Bounded Rationality Mitigates the Free-Rider Problem:

An Experimental Study on Corporate Takeovers*

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Abstract

This paper explores how bounded rationality of stock market traders affect corporate takeover outcomes. Creating experimental markets, we test two rational takeover models: Grossman and Hart's free-rider model and Shleifer and Vishny's toeholds model. Our experimental results depart from their theoretical predictions; we observed a considerable number of noise traders in the markets. In Grossman and Hart's market, the traders' bounded rationality mitigated the free-rider problem and led to successful takeovers. In Shleifer and Vishny's market, a large part of the toeholds effect arose not from Shliefer and Vishny's tendering effect, but from the number effect caused by noise traders. Our experimental findings provide the bounded rationality explanations for takeover success and the toeholds effect observed in reality.

About two decades ago, Grossman and Hart (1980) presented a theoretical proposition on takeover outcomes: corporate takeovers *never* succeed. They suggest that if a small shareholder knows that her share value will rise after the takeover success, she prefers to hold on to her shares rather than selling them to the bidder. That is, the shareholder attempts to free-ride on the benefit of a successful takeover. This rational behavior of shareholders, however, results in the socially inefficient outcome that takeovers will never be successful. This is the free-rider problem in corporate takeovers. Furthermore, Grossman and Hart (1981) developed this idea under information asymmetry (the post-takeover value is known only to a bidder, not to shareholders) and found that their free-rider proposition still hold up as long as shareholders form rational expectations.

Grossman and Hart's free-rider proposition has been widely known among academic economists. It sometimes appears in several textbooks of finance and game theory (e.g., Grinblatt and Titman (1998), Rasumusen (2001)). In corporate governance literature, the free-rider problem is often discussed as one of the drawbacks with the operation of takeover mechanism (Shleifer and Vishny (1997), Allen and Gale (2000)). In addition, in theoretical research of corporate takeovers, Grossman and Hart's result seems to have already become a classical proposition[1] and is accepted as a starting point for a considerable number of takeover models[2]

However, the reality seems opposite to their proposition. We observe that a significant number of corporate takeovers have been successful over the past few decades. Hoffmeister and Dyl (1981) find that among 84 cash tender offers made during 1976 and 1977 in the U.S., 73.8% of them (62 offers) were successful. Walking (1985) reports that using his U.S. sample of 108 takeover offers during 1972-76, 66.7% of them (72 offers) succeeded. Duggal and Millar (1994) examine 287 tender bids involving firms

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[1] For example, Bebchuk (1989) states in the introduction to his paper, "In an already classical paper, Grossman and Hart (1980) advanced the proposition … ".

[2] Shleifer and Vishny (1986), Bradley, Desai, and Kim (1988), Bagnoli and Lipman (1988), Bebchuk (1989), Hirshleifer and Titman (1990), Kyle and Vila (1991), Holmstrom and Nalebuff (1992), Harrington and Prokop (1993), Burkart, Gromb and Panunzi (1998), etc.. Hirshleifer (1995) presents a good survey of various takeover

listed on the New York Stock Exchange or the American Stock Exchange during the period 1984-1987, and show that the probability of takeover success is 55.4% (159 of 287 succeeded). Betton and Eckbo (2000), in their comprehensive study for 1353 tender offer contests from 1971 to 1990, report that the probability of takeover success for overall sample is 79%. In addition, Jensen (1993) convincingly shows that the market for corporate control was especially active in the U.S. during the 1980s and suggests that successful takeovers improve corporate efficiencies and raise social welfare. These results and views seem to reject Grossman and Hart's proposition; there is no serious free-rider problem preventing takeover success.

Why do we observe successful takeovers? Subsequent takeover models indicate that there are several institutional remedies for the free-rider problem. Shleifer and Vishny (1986) show that when a bidder has initial shareholdings (toeholds), she can realize takeover success. Bradley, Desai, and Kim (1988) suggest that two-tiered offers may resolve the free-rider problem. Bebchuk (1989) indicates that with unconditional offers, takeovers succeed with positive probabilities[3]. Bagnoli and Lipman (1988) and Holmstrom and Nalebuff (1992) find that when shareholders are not atomistic, they have incentives to tender the shares.

In this paper, we wish to suggest another factor that realizes the takeover success—bounded rationality of stock market traders. We conjecture that some stock market traders are not as rational as Grossman and Hart assume and their noise trading leads to successful takeovers. For example, it may be the case that some shareholders sell the shares to gain immediate profits, neglecting the post-takeover value of their shares. In addition, under the asymmetric information, Grossman and Hart's proposition requires shareholders to have rational expectations: the shareholders rationally expect that the post-takeover value should be higher than the bid, based on their beliefs about the bidder's rationality. This expectation

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models.

[3] In fact, Grossman and Hart (1980)(1981) themselves assume an unconditional offer (an offer committing the bidders to purchase tendered shares whether or not takeovers succeed). In corporate finance literature, however, the free-rider-proposition is usually argued under a conditional offer because the proposition is most likely to prevail (See, Hirshleifer (1995) and Grinblatt and Titman (1998)). Following this standard treatment, this paper

formation process may not be easy for some shareholders[4], and they may choose to tender or not without forming the rational expectations. Furthermore, Roll (1986) suggests that bidders sometimes make mistakes: they bid over the post-takeover value due to the winner's curse. Considering the possibility of the bidder's overbid, shareholders may regard tendering as more profitable than non-tendering. These kinds of bounded rational behavior should not be ignored, as behavioral finance literature indicates that stock market traders do not necessarily behave rationally (Shiller (2000), Shleifer (2000)). Therefore, it seems worthwhile to examine if traders' bounded rationality makes shareholders to tender the shares and enables takeovers to be successful, even without any institutional remedies for the free-rider problem.

This bounded rationality explanation for takeover success, however, seems difficult to be examined by empirical studies. This is because empirical research uses field data affected by many different factors in complicated real takeover markets and is hard to detect the effect of traders' rationality on takeover outcomes. On the other hand, experimental studies have an advantage in controlling environments and give an opportunity to examine this issue directly. This is the reason we adopt an experimental approach in this paper.

We construct simple laboratory markets for corporate takeovers as close as to Grossman and Hart's model as possible and examine the validity of Grossman and Hart's proposition ([Experiment A]). In our experimental market, there are no institutional remedies for the free-rider problem (no dilution opportunities, no two-tiered offers, no unconditional offers, no toeholds), and our original experimental device is made to have markets close to atomistic. In some sense, we design our laboratory "explicitly to give the model its best chance"(Plott (1989, 1166)). If we observe that a significant number of shareholders tender the shares (i.e., Grossman and Hart's proposition is rejected) in this controlled laboratory, we can conclude that the traders are not as rational as Grossman and Hart's shareholders and their bounded

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explores the free-rider problem under the conditional offer.

[4] Arrow (1986) argues that assuming not only each agent's rationality but also his knowledge of other agents' rationality is incompatible with the cognitive limits of the human being.

rationality leads to successful takeovers.

In addition to the free-rider problem, we explore the effect of a bidder's initial shareholdings (toeholds) on takeover success. The bidder's toeholds are regarded by financial economists as one of the means of solving the free-rider problem. As we briefly mentioned above, Shleifer and Vishny (1986) argue that when a bidder has toeholds, she can internalize the benefits of the takeover, thus overcoming the free-rider problem[5]. Consistent with their prediction, Walking (1985) and Betton and Eckbo (2000) find a positive effect of the bidder's toeholds on takeover success. In our view, however, it is unclear whether this effect comes from Shleifer and Vishny's story, because their story crucially depends upon the assumption that both bidders and shareholders are rational and their rationality is common knowledge. We create the laboratory where a bidder has 20% toeholds ([Experiment B]) and test Shleifer and Vishny's proposition directly.

To our knowledge, there have been two experimental studies of corporate takeovers. One is Kale and Noe's (1997) study that examines the validity of the non-atomistic shareholder models (Bagnoli and Lipman (1989) and Holmstrom and Nalebuff (1992)). Their experimental results support these models in some designs, but do not in other designs. Also, Cadsby and Maynes (1998) test Holmstrom and Nalebuff's (1992) model in a laboratory environment where shareholders own more than one share. Their experimental results are inconsistent with that model's predictions. These two experimental studies focus on testing non-atomistic takeover models and explore whether or not (and to what extent) the free-rider problem is alleviated by the non-atomistic shareholders. On the other hand, our study tests the atomistic shareholder models (Grossman and Hart (1980)(1981) and Shleifer and Vishny (1986)) and investigates how traders' bounded rationality affect takeover outcomes.

We find the following from our laboratory. First, when a bidder has no toeholds (Grossman and Hart's

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[5] Hirshleifer and Titman (1990) examine the effect of toeholds on takeover success by using the same setting as Shleifer and Vishny (1986), but employing a more sophisticated equilibrium concept, the perfect Bayesian equilibrium. We also examine the validity of their model in our laboratory.

market), about 40% of shareholders tender the shares and consequently 21% of takeovers succeed. This result suggests that shareholders are not necessarily rational and most of shareholders make decisions with some noise. Interestingly, the traders' bounded rationality mitigates the free-rider problem. Second, when a bidder has 20% toeholds (Shleifer and Vishny's market), the probability of takeover success rises to 67%. Hence a bidder's toeholds increase the probability of takeover success significantly. This toeholds effect, however, does not come from the Shleifer and Vishny's story (more shareholders' tendering induced by higher bids). A large part of the toeholds effect results from the number effect (fewer shares needed to complete takeovers) when there are noise traders in the market. In sum, our results suggest that bounded rationality significantly affects the outcomes of takeover markets.

This paper is organized as follows. Section 1 reviews two rational takeover models: Grossman and Hart's free-rider model and Shleifer and Vishny's toeholds model. Section 2 describes our laboratory takeover markets and explains experimental procedures. Section 3 presents the hypotheses of the rational models to be tested. Sections 4 and 5 discuss our experimental results. Section 6 examines the possible biases in our laboratory and explores the robustness of our results. Section 7 summarizes our findings and discusses their implications.

1. Theoretical Overview

In this section, we briefly review two takeover models that analyze the free-rider problem under the atomistic shareholder assumption. First, we illustrate Grossman and Hart's (1980)(1981) classical proposition. Second, we discuss the results of Shleifer and Vishny (1986) on the toeholds effect. In reviewing these papers, we suggest that their propositions crucially depend on the assumption that stock market traders make rational decisions and form rational expectations.

1.1 The Free-rider Problem in Corporate Takeovers

Suppose that one bidder (raider) attempts to take over the firm by purchasing the firm's shares from atomistic shareholders. The bidder does not initially hold any shares of the target firm, and she offers a bid price per share x under a conditional offer. The shareholder observes x and decides whether to tender her shares. If the bidder can successfully purchase 50% of the firm's total shares, S, then she succeeds in the takeover; she gains control of the firm and improves the value of the firm by the amount $z > 0$ per share. This z is private information for the bidder: the bidder knows its value but the shareholders only know that it follows a certain prior distribution[6]. On the other hand, if the bidder cannot acquire 0.5 of the shares, then she fails in the takeover; she does not purchase any shares and cannot realize the increase in firm value. We assume that the pre-takeover value of the firm under the incumbent management is zero[7]. Since z is positive, it is obvious that the success of the takeover produces social benefits. Then, the important point to explore is whether such a value-increasing takeover can succeed or not.

Grossman and Hart (1980)(1981) argue that this type of takeover *never* succeeds. They deduce this striking result by pointing out there is a free-rider problem among shareholders.

If the takeover is successful, the bidder's profit is 0.5S (z - x). Therefore, to obtain some gain from this takeover, the bidder must make the bid x smaller than the post-takeover value of the share z, i.e., $x < z$. This $x < z$ is the bidder-profitability condition.

Next, let us consider the shareholders' decisions. First, suppose that the takeover is successful. Then, the shareholder can obtain the bid price x per share if she has chosen to tender shares whereas she obtains z per share if she holds on to her shares. On the contrary, suppose that the takeover is unsuccessful. Then, no transactions occur between the bidder and shareholders, and hence the shareholder earns zero profits whether or not she has chosen to tender her shares. This shareholder's payoff is summarized in Table 1. In addition, since each shareholder is atomistic, her tender decision has no impact on the outcome of the

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[6] After Grossman and Hart's (1980)(1981) papers, theoretical models of the free-rider problem usually assume information asymmetry regarding the post-takeover value and examine how shareholders formulate their expectations of that value. (Shleifer and Vishny (1986), Hirshleifer and Titman (1980), Chowdhry and Jegadeesh (1994), and Bris (2002)). Therefore, throughout this paper, we explore the free-rider problem and the possibility of takeover success under this information asymmetry setting.

takeover. Under these conditions, the (weakly) dominant strategy for the shareholder is to accept the offer if $x > z$[8], and to reject the offer if $x < z$. Therefore, $x > z$ is the shareholder-acceptability condition.

In the world where z is private information for a bidder, a shareholder must predict z in order to determine her action. However, as long as the shareholder forms rational expectations, she realizes that the bidder makes the offer $x < z$ to earn profits, and hence the shareholder expects that x is lower than z. Therefore, shareholders will reject this offer attempting to obtain the post-takeover value z. That is, she does not contribute to the success of the takeover, but seeks to free ride on the benefit of its success. This self-interested behavior of each shareholder, however, leads to the socially inefficient outcome that a value-increasing takeover always fails. This is Grossman and Hart's classical proposition.[9]

Proposition 1 (Grossman and Hart (1980)(1981))

> When the post-takeover value z is unknown to atomistic shareholders and the bidder has no initial shareholdings, no shareholders tender the shares and takeovers can never be successful.

We believe that this free-rider proposition is persuasive for most academic economists, since the model is based on the normal assumption of economics that people are rational and form rational expectations. In deriving Proposition 1, we have assumed that shareholders (i) fully understand their payoff matrices (Table 1), and (ii) rationally expect z by observing x, based on their beliefs on the bidder's rationality.

This presumption, however, is not without its critics. Some scholars suggest that human beings do not behave as rationally as economists usually assume, but that they are at best boundedly rational. In fact, there are a significant number of empirical and experimental evidence for the bounded rationality in human

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[7] This simplifying assumption is the same as that in Hirshleifer and Titman (1990).

[8] If we assume that shareholder accept the offer when they are indifferent about whether or not to tender their shares, this condition can be rewritten as $x \geq z$.

[9] In Grossman and Hart (1980)(1981), they make the stronger argument than this; when there are some costs of the takeover *C*, takeovers never occur because the bidder will lose *C*.

behavior[10]. Given these evidence, it seems reasonable to suppose that some shareholders may not satisfy the above conditions, (i) or (ii), and might tender the shares; takeovers sometimes succeed. We explore this possibility in our laboratory.

