
&= \text{Prob}\left[x_i < X^{**}\right] \cdot \Big(1 - \text{Prob}\left[k \leq \hat{a}(Y) - 2\right]\Big) \\
&= \left(1 - \frac{Y - X^{**} + \varepsilon}{2\varepsilon}\right) \cdot \left(1 - \text{Bin}\left[\hat{a}(Y) - 2, m - 1, \frac{Y - X^{*} + \varepsilon}{2\varepsilon}\right]\right). \qquad (6)
\end{aligned}$$

The expected payoff of an attacking small speculator with the threshold signal is

$$EU(X^*) = \frac{1}{2\varepsilon} \int_{X^*-\varepsilon}^{X^*+\varepsilon} D \cdot \Big(P_1(Y) + P_2(Y)\Big)\, dY. \qquad (7)$$

The equilibrium threshold signal X^* is defined by

$$EU(X^*) = c. \qquad (8)$$

3 Experimental Design

Sessions were run at a PC pool in the School of Political Science and Economics at Waseda University, Tokyo on June 28, 2005. There were 10 participants. Most of the participants were economics undergraduates. The experiment was programmed and conducted with the software z-Tree (Fischbacher (1999)). Instructions were read aloud. Throughout the sessions participants were not allowed to communicate and could not see others' screens.

First, we ran 1 session for No-Soros case. Next, we ran 1 session for Soros case.

In No-Soros case, there are 10 "small" subjects and no "large" subject (i.e., no Soros). In this case, the possible maximum number of N is 10 in No-Soros case.

In Soros case, subjects are split evenly into two groups. The session for Soros case was conducted in each group separately. Out of 5 subjects in each group, 4 subjects were "small" and 1 subject was "large" (Soros). We set $\lambda = 6$. Therefore, the possible maximum number of N in each group is again 10 ($m + \lambda = 4 + 6 = 10$ in each group) in Soros case.

Each session consisted of 10 independent rounds. In each round all subjects had to decide between alternatives A and B for 5 independent situations. In Soros case, 1 subject was randomly chosen as Soros in each round. Thus the subject who was chosen as Soros could be different across 10 rounds.

For each situation, a state Y, the same for all subjects, was randomly selected from a uniform distribution in the interval [30, 90]. Instead of being informed about Y, each subject received a private noisy signal, independently and randomly drawn from a uniform distribution in the interval [Y-10, Y+10]. These numbers were displayed with two decimal digits. We did not order the signals so as not to induce so-called threshold strategies. We did not conduct sessions with common information where subjects were informed about Y. In the preliminary experiment, we conducted only sessions with private information, concentrating on seeing the difference between No-Soros case and Soros case when signal are noisy and private.

The payoff for alternative A was ¥10 with certainty. The payoff for B was ¥30, if $N \geq a(Y) = 20 - Y/4$ held, zero otherwise. All parameters of the game and the rules were common knowledge except for drawn states Y and private signals.

Once all players had completed their decisions in one round, they saw — for each situation — the value of Y, how many people had chosen A, how many people had chosen B, payoff of A, payoff of B (which automatically showed whether action B was successful or not), and their individual payoffs. After all players had left the information screen a new round started and information of previous rounds could not be revisited. Subjects were allowed to take notes and many of them did.

After two sessions finished, participants had to respond to eight questions about their behavior in a questionnaire and were free to give additional comments regarding the experiment. Once the questionnaire was completed, each participant was paid in private.

The experiment length was about 100 minutes.