1.2 The Bidder's Toeholds and the Takeover Success.

Next, consider the case where the bidder initially holds some shares of the target firm. Let α represent the proportion of the firm's shares owed by the bidder (we assume $0 < \alpha < 0.5$). Then, the bidder's profits from the successful takeover can be written as

$$[\alpha z + (0.5 - \alpha)(z - x)]\ S \qquad (1)$$

Notice that the bidder obtains some gains (αz) from her initial holdings (toeholds) if takeovers are successful. In other words, the bidder can internalize a part of the increase in firm value generated by successful takeovers. This means that the bidder with toeholds has a greater incentive to make the takeover succeed and can also afford to offer a higher bid to facilitate shareholders' tendering. In fact, the bidder-profitability condition (which assures the bidder of positive profits from successful takeovers) in this case can be written as

$$x < [0.5/(0.5-\alpha)]z. \qquad (2)$$

As $[0.5/(0.5-\alpha)]$ is greater than 1, (2) implies that the bidder can make the bid x greater than z.

Shleifer and Vishny (1986) argue that shareholders expect z rationally. The rational shareholders would recognize that the bidder must make a profitable bid and hence the bid satisfies (2). Then after observing the bid x, they would expect that

$$z > [(0.5-\alpha)/0.5]\ x \qquad (3)$$

from (2).

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[10] Conlisk (1996) offers an excellent survey.

Let us develop this point in more detail. For simplicity, assume that z's prior distribution is uniform on $[0, z_{max}]$. Then, from (3), the shareholders' conditional expected value of z, E(z | x), is

$$E(z \mid x) = [\, [(0.5-\alpha)/0.5]x + z_{max}\,]/2. \qquad (4)$$

For the shareholder to accept an offer, the bid x must be larger than this expected value of z. Hence, we can state the shareholder's acceptability condition as

$$x \;>\; [\, [(0.5-\alpha)/0.5]x + z_{max}\,]/2. \qquad (5)$$

Notice that as a bidder makes the bid x (the left-hand side) higher, shareholders' expectation of z (the right-hand side) becomes higher, but the latter increase is not as large as the former (dE(z | x)/dx is positive but less than one). Therefore, we know that there exists an x which satisfies (5). Rearranging (5), we get

$$x \;>\; [z_{max} / (1+2\alpha)] \;\equiv\; x_c\,. \qquad (6)$$

(6) says that shareholders accept an offer if the bid x is greater than the critical value x_c. Thus, with a bid greater than x_c, all shareholders tender the shares and takeovers are successful with the probability of one. Also, we know from (2) that a bidder whose z is greater than $[(1–2\alpha)\, z_{max} / (1+2\alpha)]$ ($\equiv z_c$) can obtain positive profits with these bids. Therefore these bidders would offer a bid $x > x_c$[11]. That is, takeovers succeed when z is greater than z_c and this high-z-bidder makes a bid greater than x_c.

To summarize, under our assumption of uniform distribution of z, we can restate Shleifer and Vishny (1986)'s propositions as follows.

Proposition 2 (Shleifer and Vishny (1986))

When the post-takeover value z is unknown to the atomistic shareholders, z follows uniform distribution $[0, z_{max}]$, and the bidder initially holds the fraction of α of the shares of the target firm,

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[11] If a bidder considers that shareholders certainly tender their shares if they are indifferent about whether or not to do so, the shareholder acceptability condition (6) includes equality and a bidder's best strategy becomes $x = x_c$ (Hirshleifer and Titman (1990, 296) point out this). In this case, the prediction of a bid price by Shleifer and Vishny's (1986) model becomes more restricted.

2-1. when x is greater than x_c, all shareholders tender the shares and takeovers always succeed,

2-2. when z is greater than z_c, a bidder offers x greater than x_c, and

2-3. when z is greater than z_c, takeovers always succeed,

where $z_c \equiv [(1-2\alpha)\, z_{max} / (1+2\alpha)]$ and $x_c \equiv [z_{max} / (1+2\alpha)]$.

This proposition suggests that when the bidder initially holds the shares of target firm and has high z, she can succeed in value-increasing takeovers. In other words, the free-rider problem in corporate takeovers can be solved by the bidder's initial toeholds. The proposition also indicates that the probability of takeover success and shareholders' tendering decisions are increasing step functions of the post-takeover value z and the bid price x.

We should note that Proposition 2 is derived assuming the higher-level rationality of traders compared to Proposition 1. First, Proposition 2-1 imposes on shareholders a harder task in expecting z: shareholders must recognize equation (2) and conduct the expectation calculation of z using equation (4). Second, Proposition 2-2 requires a bidder to rationally recognize the above shareholders' expectation formation process. Lastly, Proposition 2-3 becomes valid only when both Propositions 2-1 and 2-2 hold.

Hence the empirical validity of Proposition 2 crucially depends on to what degree a bidder and shareholders behave rationally and they rationally predict other party's rational behavior. Hirshleifer and Titman (1990) claim that when shareholders are boundedly rational (there is some perturbations on the shareholders' prediction or shareholders have some personal costs or benefits of tendering which are unknown to the bidder), the takeover succeeds probabilistically and the probability of takeover success is continuously increasing in the bid price x. Their results suggest that the bounded rationality of traders may significantly change Shleifer and Vishny's results. We test Shleifer and Vishny's propositions in the controlled laboratory and examine how takeover outcomes are affected by the traders' bounded rationality.

2. Experimental Design and Procedures

To test Grossman and Hart's and Shleifer and Vishny's propositions, we create takeover markets in laboratory. Since we focus on whether takeover success is caused or affected by the traders' bounded rationality, we wish to exclude any institutional factors that might affect takeover outcome (two-tiered offers, unconditional offers, dilution opportunities, non-atomistic shareholders) except the bidder's toeholds. In other words, we construct experimental markets as close to Grossman and Hart's and Shleifer and Vishny's models as possible and directly test their propositions that are derived from the rational traders' assumptions. If their propositions are not supported in this controlled environment, we are able to suggest that takeover outcomes are significantly influenced by the trader's bounded rationality. We describe our experimental design and procedure below.

Our experiments were conducted in November 1997, January 1998, and May 1998 using undergraduate students at Osaka University who volunteered to participate in a "decision-making game". In order to mitigate any value biases, we (the experimenters) did not use any terms that would indicate that the experiment was about takeovers.[12] We told participants that they were buying and selling commodities in the experiment. Thus, during the experiments, words about takeovers used in this paper (e.g. "bidder", "shareholder", "share") were replaced by those about commodity trading (e.g. "buyer", "seller", "commodity").

In the experiments, a group consists of one bidder and twenty shareholders. Before the experiment, the experimenter assigns roles to each participant by lottery. These roles are fixed during the experiment.

From the instructions, both the bidder and the shareholders know that i) the post-takeover value z varies from 0 to 200 at intervals of every 10 number, ii) Each period z will be determined at random by the instructors, and iii) z is revealed only to the bidder, but not to the shareholders (asymmetric information).

The experiment consists of 20 rounds for each group. One round of the experiment proceeds as follows.

1) The experimenter informs the bidder of z (0, 10, 20, … 180, 190, 200),

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[12] In this respect, we follow the previous experiments of Kale and Noe (1997) and Cadsby and Maynes (1998).

2) Looking at the value of z revealed by the experimenter, the bidder offers a bid price x.

3) Observing the bid price x, shareholders choose either "to tender" (accept the offer) or "not to tender" (reject the offer).

4) Finally, the experimenter announces to all of the participants the number of shareholders who have tendered the shares, and the value of z for this round.

This is one round of the experiment. It is repeated 20 times. The 20-round length is common knowledge to all participants. The reason why we repeated the same game is that we would expect subjects to learn from their feedback. Also, no communication is allowed throughout the experiment. Each participant sits at her desk with side-board blinders to ensure as much privacy and anonymity as possible.

We conducted two kinds of experiments, [Experiment A] and [Experiment B]. These two differ according to whether or not the bidder initially holds the shares of the target firm. In [Experiment A], a bidder initially has no shares, and each shareholder owns one share (i.e., shareholders as a whole have 20 shares). We call this case the *no toeholds case* (*Grossman and Hart's market*). In this case, when the bidder can purchase the shares from 10 shareholders or more, she succeeds in the takeover. Then the bidder's payoff is 10 (z – x), and the shareholders who have accepted the offer (tendered) obtain the offer price x while the shareholders who have rejected the offer (not tendered) obtain the post-takeover value z.[13] [14] When 9 shareholders or less accept the offer, the takeover fails. Then, no transaction occurs,[15] and both the

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[13] In fact, in determining each shareholder's payoff, we judge the takeover outcome by the numbers of shareholders to accept the offer *other than her.* We will explain this point later.

[14] This shareholder payoff structure assumes that shareholders, having decided to tender, can sell their shares with *certainty* in successful takeovers. Although this "certainty assumption" is introduced to make shareholders' decisions easier, it contradicts the bidder's behavior in our setting in that she never buys more than 10 shares in successful takeovers. For consistency of the experimental procedures, we would have to drop this certainty assumption and adopt the "uncertainty assumption", determining by lottery which shareholders could sell the shares when the number of tendering shareholders is more than 10 in successful takeovers. We can show, however, that the optimal tendering strategy of shareholders under the uncertainty assumption is the same as that under the certainty assumption ('not tendering' is the weakly dominant strategy for shareholders under both assumptions). Therefore, we adopt the certainty assumption for simplicity in our experiments.

[15] We consider conditional offers. See footnote 3.

bidder's and shareholders payoffs are zero.[16]

In [Experiment B], the bidder initially holds 5 shares, while each shareholder holds one share as in [Experiment A]. That is, the bidder's toeholds are 20% (5/25) of the shares (α=0.2). We call this case the *toeholds case* (*Shleifer and Vishny's market*). In this case, when the bidder can purchase the shares from 8 shareholders or more, she obtains more than half of the shares ((5+8)/25) and succeeds in the takeover. Then, the bidder' payoff is 5z + 8(z – x), while the shareholders' payoffs are the same as in [Experiment A]. When 7 shareholders or less accept the offer, the takeover fails, and all the participants' payoffs are zero.

In addition, we tried to make as rational a bidder and shareholders as possible in the laboratory to give Grossman and Hart's and Shleifer and Vishny's propositions their best chance. One key factor might be whether shareholders can expect the post-takeover value z by observing the bid price x using the bidder's profitability condition (z > x in the no toeholds case and z > [(0.5-α)/0.5]x in the toeholds case). Hence, in addition to repetition of the rounds, we add one more devise in the experiments for 8 of 10 groups (Groups A-2, A-3, A-4, A-5 and Groups B-2, B-3, B-4, and B-5). For these groups, we give the bidder's payoff calculation table (Buyer's Payoff Sheet 2, see Appendix) to shareholders as well as to bidders to help shareholders form the rational expectation of z.

Our experimental markets exclude the opportunities of two-tiered offers, unconditional offers, and the dilution but still include the other institutional factor that may affect takeover outcome—non-atomistic shareholders. Bagnoli and Lipman (1988) and Holmstrom and Nalebuff (1992) show that when there are only a finite number of shareholders, each shareholder determines her tendering decision by recognizing its impact on the probability of success, and consequently she has more incentive to tender; takeovers are successful even in the no toeholds case. This implies that, under usual laboratory settings, unless we gather an infinite number of participants for experiments, we are unable to exclude non-atomistic shareholders'

[16] This setting is the same as in the models we addressed in Section 1.

behavior. [17]

Therefore, to create the atomistic market as in Grossman and Hart's and Shleifer and Vishny's models, we need to construct some experimental device that makes each shareholder choose her decision without considering its effect on the probability of takeover success. For this purpose, we judge the takeover outcome (success or failure) for each shareholder by the number of shareholders to tender *other than herself*. To be specific, in [Experiment A] ([Experiment B]), if 10 (8) or more shareholders *other than her* tender, we say that the takeover is successful for her, and she obtains the payoff in the case of takeover success (gets x if she has tendered, z if she has not). In this setting, each shareholder's tendering decision does not affect the outcome of takeovers for that shareholder and she is expected to decide whether to tender as if she were an atomistic shareholders. On the other hand, for the bidder (and for us, experimenters), we follow the usual rule, i.e., takeovers succeed if 10 (8) or more shareholders accept the offer in [Experiment A] ([Experiment B]).[18]

For more details about our experimental procedures, see the players instruction sheets that are shown in the Appendix. We conducted [Experiment A] and [Experiment B] for five groups each. As one group consists of 21 persons (one bidder and 20 shareholders), 210 students participated the experiments. All students were inexperienced in the sense that they had not participated in such an experiment before. We

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[17] One may argue that 20, the number of shareholders in our experiment, is large enough to ensure atomistic shareholder markets. However, this intuitive argument is false. The results of the non-atomistic shareholder models indicate that even when the number of shareholders is 20, each shareholder's decision and the takeover outcome differ considerably from those under atomistic shareholder markets. For example, let us suppose that the post-takeover value z is 100 and a bidder with no initial shares offers a bid price (x) of 75. Then, using equation 2 of Kale and Noe's (1997) paper, we obtain the theoretical results that (i) each of the 20 shareholders chooses the mixed strategy where she tenders her share with probability of 0.506; (ii) the probability of takeover success is 60.94%. These results are far from Grossman and Hart's results (no shareholders tender and no takeovers are successful). Judging from this numerical example, in the usual laboratory setting we cannot expect that 20 shareholders behave as atomistic shareholders would.

[18] Under our experimental device, different takeover outcomes among the participants may occur in the same round. For example, suppose that just 10 shareholders accept the offer in [Experiment A]. Then a takeover is successful for a bidder and non-tendering shareholders, but it is unsuccessful for tendering shareholders because the number of tendering shareholders *other than* each tendering shareholder is 9. These different outcomes among the participants seem odd, but we consider that this possibility does not significantly affect the behavior of each participant.

paid the participants monetary rewards related to the payoffs they gained in the experiment. Average monetary rewards of participants were \$ 24.44 (3,177 yen if \$1.00 = 130 yen) for sellers and \$ 28.71 (3,732 yen) for bidders. It took about 110 minutes to conduct one experiment.

3. Hypotheses

Under these experimental settings, we test Grossman and Hart's and Shleifer and Vishny's rational traders' models. We have the following hypotheses for [Experiment A] and [Experiment B] .

[Experiment A] (a bidder has no initial shares of the target firm)

Hypothesis A-1: No shareholders tender the shares and takeovers never succeed.

This hypothesis is the restatement of Proposition 1 (Grossman and Hart's proposition). We would observe this result if a bidder and shareholders are always as rational as economic theorists assume.

[Experiment B] (a bidder initially has the fraction 0.2 of the shares of the target firm)

Hypothesis B-1: Takeovers always (never) succeed when $z > (<)$ 85.71.

Hypothesis B-2: All (No) shareholders tender the shares and takeovers always (never) succeed when $x > (<)$ 142.86.

Hypothesis B-3: x (bid price) is greater than 142.86 when $z > 85.71$.

These hypotheses are obtained by substituting the parameters of [Experiment B] ($\alpha = 0.2$, $z_{max} = 200$) into z_c and x_c in Proposition 2 (Shleifer and Vishny's proposision)[19].

4. The Results of [Experiment A]

4.1 Overview

We present the experimental results of [Experiment A] in Table 2. This Table 2 indicates information about

[19] We assume that shareholders consider that z follows the uniform distribution. This assumption is reasonable because they know from the instructions that z is determined at random in each period.

the value of z presented to the bidder by the experimenter[20], the bid price x offered by the bidder, and the numbers of shareholders who tendered the share for each round. The bottom three rows of the table present the average bid price, the tendering probability (total number of tendering shareholders / total number of shareholders (20×20)), the number of rounds of successful takeovers, and efficiency (defined later) for each group. This Table 2 clearly shows the first result in our laboratory.

Result A-1: A substantial number of shareholders tender the shares and takeovers can be successful even in the no toeholds case.

In Table 2, we easily observe that the number of sellers to tender is far from zero in each round. For example, in the first round of Group A-1, z is 150, x is 100, and 13 (of 20) shareholders tendered the shares. In the second round of Group A-1, z is 100, x is 80, and 9 shareholders chose to tender. Although Grossman and Hart's proposition states that no shareholders tender at all, we do not find any rounds consistent with their proposition. As a natural consequence of this, takeovers were successful in some rounds (successful rounds are indicated by the bold letters of the number of tendering shareholders in the table). For example, in group A-1, takeovers succeed in 5 of 20 rounds (Rounds, 1, 6, 7, 15, and 18). Also, there are 3, 4, 1, and 8 successful rounds in Groups A-2, A-3, A-4, and A-5, respectively.

In addition, we calculate the economic efficiency of takeovers for each group. As we mentioned in section 1, the takeovers we examine in the present paper are all value-increasing because they realize the positive post-takeover value z if they are successful. Hence, from a social point of view, it is desirable that all takeovers succeed. In order to find to what degree these post-takeover values z are realized by successful takeovers, we define the *efficiency* of each group as

efficiency = (the sum of z realized by successful takeovers over the 20 rounds / the sum of z over the 20 rounds)

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[20] The value of z for each period had been determined by the experimenter with dice before the experiments. To make comparisons easily, we used the same stream of z for all the groups.

This *efficiency* represents the percentage of the post-takeover values actually realized by successful takeovers compared to post-takeover values given by the experimenter for one group. According to Grossman and Hart, this efficiency measure should be zero because they expect no takeovers succeed. The efficiency for each group in our laboratory is shown in the last row of the table. We notice that this measure ranges from 2.19% (Group A-4) to 41.67% (Group A-5), which shows that some of social value are actually realized as a result of takeover success.

Table 3 summarizes the results of the shareholders' tendering decisions, the probability of takeover success, and efficiency for all the groups of [Experiment A]. Panel A shows that 794/2000 shareholders choose to tender the shares and hence shareholders' tendering probability is 0.397 (39.7%) in [Experiment A]. About 40% of shareholders tender the shares even in the no toehold case, which considerably departs from 0% of Grossman and Hart' s prediction. In Panel B, we find that takeovers are successful in 21 out of 100 rounds and the probability of takeover success is 0.21 (21%). Panel C shows that the efficiency over the five groups of [Experiment A] is 19.12%

Thus, our experimental evidence does not support Hypothesis A-1. As we explained earlier, our laboratory markets in [Experiment A] do not have any economic factors or institutional environments that have been claimed to be solutions to the free-rider problem: dilution, a bidder's initial shareholdings (toeholds), unconditional offers, two-tier offers, etc. Despite the absence of these remedies for the free-rider problem, we observed that a substantial number of shareholders tendered the shares and the free-rider problem was mitigated in our laboratory.

These results suggest that shareholders as well as a bidder are not necessarily as rational as takeover models suppose. To see this point in more detail, we examine shareholders' tendering behavior and a bidder's bidding behavior next.

4. 2 Shareholders' Tendering Behavior

Figure 1 plots the data of a bid price x and the shareholders' tendering probability (the number of tendering shareholders/20) of each round for five groups in [Experiment A]. For example, the point (20, 0.3) corresponds to the data of the 18th round of Group A-3 where the bid price is 20 and the number of tendering shareholders is 6 (i.e., the tendering probability is 0.3 = 6/20). A point with “2” (“3”, “4”) indicates that there were two (three, four) rounds corresponding to the point. Also, we draw Grossman and Hart’s prediction by the solid line (G&H Prediction). This “G&H Prediction” line shows that the shareholders’ tendering probability is always zero irrespective of bid prices. Figure 1 indicates, however, that most of the points considerably depart from G&H Prediction line. The shareholders’ tendering probability lies in the wide range (0.05-0.70) for several levels of bids (10-190). Therefore, we can conclude that shareholders’ rational behavior supposed by Grossman and Hart are not generally observed in our laboratory.

Similarly, Figure 2 charts the probability of takeover success (the number of successful rounds /the number of rounds) against a bid price. While the probability of success is zero when a bid price is 10, 40, 80, 90, 160, 170, and 190, consistent with Grossman and Hart’s proposition, it is positive when a bid is 20, 30, 50, 60, 70, 100, 110, 120, 130, 140, 150, and 180. That is, takeovers succeeded over the wide range of bid prices.

To examine shareholders’ tendering decisions to bid prices in more detail, we conducted the following probit analyses for [Experiment A].

$$\text{Model 1: Prob} = F\,(a + b\,x) \qquad (7)$$

$$\text{Model 2: Prob} = F\,(a + b\,x + c_1\,\text{ROUND} + c_2\,\text{GROUP2} + c_3\,\text{GROUP3} + c_4\,\text{GROUP4} + c_4\,\text{GROUP5}) \qquad (8)$$

where Prob is the probability of the shareholder tendering, F(k) is standard normal distribution function, and x is the bid price offered by a bidder. To control for the group effect and monotonic trends in the probability of tendering over time, we add in Model 2 group dummies (GROUP2-GROUP5) and the variable ROUND which equals 1 for the 1^{st} round, equals 2 for the 2^{nd} round, and so on. The left panel of Table 4 reports the probit regression results. Notably, in both Models 1 and 2, the coefficients of the bid price x are positive and statistically significant (p-values are less than 1% in both models). This indicates that the shareholders' tendering probability is increasing in the bid price x; shareholders are induced to tender the shares by a high bid price. We depict the prediction of the shareholders' tendering probability calculated by the estimation results of Model 1 as the dotted line (Probit Regression Result) in Figure 1.

The right panel of Table 4 shows the probit regression results on the probability of takeover success. We run the same form of probit regressions as (7) and (8) except that a dependent variable, Prob, is the probability of the takeover success. The results of the table show that the coefficients of the bid price are positive but they are not statistically significant in both Models 1 and 2. Just for reference, we depict the prediction of the probability of takeover success calculated by the estimation results of Model 1 as dotted line (Probit Regression Result) in Figure 2.

4.3 Bidders' Bidding Behavior

Figure 3 describes bidders' bidding behavior in [Experiment A]. In the figure, each point corresponds to the post-takeover value z and the bid price x in each round. A bidder's profitability condition (zero-profit-line) is also depicted as 45-degree line.

We find that most of the points lie under the zero-profit-line, which shows that the bidders offer the bids (x) lower than the post-takeover values (z). In 14 (of 100) rounds, however, the bidders make overbids, that is, the bidders offer higher bids than the post-takeover values z. Why did some bidders overbid? We consider two possibilities. The first one is confusion: a bidder misunderstood the value of z or could not calculate her payoffs, and unconsciously offered too high a bid. Another possibility is that bidders overbid to establish a reputation for offering higher bids and induce shareholders to tender in later rounds. If this second possibility were the case, the bidder's overbid behavior would be observed less in later rounds than in earlier rounds because the value of reputation must decrease as the session approaches its end. To examine this reputation effect, we run regressions on the bid price x using Ordinary Least Squares. We use as explanatory variables, z (post-takeover value), ROUND (which equals 1 for the 1st round, equals 2 for the 2nd round, and so on) and group dummies (GROUP2, GROUP3, GROUP4, and GROUP5). If a bidder decides her bid due to the reputation concern, ROUND should have negative effects on a bid price. The estimation result (omitted here to save space), however, shows that the coefficient of ROUND is positive and insignificant. Thus, overbids remain an anomaly and seem to represent some aspects of irrational behavior by bidders. In any case, it is interesting to examine whether the overbids affect shareholders' tendering behavior by changing shareholders' expectations about the bidder's decision-making. We will see it in the part of the next subsection.

4.4 Why Shareholders Tendered the Shares?

We observed that a substantial number of shareholders tendered the shares in [Experiment A], which was inconsistent with Grossman and Hart's proposition. To understand this gap between the theory and the experimental result, we checked the answers to questionnaire that had been conducted after the session of each group. In the questionnaire, there are questions that ask the subjects of shareholders how they made decisions during the experiment (See, Appendix).

> "When you make decisions (whether you would sell or would not sell), what did you take into account? Explain briefly."

> "Did your decision making change as this experiment proceeded? If yes, How did your decision making change?"

Among 100 subjects of shareholders in total of five groups in [Experiment A], 93 subjects answered to at least one of these questions.

In these 93 answers, we found only 3 shareholders who explicitly answered that they had known at the beginning of the 1st round that not tendering was more profitable strategy than tendering. These three subjects actually chose not to tender over all 20 rounds. Their recognition and decision-making are exactly equal to those of Grossman and Hart's supposition. We call them the *rational shareholders*.

The rest (majority) of subjects, however, do not seem as rational as Grossman and Hart's shareholders.

First, 12 subjects answered that they had noticed at some point of time during the session that not tendering was more profitable. Observing their tendering data, we found that each of these 12 subjects had not tendered at all after some specific round: one subject had not tendered after 1st round, one subject not after 5th round, three subjects not after 7th round, one subject not after 11th round, one subject not after 13th round, one subject not after 15th round, two subjects not after 16th round, and two subjects not after 17th round. We call these subjects the *adaptive shareholders* in the sense that they seem to have become rational shareholders through their experience (the learning effect). The adaptive shareholders tendered in 5.3 rounds on average. Their tendering probability, 0.267 (=5.3/20), is lower than the average over all subjects (0.397) but still considerably departs from Grossman and Hart's prediction.

Second, other 15 subjects appear to have failed to notice through the session that not tendering was more profitable strategy. We call them the *naive shareholders*. 9 of them seem to have made decisions by comparing z and x but have not recognized that z should be larger than x (they tendered 8.2 rounds on average; tendering probability is 0.411). 5 of them do not seem to have understood the payoff matrices (they tendered 12 rounds on average; tendering probability is 0.6) and 2 of them explicitly stated that they chose their decisions randomly (they tendered 9 rounds on average; tendering probability is 0.45). The naive shareholders as a whole tendered in 9.5 rounds on average. Their tendering probability, 0.475 (=9.5/20), is higher than the rational and adaptive shareholders.

In addition, although we tried to create atomistic markets using our experimental device, there were 13 subjects who seemed to make decisions considering that they could affect takeover outcome. We call them the *non-atomistic shareholders*. They belong to one or more of the following categories: those who appeared to consider that they could be pivotal shareholders to affect takeover success for themselves (pivotal confusion), those who stated that they tendered the shares to make takeovers successful for other subjects (altruistic motive), those who tried not to tender to make takeovers unsuccessful for other subjects (spiteful motive), and those who appeared to just want to influence the outcome in the laboratory (influence motive). The non-atomistic shareholders as a whole tendered the shares in 13 rounds on average and the tendering probability is 0.65. We discuss the effects of non-atomistic behavior on the experimental results later in Section 6.

The other 50 subjects are not classified into one of the above types of shareholders, because their answers were too little or ambiguous to interpret, or they can be classified into more than two types. These 50 subjects tendered in 7.44 rounds on average (the tendering probability is 0.372).

Although we recognize the limitation of our questionnaire analysis, it seems to provide useful information on why shareholders tendered the shares in [Experiment A]. It suggests that there were a significant number of noise traders in our laboratory. While we found only 3 subjects regarded as the rational shareholders, we observed 27 bounded rational shareholders (12 adaptive and 15 naive shareholders). Taking only these three types of shareholders, the tendering probability is still 0.345, which significantly departs from Grossman and Hart's prediction. Therefore, we can say that some shareholders tendered the shares because they were not as rational as Grossman and Hart assume, and that made takeovers successful in our laboratory; bounded rationality mitigated the free-rider problem.

Lastly, we explore another possible explanation for shareholders' tendering. Even rational shareholders would tender the shares if they predict that the bidder makes an overbid ($x > z$). Roll (1986) and Varaiya (1988) suggest that bidders sometimes pay a premium over the true value of the target firm in the real takeover markets, due to their hubris or the winner's curse. In our laboratory, we actually observed some overbids by bidders. It provides the opportunity to examine if a bidder's overbid induces shareholders to tender the shares.

We estimated the probit regression of tendering probability, adding OVERBID which is a dummy variable that takes a value of 1 if an overbid has occurred at least once prior to the previous round, and 0 otherwise[21]. The regression result is presented in the Model 3 of the Tendering Probability panel of Table 4. We find that the coefficient of OVERBID is positive (0.0671) but insignificant (p-value = 0.501). We also

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[21] By this definition, OVERBID always takes 0 at the 1st round of each group.

add OVERBID to the regression equation of the probability of takeover success. This result is shown in the Model 3 in the right panel (The Probability of Takeover Success). The coefficient of OVERBID is insignificantly positive again in this regression (p-value = 0.111). We also estimated the same regressions using NUMOVERBID (the accumulative number of overbid rounds prior to the previous round) or PREOVERBID (a dummy variable that takes a value of 1 if overbid has occurred in the previous round, and 0 otherwise), instead of OVERBID, in both the tendering probability and the probability of success equations. But we obtained no significant coefficients of NUMOVERBID and PREOVERBID.

These results suggest that the bidder's overbid did not significantly affect shareholders' decisions. We can conclude that the shareholder tendering in our laboratory occurred mainly due to the absence of shareholders' rationality itself, not due to their expectations of the absence of the bidder's rationality.

5 The Results of [Experiment B]

5.1 Overview

Table 5 represents the results of [Experiment B] (the toeholds case). We observe more takeover-success-rounds (rounds where the number of tendering shareholders is 8 or more) here than in [Experiment A] (the no toeholds case, see Table 2). As we saw above, Hypothesis B-1 derived from Shleifer and Vishny's proposition suggests that takeovers can be successful in the toeholds case. Therefore, at first glance, our laboratory results in Table 5 may seem to be consistent with their proposition. To be more precise, in Table 6, Panel B indicates that the probability of takeover success is 67.0% in [Experiment B]. This result is very close to and insignificantly different (p-value = 0.579) from the Shleifer and Vishny's prediction, 70.0% (according to Hypothesis B-1 the probability of takeover success and the shareholders' tendering probability should be 0.7, considering that z is greater than 85.71 in 70 of 100 rounds in [Experiment B]).

However, Table 6 also shows the data that are inconsistent with Shleifer and Vishny's prediction. First, Panel A indicates that the shareholders' tendering probability is 0.445, which is far lower than their prediction 0.7 (the difference is statistically significant: p-value = 0.000). Second, Panel C shows that the efficiency defined earlier is 71.93%, which is also lower than that of Shleifer and Vishny' prediction 87.28% (the efficiency in case that all takeovers succeed when z > 85.71). This low efficiency seems to suggest that takeovers succeeded in low-z (< 85.71) rounds in the laboratory.