4 Results

Our main question is whether or not speculators attack the peg (i.e., subjects choose B) more aggressively in Soros case than in No-Soros case. In order to answer this question, we estimate the probability with which a subject i chooses B by fitting a logistic distribution function to observed choices.[3]

$$\text{Prob[Subject } i \text{ chooses B]} = \frac{\exp(\beta_0 + \beta_1 x_i + \beta_2 I[\text{Soros case}] + \beta_3 I[\text{Large}])}{1 + \exp(\beta_0 + \beta_1 x_i + \beta_2 I[\text{Soros case}] + \beta_3 I[\text{Large}])} \tag{9}$$

where I[Soros case] is a dummy variable which takes the value of unity in Soros case and zero in No-Soros case, and I[Large] is a dummy variable which takes the value of unity if a subject i is chosen as Soros and zero otherwise. Theoretical predictions of the global game solutions are the following.

1. A subject is more likely to choose B when he receives a larger signal ($\beta_1 > 0$).

2. A subject is more likely to choose B in Soros case than in No-Soros case ($\beta_2 > 0$).

3. A subject is more likely to choose B when he is chosen as Soros than otherwise ($\beta_3 > 0$).

4.1 Results: All Sample

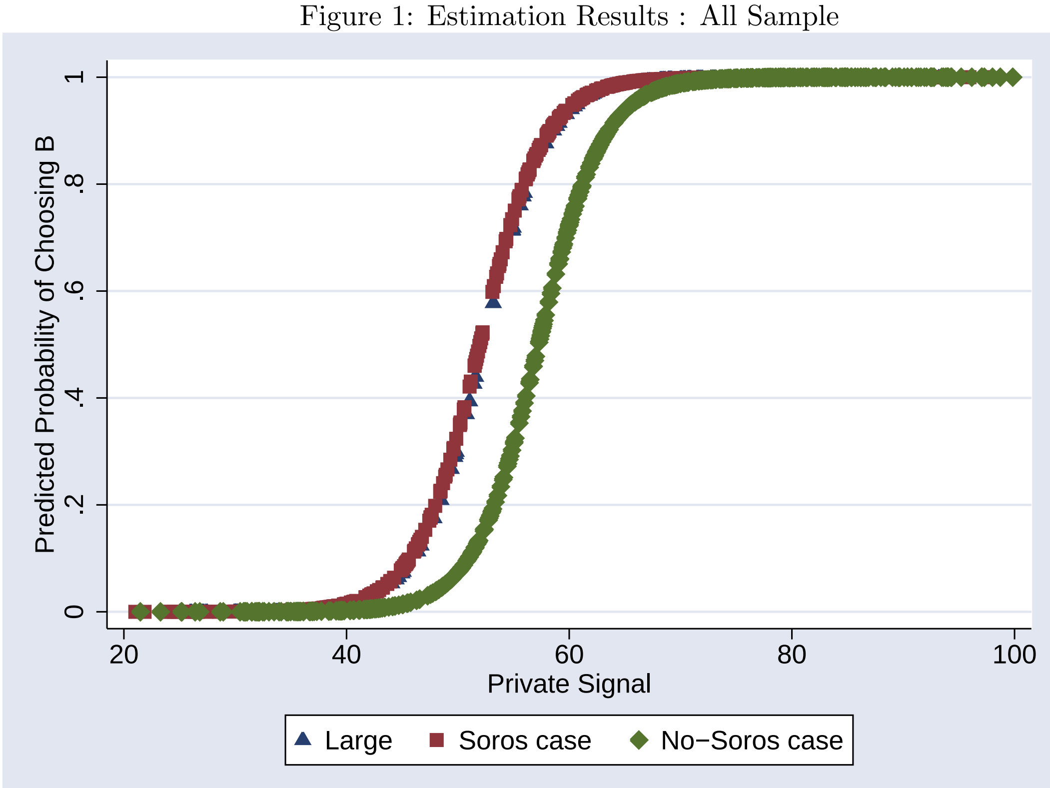
Estimation results obtained from all sample are summarized in Table 2. β_0, β_1 and β_2 are significant at the 1 % level. Moreover, the signs of β_1 and β_2 are positive as theoretical predictions. However, the sign of β_3 is negative, as opposed to theoretical prediction, although it is insignificant. This indicates a subject is *less* aggressive in attacking the peg when he is chosen as Soros than otherwise.