Figure 4 plots the value of z and the probability of takeover success in [Experiment B]. The dark solid line represents Shleifer and Vishny's prediction (S&V Prediction). We observe that takeovers succeed even when z < 85.71 and not all takeovers succeed when z > 85.71, inconsistent with Hypothesis B-1. Hence, we get the following result.

Result B-1: Takeovers can be successful in wide range of z in the toeholds case.

This result suggests that Shleifer and Vishny's story does not apply in our laboratory.

Hirshleifer and Titman (1990) present another possibility of takeover outcome when a bidder initially holds the shares. They use the same setting as Shleifer and Vishny's and propose a perfect Bayesian equilibrium with the following properties; (i) a bidder makes a bid equal to the post-takeover value (x=z), (ii) the takeover succeed with probability $P = (x / z_{\max})^{(0.5-\alpha)/\alpha}$. According to this P function, we calculate the Hirshleifer and Titman's prediction of the probability of takeover success. This prediction is depicted as a white solid line (H&T Prediction) in Figure 4. Our laboratory data seem closer to Hirshleifer and Titman's prediction than to Shleifer and Vishny's prediction, in the sense that probability of takeover success takes the value between 0 and 1. We find that, however, the laboratory data depart from Hirshleifer and Titman's prediction: the data tend to be above their prediction line.

Next we will see shareholders' behavior and bidders' behavior separately and examine whether data support other hypotheses in [Experiment B].

5.2 Shareholders' Tendering Behavior

Figure 5 plots the data of a bid price x and the shareholders' tendering probability of each round in five groups in [Experiment B]. Shleifer and Vishny's prediction (Hypothesis B-2) is drawn by the dark solid line (S&V Prediction). First, we find that when a bid price (x) is below 142.86, the shareholders' tendering probability lies between 0.1 and 0.7 although Shleifer and Vishny predict that this probability is zero. Second, we also point out that when a bid is greater than 142.86, the shareholders' tendering probability ranges from 0.35 to 1 while it should be always 1 according to Shleifer and Vishny's prediction. Figure 6 also shows similar results. It charts the probability of takeover success against a bid price in [Experiment B]. While the probability of success is zero when a bid price is 10, 20, 30, consistent with Shleifer and Vishny's prediction, it is positive when a bid is between 40 and 140. Observing x >142.86 sample, the probability of takeover success is 1 for all bid prices except that it is 0.85 for a bid of 160. This result is very close to Shleifer and Vishny's prediction. In addition, Hirshleifer and Titman's prediction is also depicted by a while solid line (H&T prediction). Comparing this line and the points in Figure 6, Hirshleifer and Titman's prediction does not seem to fit our laboratory data: the data tend to be above H&T prediction line.

In any case, from Figures 5 and 6, we obtain the following result.

Result B-2: A substantial number of shareholders tender the shares and takeovers can be successful in wide range of bids (x) in the toeholds case.

This result suggests that shareholders' rational behavior supposed by Shleifer and Vishny is not necessarily observed in our laboratory. This result seems quite natural if we consider that (i) the expectation of z in [Experiment B] must be harder than in [Experiment A], and (ii) a significant number of noise shareholders were observed even in [Experiment A].

Table 7 represents the regression results of the shareholders' tendering probability and those of the probability of takeover success for [Experiment B]. We find that in both tendering probability and the probability takeover success regressions, the coefficients of bid prices (x) are positive and statistically significant. The positive effect of the bid on the probability of takeover success is consistent with the empirical results of Walking (1985) and Betton and Eckbo (2000). We depict the predictions of the shareholders' tendering probability and the probability of takeover success calculated by the estimation result of Model 1 of each panel as the dotted line (Probit Regression Result) in Figures 5 and 6, respectively.

5.3 Bidders' Bidding Behavior

Figure 7 shows bidders' bidding behavior in [Experiment B]. As in the Figure 3, each point corresponds to the post-takeover value z and the bid price x in each round. A bidder's profitability condition line (zero-profit line) is also depicted. According to Shleifer and Vishny's prediction (Hypothesis B-3), x (bid price) should be greater than 142.86 when z > 85.71. This means that a bid should lie above the dark solid line (S&V lower bound) when z > 85.71.

We observe, however, that there are a significant number of bids under this S&V lower bound line. Out of 70 bids in z > 85.71 rounds, only 19 bids (27.1%) are above 142.86 whereas 51 bids (72.9%) are under 142.86. This contradicts with Hypothesis B-3.

Result B-3: Most of bidders do not offer a bid greater than 142.86 when z > 85.71 in the toeholds case.

This result suggests that bidders (as well as shareholders) do not behave as Shleifer and Vishny (1986) suppose. It implies that (i) most of bidders did not notice this strategy or bidders made their decisions with noise, and /or (ii) bidders did not consider that shareholders could make rational decisions.

Lastly, we examine whether Hirshleifer and Titman's (1990) prediction of the bid fits our laboratory data. Their model suggests that a bid (x) is exactly equal to the post-takeover value (z), that is, x = z. To see whether this applies in our laboratory, we run the regressions of a bid price x against z. If Hirshleifer and Titman's prediction is correct, the coefficient of z should be 1 and the intercept should be zero. We show this regression result in Figure 7 (The standard errors are in the brackets). The coefficient of z is 0.6465 which is significantly different from 1, and the intercept is 35.197 which is also significantly different from 0. Therefore Hirshleifer and Titman's prediction about the bid is rejected in our laboratory.

The regression including ROUND and group dummies as well as z does not change the result (coefficient of z is 0.6358 which is significantly different from 1, the intercept is 33.352 which is also significantly different from 0, neither ROUND or group dummies is insignificantly different from 0).

Overall, our laboratory results of [Experiment B] depart from the predictions of the takeover models. Nonetheless, we observed that a bidder's toeholds considerably increased the probability of takeover success, just as Shleifer and Vishny (1986) suggested. In the next subsection, we discuss this point and examine where the toeholds effects come from.

5.4 The Effect of Toeholds

Empirical studies report that the bidder's initial shareholdings (toeholds) have the positive effects on the takeover outcome. For example, Walking (1985) finds a positive relationship between the bidder's initial shareholdings and the probability of takeover success, using data from the U.S. capital markets over 1972-76. Betton and Eckbo (2000) also show that the toeholds increase the probability of the initial bid success. These findings on the positive effects of toeholds on takeover success are usually explained by Shleifer and Vishny's (1986) story: the bidder with toeholds affords to offer a higher bid and consequently shareholders are more likely to tender. We call this the *tendering effect* of toeholds.

In this paper, we suggest another hypothesis that explains the positive effect of toeholds on takeover success: a bidder's toeholds reduce the number of shares needed to complete takeovers and therefore raise the probability of takeover success, given shareholders' tendering decisions. For example, in our laboratory, to make a takeover successful, while a bidder has to purchase 10 shares or more in [Experiment A] (the no toeholds case), she has to purchase only 8 shares or more in [Experiment B] (the toeholds case). We call this effect the *number effect* of toeholds. We should note that no number effect exists in Shleifer and Vishny's model, because they predict only two outcomes of shareholders' behavior: all shareholders tender or all do not tender. In that case, the probability of takeover success is either 1 or 0 and is not affected by the number of shares needed for takeover success. The number effect arises only when shareholders (as a whole) make tendering decisions probabilistically or randomly (i.e., the tendering probability is between 0 and 1).

It is unclear from empirical studies which effect (tendering effect or number effect) gives rise to the positive effect of toeholds. In addition, we are unable to deny other possibilities in which toeholds increases the probability of success in the real takeover markets[22]. This is because in empirical studies (in general) it is not necessarily easy to isolate some specific factors from naturally occurring phenomena in a complex reality. In contrast, our experimental research gives us an opportunity to focus on the specific effects and to measure its magnitude in a controlled laboratory environment. Below, we examine the magnitude of the tendering effect and the number effect in our laboratory.

Panel A of Table 8 compares the probability of takeover success and the shareholders' tendering probability in [Experiment A] with those in [Experiment B]. We observe that the probability of takeover success is higher in [Experiment B] than in [Experiment A]. The difference is 0.46 and statistically significant at 0.1% level. This 46% point increase in the probability of success corresponds to the toeholds effect: as the initial shareholdings by a bidder increases from 0% to 20%, the probability of takeover success rises from 21% to 67%. As for the shareholders' tendering probability seen in the next row, however, the difference between [Experiment A] and [Experiment B] is relatively small: the tendering probabilities in [Experiment A] and [Experiment B] are 0.397 and 0.445, respectively (although this difference is statistically significant). This suggests that a bidder's toeholds do not increase the shareholders' tendering probability considerably. From this observation, we conjecture that the positive effect of toeholds on the probability of success mainly comes not from the tendering effect, but from the number effect.

Figures 8 and 9 illustrate the distributions of the rounds classified by the number of tendering

[22] Walking (1985) discusses two other hypotheses on the positive effect of toeholds on takeover success. One is the strong influence of the bidder on the target management, and the other is the increased shareholder fear of becoming inactive minorities.

shareholders in [Experiment A] and [Experiment B]. For example, in Figure 8, we observe that there are 10 rounds in [Experiment A] in which 5 shareholders have tendered. The dotted vertical line in each figure represents the border of takeover success or failure in each experiment.

Comparing these two figures, we observe a small tendering effect on takeover success. In [Experiment A], the numbers of rounds are large (the bars are long) for less tendering rounds. To be more concrete, the bars are long for the rounds in which the number of tendering shareholders lies from 5 to 10. On the other hand, in [Experiment B], the numbers of rounds are large (the bars are long) for the rounds in which the number of tendering shareholders lies from 6 to 12. This move of the bars toward the right direction should contribute in more successful takeovers in [Experiment B], which represents the tendering effect. We should note that, however, the number effect appears to be of more importance. In [Experiment B], the dotted vertical line (the border of the takeover outcome) shifts to the left, which makes the rounds with 8 and 9 tendering shareholders successful. Since these two rounds have large numbers (long bars), we can say that a significant part of takeover success in [Experiment B] is attributable to the number effect.

To grasp the exact magnitude of each effect, we calculate the probability of takeover success in [Experiment B] assuming that takeovers succeed when a bidder purchases 10 (not 8) shares or more. This hypothetically calculated probability of success in [Experiment B] can be interpreted as the probability of success in the toeholds case without the number effect, since the number of the shares required for takeover success (10) is the same as that in the no toeholds case. We find that this calculated probability of success is equal to 0.34 (34%). This suggests that out of the 46% point rise in the probability of success gained by the toeholds, 13% (34% minus 21%) comes from the tendering effect and 33% (67% minus 34%) stems from the number effect. This result is summarized in Panel B of Table 8.

In sum, we have shown that the tendering effect, which Shleifer and Vishny (1986) suppose, was only small part of the toeholds effect in our laboratory. A large portion of the toeholds effect came from the number effect. The number effect occurred due to shareholders' probabilistic (or random) tendering decisions that were caused by the traders' bounded rationality.

6. Discussion

In interpreting our evidence, we should note that some of our results might come not from the nature of takeover markets but from the specific devices in our laboratory. It is possible that these devices affected subjects' decisions and gave rise to biased results. We examine this possibility, in particular, the effect of the repetition, the pivotal confusion, and the other-regarding preferences on our experimental results.

6.1 Implicit Cooperation

In our laboratory, we repeated the round 20 times to give the subjects the chances to be rational traders. This repetition, however, may have caused implicit cooperation over time between a bidder and shareholders and/or that among shareholders: the bidder has kept making generous bids and shareholders carry on accepting; shareholders jointly choose to tender the shares to realize takeover success. This cooperation would be unlikely to occur in the real takeover markets where traders do not seem to make takeover transactions repeatedly with the same members. Therefore, we check whether or not the repetition setting of our laboratory creates the subjects' cooperation and biased results.

Kreps, Milgrom, Roberts, and Wilson (1982) suggest that if there exists implicit cooperation in a finite period game, the degree of cooperation decreases over time because the value of reputation for cooperation becomes lower in later periods. Indeed, some public goods experiments with a finite number of rounds show that cooperation (contributions to public goods) occurs and that the cooperation rate (the contribution rate) declines as the session approaches close to its end [23].

Hence, we examine the existence of the subjects' cooperative behavior by checking i) whether the bid prices decline over time and ii) whether the degree of shareholder tendering decreases over time. In fact, these two can be easily checked by the experimental results we saw before. As for the bid prices, we observed in Sections 4.3 and 5.3 that the bid prices did not decline as the round went on (ROUND were

[23] See, Dawes and Thaler (1988), Davis and Holt (1993, Chapter 6), and Ledyard (1995).

insignificant in any bid price regressions). As for tendering probability, we saw in Tables 4 and 7 that the tendering probability did not decrease over time (ROUND were insignificant in any tendering probability regressions). Therefore, we found no evidence suggesting that implicit cooperation among subjects occurred in our laboratory.

6.2 Pivotal Confusion

In our experimental setting, each shareholder's tendering decision has no effect on the takeover outcome that determines her payoff. As we mentioned in Section 4.4, however, some subjects seemed to misunderstand this rule and incorrectly perceive that she might be a pivotal shareholder to affect her takeover outcome. If this is the case, as Bagnoli and Lipman (1988) and Holmstrom and Nabeluff (1992) suggest, the shareholder is more likely to tender the share expecting that her tendering raises the probability of a takeover success. We call this confused shareholder behavior "pivotal confusion".

To explore to what degree such pivotal confusion occurs, we checked the shareholders' (sellers') record sheets. On this sheet, each shareholder enters her decision (sell or not sell), the number of shareholders who sold their shares, the number of shareholders other than her who sold their shares, and her payoff. By inspecting the mistakes on these items in each shareholder's record sheet, we can specify for whom and in what round the pivotal confusion occurs. Suppose, for example, that in one round on one shareholder's record sheet, we find that 'her decision' = 'sell', 'the number of the shareholders who sold their shares' = '8', and 'the number of the shareholders other than her who sold their shares' = '8'. This shareholder clearly makes a mistake in this round: since her decision is 'sell', 'the number of shareholders other than her who sold their shares' must be '7' (8 minus 1). In this case, we judge that pivotal confusion occurs in this round for this shareholder.

We find 23 pivotal confusions out of a total of 2000 selling opportunities (20 shareholders $\times$ 20 rounds $\times$ 5 groups) in [Experiment A], and 32 pivotal confusions in [Experiment B]. Hence the proportions of pivotal confusion are thus only 1.15% (23/2000) and 1.6% (32/2000). This suggests that as far as we judge from shareholders' (sellers') record sheets, the pivotal confusion hardly occurs throughout the experiments. For reference, we calculate the shareholders' tendering probability excluding the above pivotal confusion samples. The tendering probabilities turned out to be 0.395 in [Experiment A] and 0.446 in [Experiment B], which were almost same as the probabilities for all samples.

In addition, we inquired the numbers of shareholders who had experienced pivotal confusion in at least one round during the session (pivotal-confusion-experienced shareholders). We found 17 (of 100) and 16 (of 100) pivotal-confusion-experienced shareholders in [Experiment A] and in [Experiment B], respectively. Excluding these shareholders from the sample, we re-calculated the tendering probabilities. The tendering probabilities turned out to be 0.371 in [Experiment A] and 0.425 in [Experiment B], which were only slightly lower than the probabilities for all sample (0.397 in [Experiment A] and 0.445 in [Experiment B]). [24]

These suggest that although some pivotal confusion is observed in our laboratory, it does not change our basic results. In other words, the pivotal confusion cannot be a major reason that about 40% of shareholders tender their shares in [Experiment A].

6.3 Other-Regarding Preferences

In our laboratory, while each shareholder's decision does not affect the takeover outcome for herself, it does affect the outcomes for the bidder and other shareholders. Hence, if shareholders are enough kind or spiteful to others, they may choose to tender the shares from the altruistic motive or not to tender from the spiteful motive[25]. In this sense, the shareholders' tendering decisions in the laboratory may be biased compared to those in perfectly atomistic markets. To examine this bias, we use the questionnaire data again.

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[24] We also estimated the same regression equations of tendering probabilities in the left panels of Tables 4 and 7, excluding the pivotal-confusion-experienced shareholders. We found that these regression do not change our prior results: x is significantly positive in both [Experiment A] and [Experiment B] and OVERBID is insignificant in [Experiment A].

[25] We cannot ignore the effects of altruistic and spiteful behavior. See, Andreoni (1995) and Saijo and Nakamura (1995).

In the questionnaire, there is a question to ask if they have made decisions considering others.

> "When you made your decision, to what degree did you consider the influence of your decision on the other participants' payoffs?"

To this question, the subject checked (x) one box ranked from 1 (Never) to 7 (Very much). We classified the subjects who checked 1, 2, 3, or 4 as "individualistic shareholders" and the subjects who checked 5, 6, or 7 as "other-regarding shareholders". In [Experiment A], 37 shareholders are classified as the individualistic shareholders and 62 are classified as the other-regarding shareholders[26]. In [Experiment B], 44 are classified as the individualistic and 56 are classified as the other-regarding.[27]

Let us compare the shareholders' tendering probabilities between these two groups. The result is reported in Table 9. In [Experiment A], we find no difference in tendering probability between two groups. Tendering probability is 0.400 for the individualistic shareholders and 0.402 for the other-regarding shareholders, and the difference 0.002 is insignificant. This shows that high tendering probability (about 40%) in [Experiment A], which is an anomaly from Grossman and Hart's prediction, does not come from other-regarding behavior in laboratory. We conjecture that there was some altruistic and spiteful behavior in our markets but these two canceled out in the whole sample and had no effect on overall tendering tendencies. We also conducted the tendering probability regressions in the left panel of Table 4 for the individualistic shareholders sample and for the other-regarding shareholders sample. We found no significant differences in the results between two samples.

On the other hand, as for [Experiment B], Table 9 shows that the shareholders' tendering probability is higher for the other-regarding shareholders (0.476) than for the individualistic shareholders (0.405) and the

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[26] One subject was unclassified because he did not answer to the question.

[27] According to these numbers, there appear to be more other-regarding shareholders than individualistic shareholders. However, this may be due to the answering bias inherent in the above question: the subjects may be more likely to answer that they have considered the influence on others, because they do not want to be seen egoistic or nonsocial. The important point here is not the component ratios of two groups, but whether there exists any difference in tendering behavior between two groups.

difference (0.071) is statistically significant. This suggests that the tendering probability and the probability of takeover success in [Experiment B] may be biased upward slightly due to some subjects' altruistic behavior. To examine in more detail whether there is any difference in tendering behavior between two groups, we also conducted the tendering probability regressions in the left panel of Table 7 for the individualistic shareholders sample and for the other-regarding shareholders sample. However, we found no significant differences in the results between two samples. First, the intercepts are larger for other-regarding sample (-0.770 in Model 1 and -0.894 in Model 2) than for individualistic sample (-1.083 in Model 1 and –0.894 in Model 2), but the differences are insignificant. Second, the coefficients of x for other-regarding sample (0.0065 in Model 1 and 0.0066 in Model 2) are almost same as those for individualistic sample (0.0059 in Model 1 and 0.0065 in Model 2). These results suggest that even if the subject's other-regarding behavior might increase the tendering probability in [Experiment B], it did not change our basic results of shareholders' tendering behavior (Result B-2) and was unlikely to make significant biases on the other results (Results B-1 and B-3).

Furthermore, we observe one more interesting result in Table 9. It shows that the individualistic shareholders' tendering probabilities are almost same between [Experiment A] and [Experiment B]: it is 0.400 in [Experiment A] and 0.405 in [Experiment B] (the difference 0.005 is statistically insignificant, p-value = 0.85). This result leads to the following conjecture: if the market were perfectly atomistic (where all shareholders could be regarded as individualistic in the sense that each shareholder's decision had no effect on takeover outcomes for others), there would be no significant difference in the shareholders' tendering probabilities between the no toeholds case and the toeholds case. This conjecture is totally inconsistent with Shleifer and Vishny's prediction—shareholders are more likely to tender in the toehold case—and casts doubt on the validity of the tendering effect of toeholds.

7. Concluding Remarks

This paper has explored how traders' bounded rationality affects takeover outcomes. We experimentally tested two rational models, Grossman and Hart's free-rider model and Shleifer and Vishny's toeholds model. Our laboratory results are inconsistent with their predictions. First, about 40% of shareholders tendered the shares and consequently 21% of takeovers succeeded in Grossman and Hart's market ([Experiment A]). This suggests that the traders did not necessary behaved as rationally as Grossman and Hart assume. Interestingly, the traders' bounded rationality mitigated the free-rider problem and led to successful takeovers. Second, while the toeholds effect was observed in Shleifer and Vishny's market ([Experiment B]), only small part of toeholds effect was explained by Shleifer and Vishny's tendering effect. A large part of the toeholds effect results from the number effect (fewer shares needed to complete takeovers) when there are boundedly rational traders in the market.

Our paper shares viewpoints with Kyle and Vila's (1991) theoretical work, which suggests that noise trading in stock markets makes takeovers successful. Their view and ours differ according to whether the noise trading has an indirect or direct effect on takeover success. In Kyle and Vila's model, noise trading affects takeover success indirectly: it occurs *prior to* the takeover and enables a potential bidder to secretly accumulate shares before her forthcoming bid. In contrast, our experimental result shows that noise trading affects takeover success directly: it occurs *during* the takeover and helps a bidder purchase more shares with her current bid.

Our results show that a considerable number of subjects had difficulty in behaving rationally and forming rational expectations. These findings have much in common with those of other experimental studies. Many experimental studies show that people frequently depart from rational behavior even in simple decision-making problems (See, Conlisk's (1996) survey). Other asset market experiments indicate that rational expectations are not easy tasks for the traders; "the evidence suggests that expectations may or not be rational, depending on experience, difficulty of the forecasting task, and other conditions" (Conlisk (1996, 673)).[28]

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[28] See, also Sunder's (1995) survey for asset market experiments.

From our experimental results, we conjecture that there are a significant number of the bounded rational traders in real takeover markets. To this conjecture, one might claim that real market traders are more rational than our experimental subjects since the real traders have more sophisticated skills and larger monetary stakes. This argument might be true, but we should also recognize that real market traders need higher cognitive abilities to make rational decisions in takeover markets, compared to our experimental subjects. First, the real takeover markets have more complex structures than our simple laboratory (for example, probability distribution of z is not given to the traders). Second, the real market traders are not given the devices for helping them behave rationally: they have no feedback opportunities (no repetition), no payoff matrices, no payoff calculation tables, and no exercises that our subjects could have. Therefore, we consider that even in reality, some traders cannot behave rationally, but behave bounded rationally at best, and their noise decisions may significantly affect takeover outcomes.

Our experimental results cast doubt on the validity of takeover models and other models in finance. These models usually assume that traders are rational and form rational expectations based on their beliefs about others' rationality. We show that these rationality assumptions do not necessarily hold even in the simple laboratory environments. Including bounded rationality in financial economics seems useful for explaining various phenomena that have been considered as anomalies by the rational financial models.

References

Allen, F., and D. Gale, 2000, *Comparing Financial Systems*, The MIT Press, Cambridge, Massachusetts.

Andreoni, J., 1995, "Cooperation in Public Goods Experiments: Kindness or Confusion?" *American Economic Review*, 85, 891-904.

Arrow, K. J., 1986, "Rationality of Self and Others in an Economic System," *Journal of Business*, 59, S385-S399.

Bagnoli, M., and B. L. Lipman, 1988, "Successful Takeovers without Exclusion," *Review of Financial Studies*, 1, 89-110.

Burkart, M., D. Gromb, and F. Panunzi, 1998, "Why Higher Takeover Premia Protect Minority Shareholders," *Journal of Political Economy*, 106, 172-204.

Bebchuk, L. A., 1989, "Takeover Bids below the Expected Value of minority Shares," *Journal of Financial and Quantitative Analysis*, 24, 171-184.

Betton, S., and B. E. Eckbo, 2000, "Toeholds, Bid Jumps, and Expected Payoffs in Takeovers," *Review of Financial Studies*, 13, 841-882.

Bradley, M., A. Desai, and E. H. Kim, 1988, "Synergistic Gains From Corporate Acquisitions and Their Division between the Stockholders of Target and Acquiring Firms," *Journal of Financial Economics*, 21, 3-40.

Bris, A., 2002, "Toeholds, Takeover Premium, and the Probability of Being Acquired," *Journal of Corporate Finance*, 8, 227-253.

Cadsby, C. B., and E. Maynes, 1998, "Corporate Takeovers in the Laboratory When Shareholders Own More than One Share," *Journal of Business*, 71, 537-572.

Chowdhry, B., and N. Jegadeesh, 1994, "Pre-Tender Offer Share Acquisition Strategy in Takeovers," *Journal of Financial and Quantitative Analysis*, 29, 117-129.

Conlisk, J., 1996, "Why Bounded Rationality?" *Journal of Economic Literature*, 34, 669-700.

Davis, D. D., and C. A. Holt, 1993, *Experimental Economics*, Princeton University Press, Princeton, New

Jersey.

Dawes, R. M., and R. H. Thaler, 1988, "Anomalies: Cooperation," *Journal of Economic Perspectives*, 2, 187-197.

Duggal, R., and J. A. Millar, 1994, "Institutional Investors, Antitakeover Defenses and Success of Hostile Takeover Bids," *Quarterly Review of Economics and Finance*, 34, 387-402.

Grinblatt, M., and S. Titman, 1998, *Financial Markets and Corporate Strategy*, Irwin/McGraw-Hill.

Grossman, S. J., and O. Hart, 1980, "Takeover Bids, the Free-rider Problem, and the Theory of the Corporation," *Bell Journal of Economics*, 11, 42-64.

Grossman, S. J., and O. Hart, 1981, "The Allocational Role of Takeover Bids in Situations of Asymmetric Information," *Journal of Finance*, 36, 253-270.

Harringtron, J. E., Jr., and J. Prokop, 1993, "The Dynamics of the Free-Rider Problem in Takeovers," *Review of Financial Studies*, 6, 851-882.

Hirshleifer, D., 1995, "Mergers and Acquisitions: Strategic and Informational Issues," in R. Jarrow, V. Maksimovic, and W. Ziemba (eds.), *Handbooks in Operations Research and Management Science*, Elsevier Science, Amsterdam.

Hirshleifer, D., and S. Titman, 1990, "Share Tendering Strategies and the Success of Hostile Takeover Bids," *Journal of Political Economy*, 98, 295-324.

Hoffmeister, J. H., and E. A. Dyl, 1981, "Predicting Outcomes of Cash Tender Offers," *Financial Management*, 10, 50-58.

Holmstrom, B., and B. Nalebuff, 1992, "To the Raider Goes the Surplus? A Reexamination of the Free-Rider Problem," *Journal of Economics and Management Strategy*, 1, 37-62.

Jensen, M. C., 1993, "The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems," *Journal of Finance*, 48, 831-880.

Kyle, A. S., and J. L. Vila, 1991, "Noise Trading and Takeovers," *Rand Journal of Economics*, 22, 54-71.

Kale, J. R., and T. H. Noe, 1997, "Unconditional and Conditional Takeover Offers: Experimental

Evidence," *Review of Financial Studies*, 10, 735-766.

Kreps, M. K., P. Milgrom, J. Roberts, and R. Wilson, 1982, "Rational Cooperation in the Finitely Repeated Prisoners' Dilemma," *Journal of Economic Theory*, 27, 245-252.

Ledyard, J. O., 1995, "Public Goods: A Survey of Experimental Research," in J. H. Kagel, and A. E. Roth (eds.), *The Handbook of Experimental Economics*, Princeton University Press, Princeton, New Jersey.

Plott, C. R., 1989, "An Updated review of Industrial Organization: Applications of Experimental Methods," in R. Schmalensee, and R. D. Willig (eds.), *Handbook of Industrial Organization*, Volume II, Elsevier Scinence Publishers.

Rasumusen, E., 2001, *Games and Information: An Introduction to Game Theory* (3rd ed.), Blackwell Publishers, Malden, Massachusetts.

Roll, R., 1986, "The Hubris Hypothesis of Corporate Takeovers," *Journal of Business*, 59, 197-206.

Saijo, T., and H. Nakamura, 1995, "The Spite Dilemma in Voluntary Contributions Mechanism Experiments," *Journal of Conflict Resolution*, 39, 535-560.

Shleifer, A., 2000, *Inefficient Markets: An Introduction of Behavioral Finance*, Oxford University Press, Oxford.

Shleifer, A., and R. W. Vishny, 1986, "Large Shareholders and Corporate Control," *Journal of Political Economy*, 94, 461-488.

Shleifer, A., and R. W. Vishny, 1997, "A Survey of Corporate Governance," *Journal of Finance*, 52, 737-783.

Shiller, R. J., 2000, *Irrational Exuberance*, Princeton University Press, Princeton, New Jersey.

Sunder, S., 1995, "Experimental Asset Markets: A Survey," in J.H. Kagel and A. E. Roth (eds.), *The Handbook of Experimental Economics*, Princeton University Press, Princeton, New Jersey.

Varaiya, N. P., 1989, "The 'Winners Curse' Hypothesis and Corporate Takeovers," *Managerial and decision Economics*, 9, 209-219.

Walking, R. A., 1985, "Predicting Tender Offer Success," *Journal of Financial and Quantitative Analysis*, 20, 461-478.

Table 1

Shareholders' Payoffs

The Outcome of a Takeover / Shareholder's Decision	Successful	Not Successful
Tender (Accept)	x	0
Not Tender (Reject)	z	0

The table shows a shareholder's payoff matrix in conditional offers. If the takeover is successful, shareholders who have tendered the shares get the value of x (the bid premium), while shareholders who have not tendered get the value of z (the post-takeover value per share). If the takeover is not successful, both shareholders who have tendered and shareholders who have not tendered get no profits.