[3] The logistic distribution is more appropriate than the normal distribution, because we observe 'fat tails' due to irrational behavior of a few subjects who do not play threshold strategies. Moreover, estimation results of the probit model is qualitatively similar to those of the logit model. They are available upon request.

Table 2: Estimation Results : All Sample

Variable	**Coefficient**	**(Std. Err.)**	**(P value)**
Constant	-19.994	(1.685)	(0.000)
x_i	0.349	(0.029)	(0.000)
I[Soros case]	1.840	(0.363)	(0.000)
I[Large]	-0.114	(0.524)	(0.828)

Figure 1: Estimation Results : All Sample



Predicted probabilities of choosing B are depicted in Figure 1. The curve of the predicted probabilities of choosing B when the subject is *not* chosen as Soros in Soros case (the curve marked with the square symbol "■") is almost overlapped by the curve of the predicted probabilities of choosing B when the subject is chosen as Soros in Soros case (the curve marked with the triangle symbol "▲"). These two curves are positioned to the left of the curve of the predicted probabilities of choosing B in No-Soros case (the curve marked with the lozenge symbol "⧫"). This means that subjects are more likely to choose B in Soros case than in No-Soros case ($\beta_2 > 0$). Since the estimated coefficient on I[Large] is not so large in magnitude, two curves in Soros case are almost overlapped.

4.2 Results: Subsample

In theory, it is reasonable if the coefficient on I[Large] is positive. However the estimated coefficient is negative although it is insignificant. In this subsection we discuss why we obtain this seemingly inconsistent result. Then we discuss issues to note when we conduct "full" experiments.

First, we identified which subjects seemed to behave less aggressively when they were chosen as Soros. Their behavior appears to account for the inconsistent result. Then we asked them why they became less aggressive when they were chosen as Soros. Their answer was as follows. They wanted to be "the top trader": from their viewpoints, their *relative ranking* was more important than the absolute amount of money itself. To see the meaning of this in more detail, consider the following two cases. The first case is that you earn $1,000 when everyone else earns $2,000. The second case is that you earn $500 when every one else earns $100. If your objective is simply to maximize the absolute amount of money you earn, as in Corsetti, Dasgupta, Morris, and Shin (2004), you will prefer the first case to the second case. However if your objective is to be the top trader irrespective of the absolute amount of money you earn, you will prefer the second case, because your relative performance is the best in the second case and the worst in the first case. A few subjects had the latter objective function. What were their strategies to be the top trader? First, they "correctly" anticipated that other subjects were more likely to choose B in Soros case than in No-Soros case. Second, when they were chosen as Soros, *they chose A in order to make other subjects' likely choice of B fail.* Under certain situations, Soros has a "casting vote" in determining whether the choice B is successful or not. In other words, under certain situations the choice B is successful if and only if Soros chooses B, other things being equal. Suppose you are Soros in such a situation. If you want to maximize the absolute amount of money you get, of course you will choose B. But if you want to be the top trader, it might be optimal for you to choose A rather than B. In that case, the payoff for other subjects choosing B will be zero while your payoff will be c. In terms of relative ranking, you can go beyond other subjects by choosing A. Therefore, you have an incentive to choose B *less* aggressively when you are Soros under certain situations. In fact, this is why some subjects behaved less aggressively when they were chosen as Soros.

Although this "want-to-be-the-top-trader" behavior may be interesting, it is not the same as profit-maximizing behavior that Corsetti, Dasgupta, Morris, and Shin (2004) assumed. In Corsetti, Dasgupta, Morris, and Shin (2004), speculators care not about their relative ranking but only about their (expected) profit. We will not claim that profit-maximizing behavior is "correct" and "want-to-be-the-top-trader" behavior is "wrong". Rather our purpose in the experiments is to see whether the theoretical predictions of Corsetti, Dasgupta, Morris, and Shin (2004) would hold. In other words, we are interested in what would happen if every speculator behaves to maximize their profit irrespective of their relative ranking. Therefore, when we conduct "full" experiments, we will need to emphasize that we want participants to concentrate on maximizing their profit.