Table 2

The Results of [Experiment A]

(The no toeholds case)

Round Number	The Value of Z	Group A-1		Group A-2		Group A-3		Group A-4		Group A-5	
		Bid Price	# of tendering share-holders	Bid Price	# of tendering share-holders	Bid Price	# of tendering share-holders	Bid Price	# of tendering share-holders	Bid Price	# of tendering share-holders
1	150	100	**13**	110	**12**	110	9	90	6	110	9
2	100	80	9	40	6	80	6	80	3	90	9
3	190	150	7	120	4	130	6	130	4	100	6
4	170	110	7	110	6	150	**13**	150	9	180	**11**
5	150	110	9	90	9	120	**12**	130	8	150	**12**
6	140	110	**14**	130	9	120	9	120	6	130	8
7	180	140	**12**	160	9	130	7	170	9	150	**13**
8	50	30	1	60	5	30	**10**	50	**10**	70	**14**
9	150	110	5	100	**10**	130	9	130	9	150	8
10	30	50	7	40	8	30	6	10	5	40	9
11	70	50	5	50	6	50	7	50	7	70	**12**
12	90	70	5	90	7	60	7	70	9	80	5
13	160	130	9	130	**10**	120	7	140	8	100	**10**
14	120	100	6	120	6	110	**10**	110	7	130	**11**
15	120	100	**10**	100	6	100	9	110	7	120	5
16	50	40	7	80	9	40	9	40	8	60	**11**
17	90	70	7	80	6	70	6	80	8	100	7
18	30	20	**10**	60	7	20	6	40	8	40	7
19	180	150	7	190	7	140	9	170	9	80	8
20	60	30	5	50	7	50	5	60	8	40	5
Average Bid Price	Tendering Probability	87.50	0.388	95.50	0.373	89.50	0.405	96.50	0.370	99.50	0.450
# of Rounds of Successful Takeovers		5		3		4		1		8	
Efficiency		27.19 %		20.18 %		21.49 %		2.19 %		41.67 %	

All sessions were conducted at Osaka University. Subjects were Osaka University undergraduates from various majors (e.g. law, economics, medicine, engineering). The highlighted numbers in each “# of tendering shareholders” column indicate successful takeovers (ten sellers or more tendered their shares). “# of Rounds of Successful Takeovers” indicates the number of successful takeovers in each session. “Efficiency” is defined as 100 × (the sum of z realized by successful takeovers over the 20 rounds) / (the sum of z over the 20 rounds).

Table 3

Shareholders’ Tendering decisions, Takeover Outcomes, and the Efficiency

[Experiment A]

Panel A. Shareholders’ Tendering Decisions				
Number of Total Opportunities	Tendered	Not Tendered	Tendering Probability	Grossman and Hart’s Prediction
2000	794	1206	0.397	0.000
Panel B. Takeover Outcomes				
Number of Total Rounds	Success	Failure	The Probability of Success	Grossman and Hart’s Prediction
100	21	79	0.210	0.000
Panel C. Efficiency				
Total Potential Value	Value Realized	Value not Realized	Efficiency	Grossman and Hart’s Prediction
11400	2180	9220	19.12%	0.00%

Panel A: “Number of Total Opportunities” is calculated by (the total number of shareholders throughout five sessions (=100))×(the number of rounds of each session (=20)). “Tendered” indicates how many times shareholders tendered throughout all sessions, while “Not Tendered” indicates how many times shareholders did not tender throughout all sessions. “Tendering Probability” is calculated by (“Tendered”) / (“Number of Total Opportunities”). Grossman and Hart’s Prediction of the tendering probability is zero.

Panel B: “Number of Total Rounds” is calculated by (the number of rounds per session (=20)) × (the number of sessions (=5)). “Success” means the number of successful takeovers, while “Failure” means the number of unsuccessful takeovers. “The Probability of Success” is calculated by (“Success”) / (“Number of Total Rounds”). Grossman and Hart’s Prediction of the probability of takeover success is zero.

Panel C: “Total Potential Value” is calculated by (the sum of the value of z per session) × (the number of all sessions (=5)). “Value Realized” is the sum of z for successful-takeover rounds, while “Value not Realized” is the sum of z for unsuccessful-takeover rounds. “Efficiency” is calculated by 100 × (“Value Realized”) / (“Total Potential Value”). Grossman and Hart’s Prediction of “Efficiency” is zero.

Table 4

Shareholders' Tendering Decisions: Probit Regression Results

[Experiment A]

	Tendering Probability			The Probability of Takeover Success		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	- 0.4875*** (0.000)	- 0.4371*** (0.000)	- 0.4340*** (0.000)	- 1.2291** (0.001)	- 0.5876 (0.333)	- 0.5336 (0.387)
X (Bid Price)	0.0024*** (0.000)	0.0022** (0.003)	0.0021** (0.004)	0.0044 (0.208)	0.0029 (0.465)	0.0026 (0.515)
ROUND		0.0046 (0.370)	- 0.0077 (0.264)		- 0.0342 (0.227)	- 0.0787 (0.052)
GROUP2		- 0.0495 (0.584)	- 0.0559 (0.539)		- 0.4078 (0.384)	- 0.5213 (0.276)
GROUP3		0.0545 (0.545)	0.0879 (0.393)		- 0.1929 (0.668)	0.1804 (0.724)
GROUP4		- 0.0582 (0.521)	- 0.0311 (0.754)		- 1.0090 (0.075)	- 0.7285 (0.222)
GROUP5		0.1545 (0.086)	0.1347 (0.155)		0.3918 (0.355)	0.1206 (0.792)
OVERBID			0.0671 (0.501)			0.8773 (0.111)
# of observations	2000	2000	2000	100	100	100
Log Likelihood	-1338.18	-1333.97	-1333.75	-50.59	-45.67	-44.37

The left panel (Tendering Probability) shows the probit regression results of the shareholders' tendering probability. X is the bid price offered by a bidder. ROUND is the variable that represents the round number (equals 1 for the 1st round, equals 2 for the 2nd round, and so on). GROUP2-GROUP5 are group dummies to control the group specific effects. OVERBID is a dummy variable that takes 1 if a bidder's overbid has occurred at least once prior to the previous round, and 0 otherwise.

The right panel (The Probability of Takeover Success) shows the probit regression results of the probability of takeover success. The definitions of the independent variables are the same as those of the left panel.

***, **, and * indicate that the coefficient is significantly different from zero at 0.1%, 1%, and 5% level, respectively (p-values are shown in parentheses).

Table 5

The Results of [Experiment B]

(The toeholds case)

Round Number	The Value of Z	Group B-1		Group B-2		Group B-3		Group B-4		Group B-5	
		Bid Price	# of tendering share-holders	Bid Price	# of tendering Share-holders	Bid Price	# of tendering share-holders	Bid Price	# of tendering share-holders	Bid Price	# of tendering share-holders
1	150	130	**12**	120	**13**	160	**15**	130	**12**	140	**12**
2	100	100	**9**	100	**8**	180	**17**	70	5	110	7
3	190	130	**11**	120	**8**	140	**11**	170	**12**	140	**8**
4	170	140	7	90	5	160	**17**	140	6	150	**15**
5	150	100	5	160	**8**	140	**14**	140	7	140	**9**
6	140	100	6	160	**9**	120	**11**	160	**8**	140	7
7	180	120	7	150	**11**	130	**9**	190	**15**	150	**8**
8	50	80	**8**	10	4	70	**10**	80	6	100	7
9	150	110	**9**	170	**17**	120	**10**	140	**12**	130	**9**
10	30	40	6	40	4	40	**8**	40	**10**	110	**9**
11	70	80	**8**	90	7	50	**8**	70	6	100	6
12	90	80	2	110	**8**	60	**9**	110	**8**	100	**8**
13	160	150	**10**	160	**12**	120	**8**	150	**11**	130	5
14	120	160	7	130	**8**	120	**10**	130	**10**	100	**13**
15	120	130	**8**	130	6	100	**12**	130	6	100	**14**
16	50	60	**8**	80	6	50	3	60	**11**	80	**10**
17	90	120	7	110	**11**	90	7	100	**9**	90	**8**
18	30	20	4	40	**8**	50	5	40	**8**	80	**8**
19	180	190	**20**	150	**9**	130	**14**	180	**13**	90	7
20	60	30	4	60	7	70	**8**	60	**8**	70	4
Average Bid Price	Tendering Probability	103.5	0.395	100.9	0.423	105.0	0.515	114.5	0.458	112.5	0.435
# of Rounds of Successful Takeovers		10		13		17		14		13	
Efficiency		53.51 %		75.88 %		92.54 %		71.05 %		66.67 %	

All sessions were conducted at Osaka University. Subjects were Osaka University undergraduates and they were from various majors (e.g. law, economics, medicine, engineering). The highlighted numbers in each "# of tendering shareholders" column indicate successful takeovers (eight sellers or more tendered their shares). "# of Rounds of Successful Takeovers" indicates the number of successful takeovers in each session. "Efficiency" is defined as 100 × (the sum of z realized by successful takeovers over the 20 rounds) / (the sum of z over the 20 rounds).

Table 6

Shareholders' Tendering decisions, Takeover Outcomes, and the Efficiency [Experiment B]

Panel A. Shareholders' Tendering Decisions				
Number of Total Opportunities	Tendered	Not Tendered	Tendering Probability	Shliefer and Vishny's Prediction
2000	890	1110	0.445	0.700
Panel B. Takeover Outcomes				
Number of Total Rounds	Success	Failure	The Probability of Success	Shliefer and Vishny's Prediction
100	67	33	0.670	0.700
Panel C. Efficiency				
Total Potential Value	Value Realized	Value not Realized	Efficiency	Shliefer and Vishny's Prediction
11400	8200	3200	71.93%	87.28%

Panel A: "Number of Total Opportunities" is calculated by (the total number of shareholders throughout five sessions (=100))×(the number of rounds of each session (=20)). "Tendered" indicates how many times shareholders tendered throughout all sessions, while "Not Tendered" indicates how many times shareholders did not tender throughout all sessions. "Tendering Probability" is calculated by 100 × ("Tendered") / ("Number of Total Opportunities"). Shliefer and Vishny's Prediction of the tendering probability is 0.7.

Panel B: "Number of Total Rounds" is calculated by (the number of rounds per session (=20)) × (the number of sessions (=5)). "Success" means the number of successful takeovers, while "Failure" means the number of unsuccessful takeovers. "The Probability of Success" is calculated by 100 × ("Success") / ("Number of Total Rounds"). Shliefer and Vishny's Prediction of the probability of takeover success is 0.7.

Panel C: "Total Potential Value" is calculated by (the sum of the value of z per session) × (the number of all sessions (=5)). "Value Realized" is the sum of z for successful-takeover rounds, while "Value not Realized" is the sum of z for unsuccessful-takeover rounds. "Efficiency" is calculated by 100 × ("Value Realized") / ("Total Potential Value"). Shliefer and Vishny's Prediction of "Efficiency" is 87.28%.

Table 7

Shareholders' Tendering Decisions: Probit Regression Results
[Experiment B]

	Tendering Probability		The Probability of Takeover Success	
	Model 1	Model 2	Model 1	Model 2
Intercept	- 0.8226*** (0.000)	- 0.9818*** (0.000)	- 0.7328 (0.056)	- 1.3842* (0.032)
X (Bid Price)	0.0062*** (0.000)	0.0065*** (0.000)	0.0112** (0.001)	0.0127** (0.002)
ROUND		0.0031 (0.564)		0.0061 (0.819)
GROUP2		0.0352 (0.699)		0.3878 (0.365)
GROUP3		0.3123** (0.001)		1.1832** (0.013)
GROUP4		0.0952 (0.295)		0.4680 (0.268)
GROUP5		0.0394 (0.664)		0.2967 (0.474)
# of observations	2000	2000	100	100
Log Likelihood	-1334.81	-1326.93	-57.89	-54.32

The left panel (Tendering Probability) shows the probit regression results of the tendering probability. X is the bid price offered by a bidder. ROUND is the variable that represents the round number (equals 1 for the 1st round, equals 2 for the 2nd round, and so on). GROUP2-GROUP5 are group dummies to control the group specific effects.

The right panel (The Probability of Takeover Success) shows the probit regression results of the probability of takeover success. The definitions of the independent variables are the same as those of the left panel.

***, **, and * indicate that the coefficient is significantly different from zero at 0.1%, 1%, and 5% level, respectively (p-values are shown in parentheses).

Table 8

Toeholds Effect

Panel A: The Effect of Toeholds			
	[Experiment A] No Toeholds Case	[Experiment B] Toeholds Case	Difference The Effect of Toeholds
The Probability of Takeover Success	0.21	0.67	0.46*** (0.000)
Shareholders’ Tendering Probability	0.397	0.445	0.048** (0.002)

Panel B: Decomposition of the Effect of Toeholds		
Total increase in the probability of Takeover Success	Tendering Effect	Number Effect
0.46	0.13	0.33

Panel A: “The Probability of Takeover Success” is calculated by (the number of successful-takeover-rounds throughout all sessions) / (the total number of rounds throughout all sessions). In experiment A, takeover is successful when 10 shareholders or more tendered, while in experiment B it is the case when eight shareholders or more tendered. “Shareholders’ Tendering Probability” is calculated by (the number of tendering shareholders throughout five sessions) / (the total number of shareholders throughout five sessions). *** and ** indicate that the difference is significant at 0.1% and 1% level, respectively (p-values are shown in parentheses).

Panel B: “Tendering Effect” means the effect that can be attributed purely to the shift in the distribution of the number of tendering shareholders. “Number Effect” means the effect of lowering the necessary number of tendering shareholders for takeover success. To decompose the effect of toeholds between these two effects, we calculated the probability of takeover success in experiment B assuming 10 tendering shareholders or more were necessary to make a takeover successful. This hypothetical calculated probability of takeover success is 0.34. “Tendering Effect” is calculated by (0.34 – (the probability of takeover success in experiment A = 0.21)), while “Number Effect” is calculated by ((the probability of takeover success in experiment B = 0.67) – 0.34).

Table 9

The Effect of Other-Regarding Preferences

	[Experiment A]			[Experiment B]		
	Total Opportunities	Tendered	Tendering Probability	Total Opportunities	Tendered	Tendering Probability
Individualistic Shareholders	740	296	0.400	880	356	0.405
Other-Regarding Shareholders	1240	498	0.402	1120	533	0.476
Difference			0.002 (0.943)			0.001** (0.001)

"Individualistic Shareholders" means subjects in the role of shareholders who did not consider the influence of their decisions on the other participants' payoffs. "Other-Regarding Shareholders" means subjects in the role of shareholders who considered the influence of their decisions on the other participants' payoffs. "Total Opportunities" is calculated by (the number of shareholders in each category) × (the number of rounds (=20)) "Tendered" indicates total number of tendering shareholders. "Tendering Probability" is calculated by ("Tendered") / ("Total Opportunities") .

** indicate that the difference is significant at 1% level (p-values are shown in parentheses).

Figure 1 A Bid Price and Shereholders' Tendering Probability
[Experiment A]

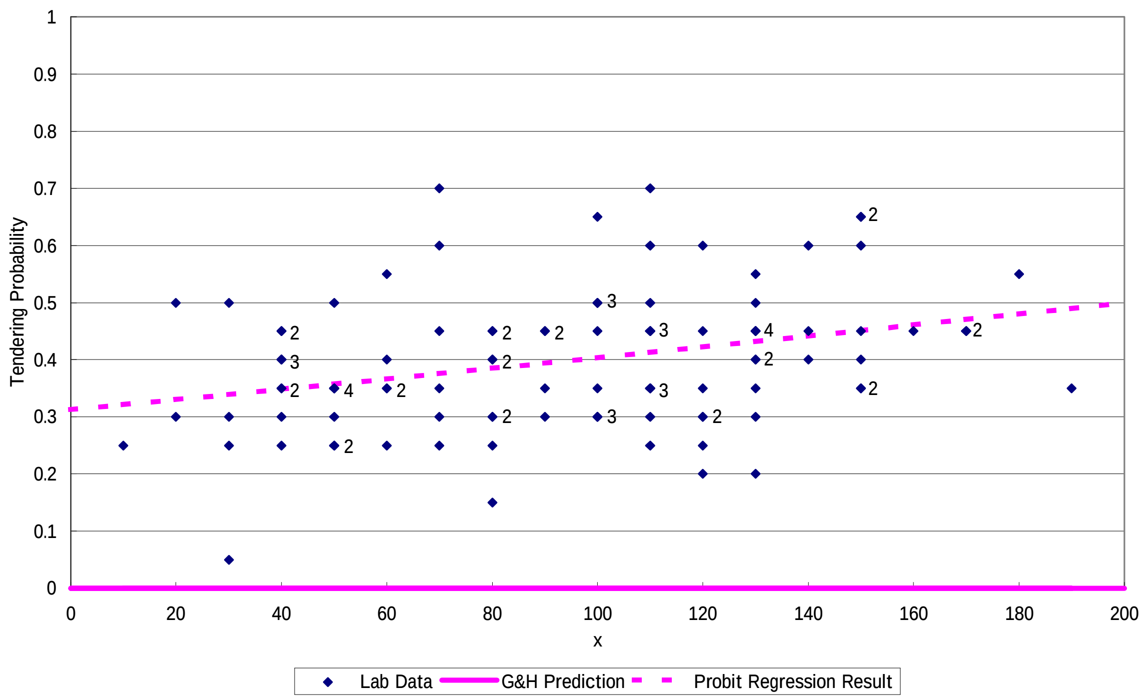


Figure 2 A Bid Price and the Probability of Takeover Success
[Experiment A]

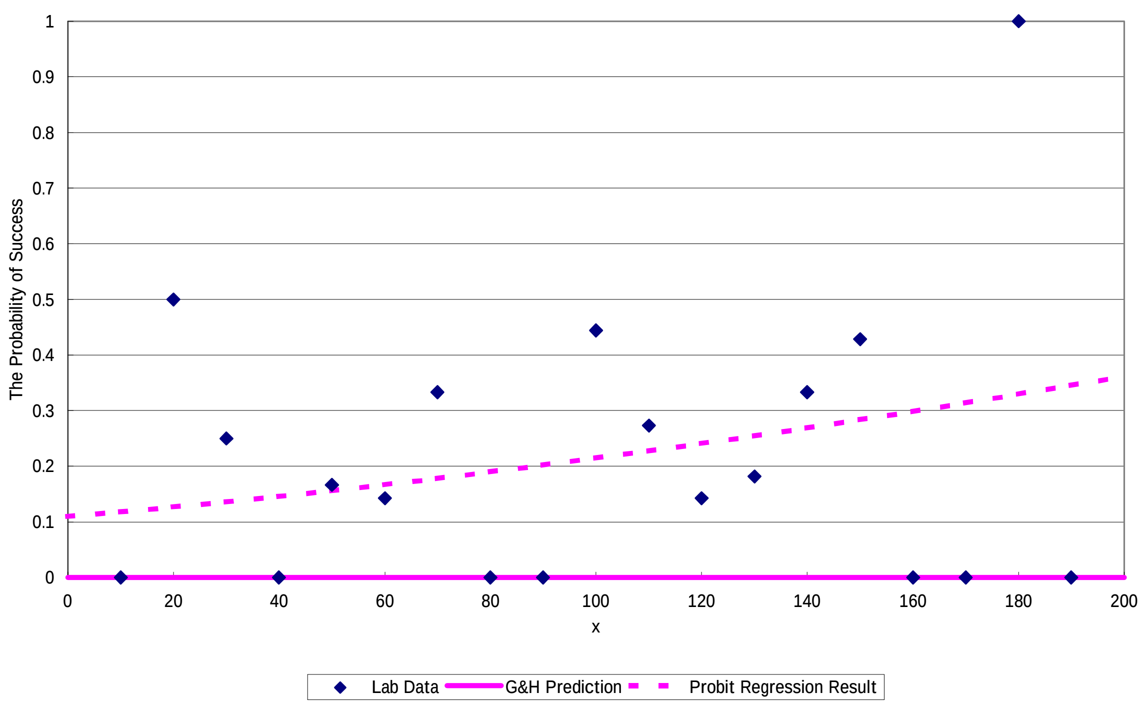


Figure 3 Bidders' bidding Strategy
[Experiment A]

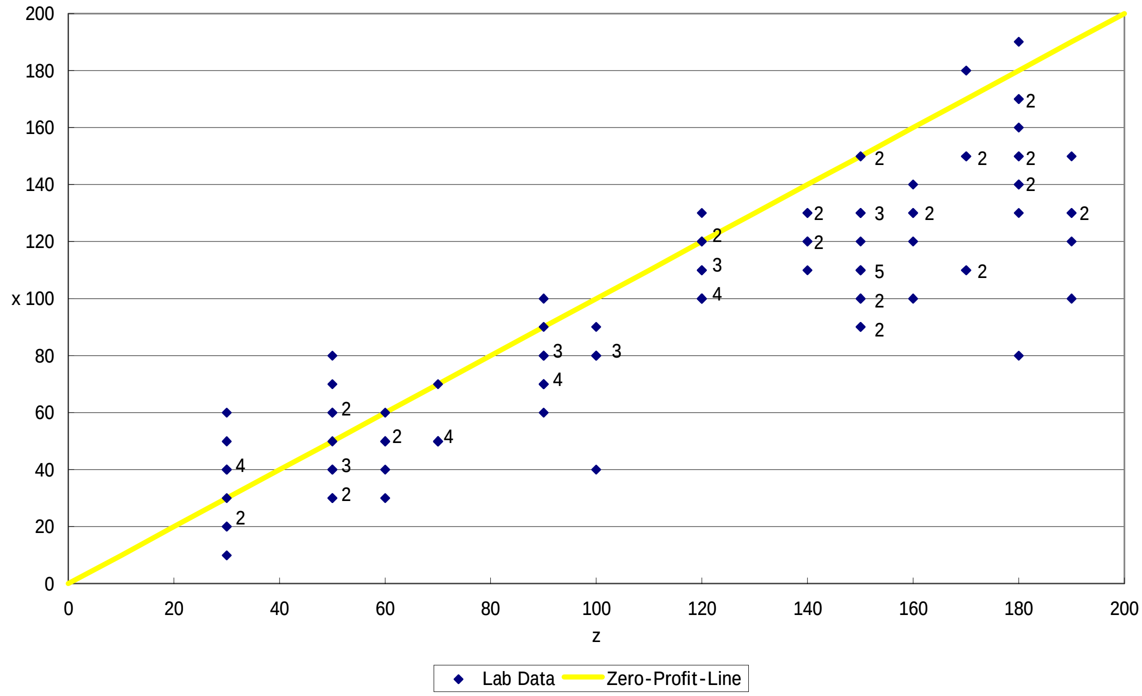


Figure 4 The Probability of Takeover Success
[Experiment B]

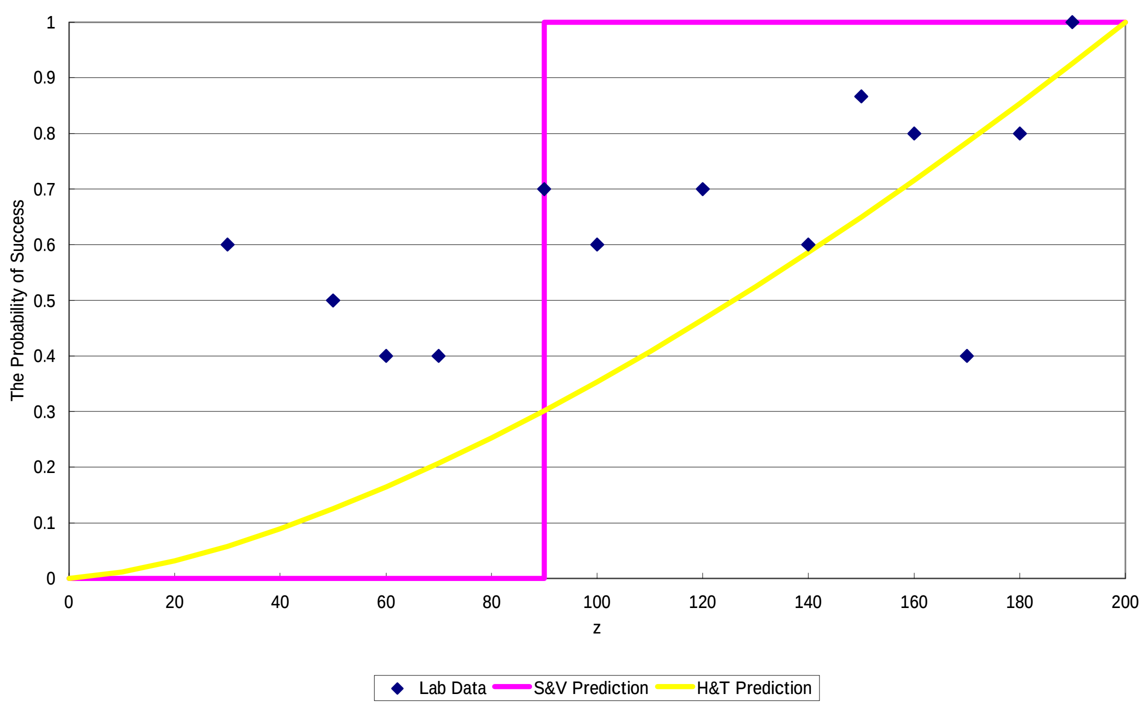


Figure 5 A Bid Price and Shareholders' Tendering Probability
[Experiment B]

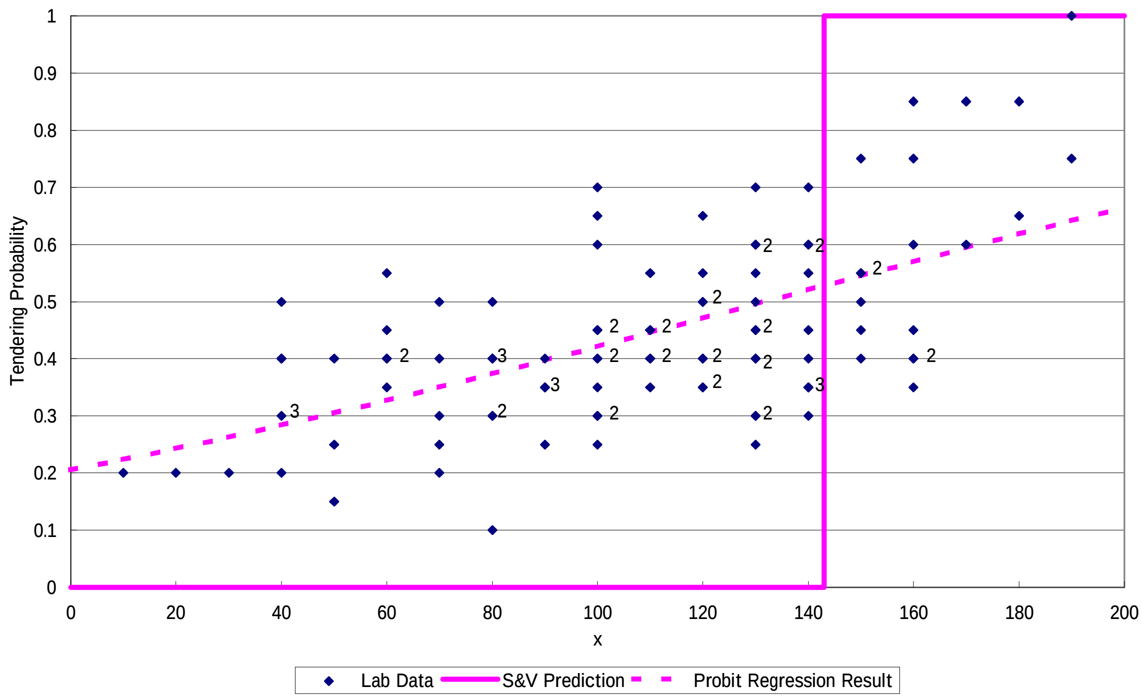


Figure 6 A Bid Price and the Probability of Takeover Success
[Experiment B]

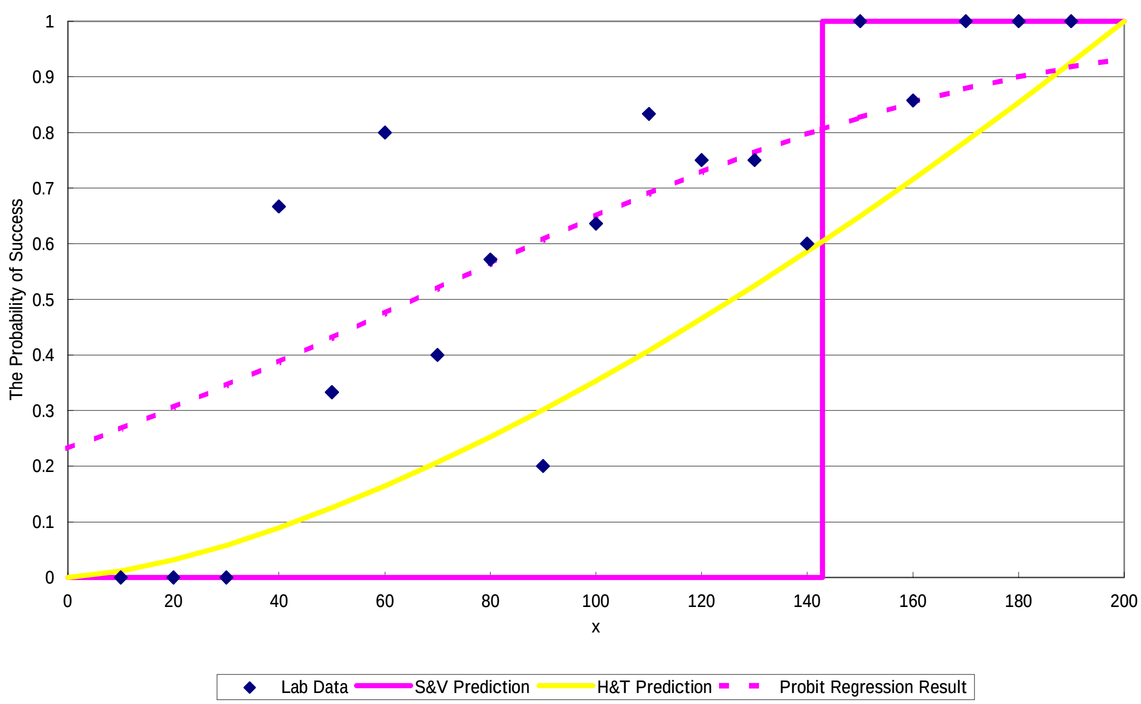


Figure 7 Bidders' Bidding Strategy
[Experiment B]