Through our conversations with subjects after the preliminary experiment, we found that subjects who "wanted to be the top trader" happened to be chosen as Soros after the 4th round. Until the 3rd round, subjects who concentrated on maximizing their profits irrespective of their relative ranking happened to be chosen as Soros. In order to see what had happened before subjects who "want to be the top trader" were chosen as Soros, we re-estimated equation (9) by using subsample: we exclude sample after the 4th round. This re-estimation uses all sample (10 rounds) in No-Soros case and subsample in Soros case (until the 3rd round). The results of this re-estimation may give us some flavor of a possible result of full experiments where all subjects concentrate on maximizing their profits.

The results are summarized in Table 3. β_0, β_1, β_2 are significant at the 1% level and β_3 is significant at the 5% level. Moreover, the signs of β_1, β_2 and β_3 are positive as theoretical predictions. This indicates that a subject is *more* aggressive in attacking the peg when he is chosen as Soros than otherwise. This is the same as the predictions of the global game solutions.

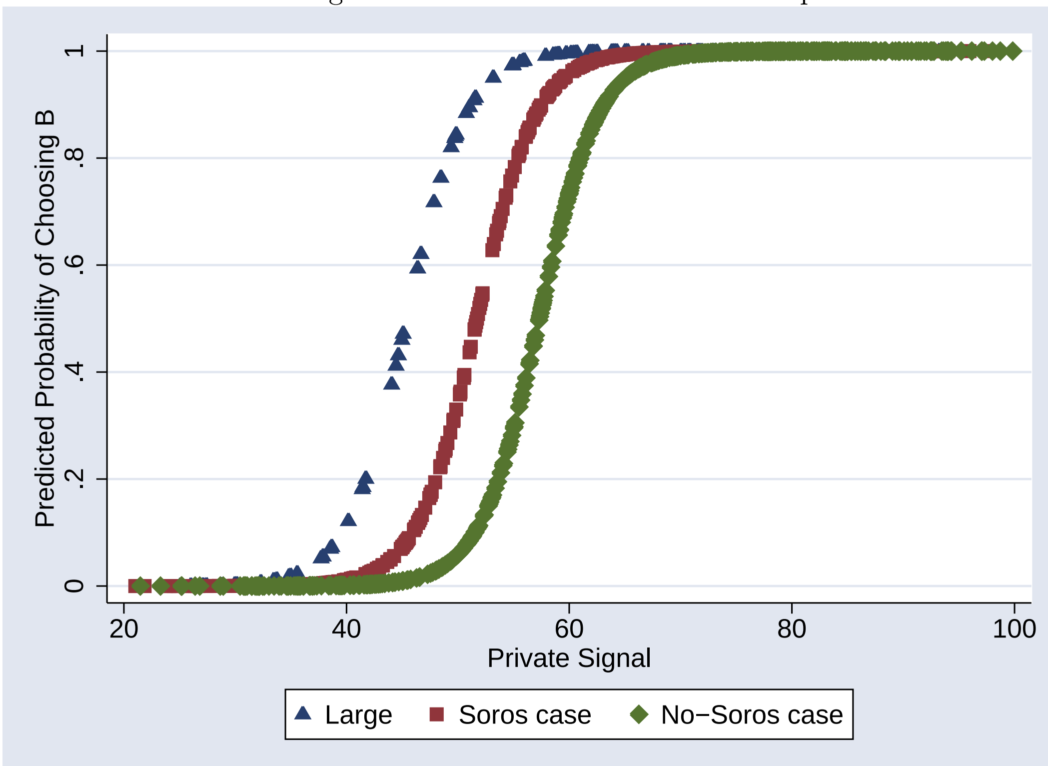
Table 3: Estimation Results: Subsample

Variable	**Coefficient**	**(Std. Err.)**	**(P value)**
Constant	-21.710	(2.302)	(0.000)
x_i	0.379	(0.039)	(0.000)
I[Soros case]	2.115	(0.560)	(0.000)
I[Large]	2.399	(1.014)	(0.018)

Predicted probabilities of choosing B are depicted in Figure 2. As can be seen, the curve of the predicted probabilities of choosing B when the subject is chosen as Soros is positioned to the extreme left. The curve of the predicted probabilities of choosing B when the subject is not chosen as Soros in Soros case is positioned in the middle. The curve of the predicted probabilities of choosing B in No-Soros case is positioned to the extreme right. This means that subjects are more likely to choose B in Soros case than in No-Soros case ($\beta_2 > 0$). Moreover, this means that subjects are more likely to choose B when they are chosen as Soros than otherwise ($\beta_3 > 0$).

The results of re-estimation indicate that we may be able to obtain the results that support Corsetti, Dasgupta, Morris, and Shin (2004) if we can adjust the experimental design such that all participants have the same objective function as the one in Corsetti, Dasgupta, Morris, and Shin (2004) (i.e., all participants are profit-maximizer). Therefore, when we conduct full experiments to test the predictions of Corsetti, Dasgupta, Morris, and Shin (2004), it will be very important to design such that all participants care about their profits irrespective of their relative ranking.

Figure 2: Estimation Results : Subsample



5 Conclusion and Future Research

This paper reported the results of a preliminary experiment designed to test the predictions of Corsetti, Dasgupta, Morris, and Shin (2004). In particular, the preliminary experiment tests (A) whether the large speculator makes other small speculators more aggressive in attacking the peg, and (B) whether the large speculator is more aggressive in attacking the peg than other small speculators. The preliminary results only partially support the theoretical predictions: while the large speculator makes other small speculators more aggressive, the large speculator is *less* aggressive in attacking the peg than other small speculators.

We argue that this result which differs from Corsetti, Dasgupta, Morris, and Shin (2004) is due to the fact that the objective function of some participants in the preliminary experiment were different from that of speculators assumed in Corsetti, Dasgupta, Morris, and Shin (2004). Indeed, if we exclude such participants from the sample, the estimated result is that the large speculator is *more* aggressive in attacking the peg than other small speculators. Thus we have to adjust the experimental design of full experiments such that all participants have the same objective function as the one assumed in Corsetti, Dasgupta, Morris, and Shin (2004).

References

CHEUNG, Y.-W., AND D. FRIEDMAN (2005): "Speculative Attacks: A Laboratory Study in Continuous Time," mimeo.

CORSETTI, G., A. DASGUPTA, S. MORRIS, AND H. S. SHIN (2004): "Does One Soros Make a Difference? A Theory of Currency Crises with Large and Small Traders," *Review of Economic Studies*, 71(1), 87–113.

FISCHBACHER, U. (1999): "z-Tree. Toolbox for Readymade Economic Experiments," IEW Working paper 21, University of Zurich.

FLOOD, R. P., AND P. M. GARBER (1984): "Collapsing Exchange-Rate Regimes: Some Linear Examples," *Journal of International Economics*, 17(1-2), 1–13.

HEINEMANN, F., R. NAGEL, AND P. OCKENFELS (2004): "The Theory of Global Games on Test: Experimental Analysis of Coordination Games with Public and Private Information," *Econometrica*, 72(5), 1583–1599.

KRUGMAN, P. (1979): "A Model of Balance-of-Payments Crises," *Journal of Money, Credit and Banking*, 11(3), 311–325.

MORRIS, S., AND H. S. SHIN (1998): "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks," *American Economic Review*, 88(3), 587–597.

OBSTFELD, M. (1996): "Models of Currency Crises with Self-Fulfilling Features," *European Economic Review Papers and Proceedings*, 40(3-5), 1037–1047.