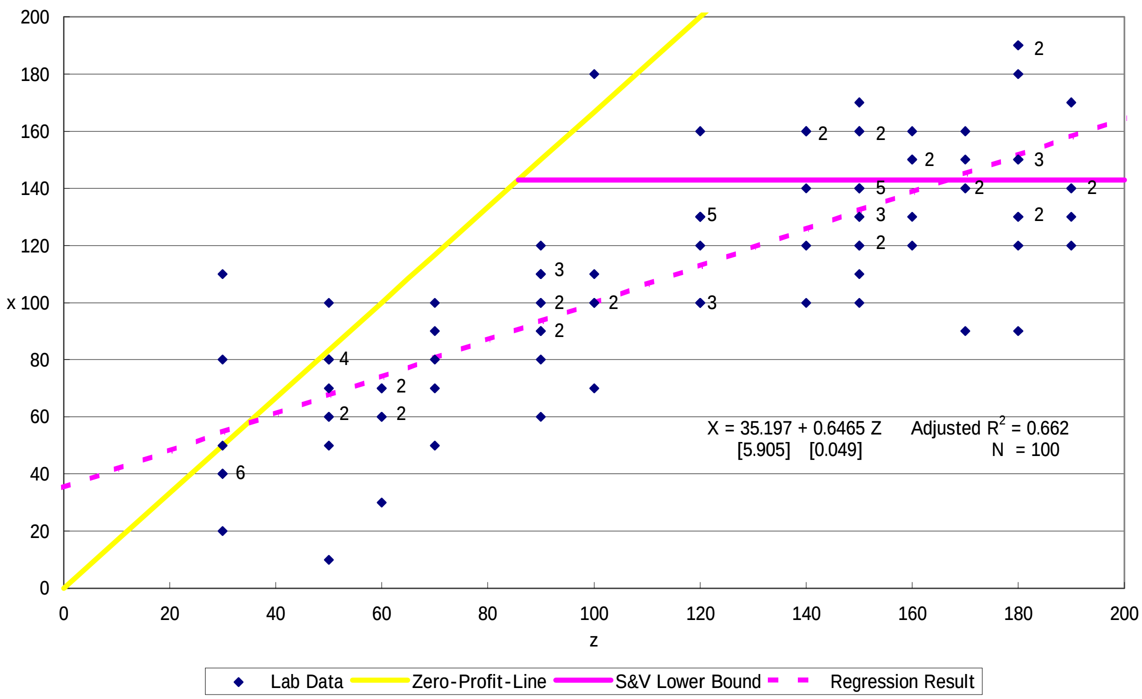


Figure 8 The Distribution of the Rounds Classified by Number of Tendering Shareholders
[Experiment A]

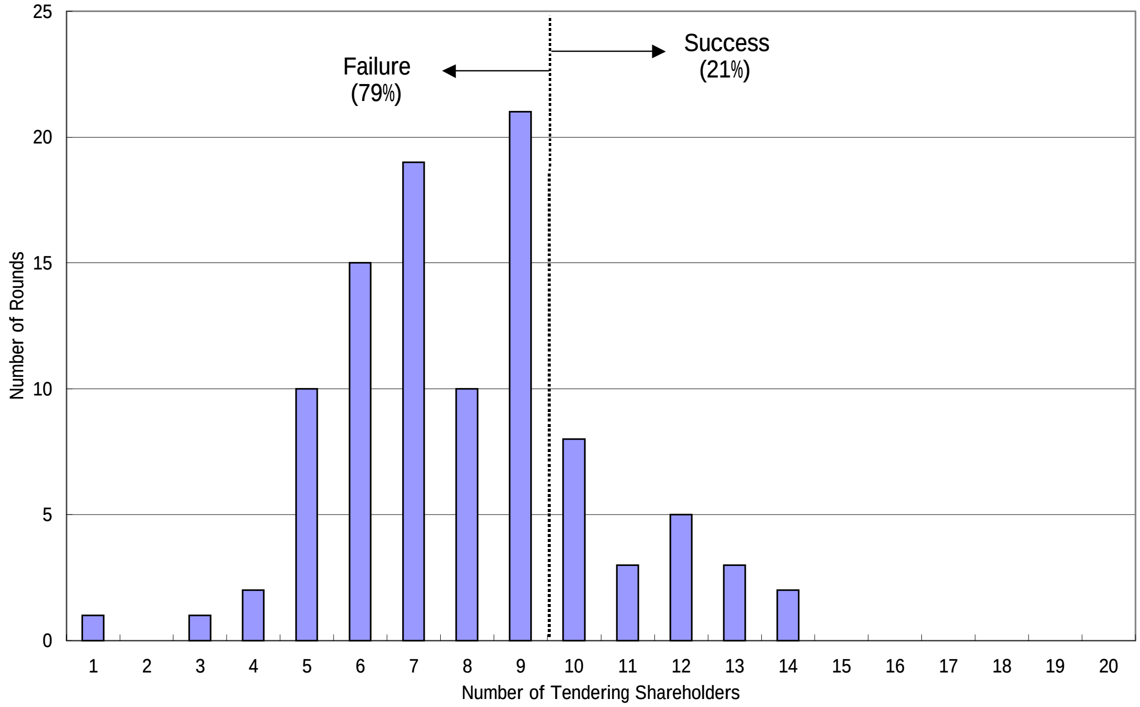
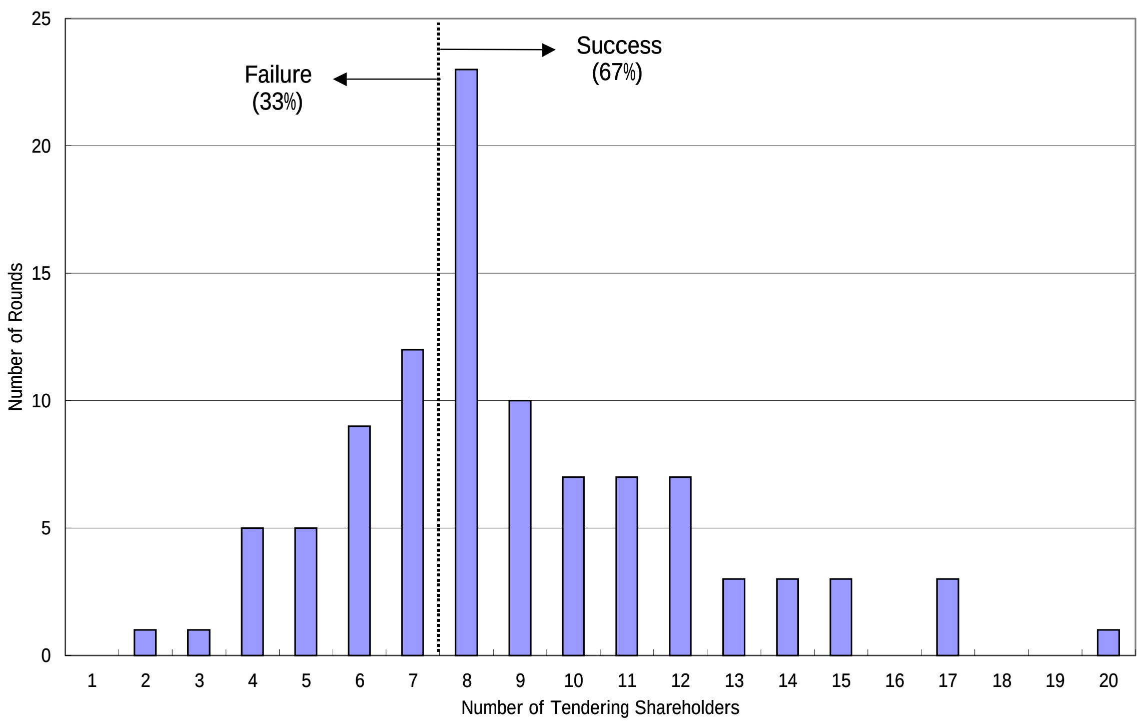


Figure 9 The Distribution of the Rounds Classified by Number of Tendering Shareholders
[Experiment B]



Appendix: Players Instructions for [Experiment A][29] (Exact Transcript)

Overview of this Experiment

1. We will begin the explanation of this experiment with a recorded tape. The experimenter will operate the tape. After the explanation, you may ask questions.

2. You will draw an envelope. A piece of paper in the envelope assigns your role in this experiment.

3. If you are assigned to the Buyer, move to the seats to which the experimenter will guide you, with everything on your desk.

4. There are both the sheets for the Buyer and the sheets for Sellers on your desk. Make sure that you have the sheets you will use in this experiment. Summary and Explanation, Individual Card, and Overview of this Experiment are on white papers. They are common to both the Buyer and Sellers. Except for these white papers, the sheets for the Buyer are PINK, and the sheets for Sellers are GREEN. Make sure that you have the appropriate sheets for you. The experimenter will distribute the Desired Purchasing Price Cards (pink) to the Buyer, and the Selling Decision Cards (green) to Sellers.

Make sure that you have the following:

Buyer

- Summary and Instructions (white)
- Individual Card (white) *Fill in your card before the experiment begins.
- Overview of this Experiment (white)
- Buyer's Record Sheet (pink)
- Desired Purchasing Price Cards (pink)
- Buyer's Payoff Sheet 1 (pink)
- Buyer's Payoff Sheet 2 (pink)
- Receipt (white) *Enter your name and address, and impress your seal before the experiment begins.
- Ballpoint pen.

Sellers

- Summary and Instructions (white)
- Individual Card (white) *Please fill in your card before the experiment begins.
- Overview of this Experiment (white)

[29] Instructions for [Experiment B] are the same except for a buyer's initial commodity holdings. In footnotes, we show the place where [Experiment B] instructions are different.

- Sellers’ Record Sheet (green)
- Selling Decision Cards (green)
- Sellers’ Payoff Sheets (green)
- Receipt (white) *Enter your name and address, and impress your seal before the experiment begins.
- Ballpoint pen.

* Even if you are the Buyer (a Seller), you may refer to the sheets for Sellers (the Buyer).

5. Before this experiment begins, you may ask questions. If you have any questions during this experiment, raise your hand without saying a word. The experimenter will come to your seat.

6. We will start the first experiment. **Do not communicate with any other participant during the experiment**.

i. The experimenter will let the Buyer know the value (Z) of a commodity. If you are the Buyer, record the value on your Record Sheet. You are not to read the value aloud.
ii. If you are the Buyer, enter your desired purchasing price of the commodity in your Desired Purchasing Card for the said round, remove and hand it to the experimenter. You may consider slowly. If you are a Seller, please wait for a while.
iii. The experimenter will announce the commodity’s desired purchasing price that each Buyer will have decided. If you are a Seller, decide whether to sell your commodity or not. Enter the Selling Decision Card for the said round according to your decision, remove and place it face down on the right edge of your desk in such a way that the face of the card will not be seen by any other participant. The experimenter will collect your card.
iv. The experimenter will announce to all of the participants the value of Z and how many Sellers have sold the commodities. Record the announced value in your Record Sheet.
v. Record also your payoff according to your Payoff Sheet(s).

*The experiment will be repeated twenty times.

7. When the twentieth round of the experiment has finished, the experimenter will say “We have finished this experiment.” and this experiment will finish. Your Record Sheets will be collected. While the experimenter calculates your monetary reward, fill in our questionnaire.

8. Your reward of this experiment will be paid. Wait until your Individual Number is called.

9. If your Individual Number is called, come to the experimenter’s desk with your Individual Card, Receipt and the questionnaire.

10. You will receive your reward. Enter the amount of money that the experimenter will tell you in the price column of your Receipt. Make sure that you have entered your name and address in the Receipt. Impress your seal if not, and receive your reward. Then the whole experiment will finish.

Summary and Instructions

(Read the following while listening to the tape)

We will begin the instructions of this experiment from now. See *Summary and Instructions* on your desk.

Summary

This is an experiment in economic decision-making. The instructions are simple, and if you follow them carefully and make good decisions, you would earn a considerable amount of money. The experiment will be repeated twenty times. In each repetition, or "round", your payoff will be calculated and the sum of your payoffs in the all of the rounds will determine your actual payoff which will be paid in cash at the end of this experiment. Later we will explain how to calculate your payoff.

The experiment will be conducted between one Buyer and twenty Sellers of a commodity. Who is going to be the Buyer and who are going to be Sellers will be decided by lottery.

If you are the Buyer, you will offer the price at which you would like to buy the commodity, or your "desired purchasing price" to twenty Sellers. Each Seller possesses the commodity. He or she will choose "Sell" or "Not Sell", referring to the "desired purchasing price" offered by the Buyer.

During this experiment, neither the Buyer nor the Sellers are allowed to talk to any other participant. If somebody should talk, the experiment will be suspended. Also, you are asked to follow the various instructions given by the experimenter.

Instructions

When you sit down, make sure that there are the follows on your desk.

-Summary and Instructions (this sheet) -Individual Card

-Buyer's Record Sheet -Record Sheets (for Sellers)

-Desired Purchasing Price Card and Selling Decision Card

(one small piece of pink paper and one small piece of green paper)

-Overview of this Experiment -Buyer's Payoff Sheet 1

-Buyer's Payoff Sheet 2 -Sellers' Payoff Sheet

-Receipt -Ballpoint pen

Fill in your *Individual Card*, and enter your name and address and impress your seal before the experiment begins.

Sellers' Record Sheet is for recording your information on this experiment, if you are a Seller.

Buyer's Record Sheet is for recording your information on this experiment, if you are a Buyer.

Desired Purchasing Cards are for entering the price at which you would like to buy the commodity (desired purchasing price), when you are a Buyer. Now you have only one Desired Purchasing Card. It makes a pair with the Selling Decision Card. For the experiment you will be given twenty cards. You will use one of them in each round. Remove and hand it to the experimenter.

Selling Decision Cards will be used if you are a Seller. You will enter your decision, "Sell", or "Not Sell" the commodity you have, in the cards considering the Desired Purchasing Price the Buyer will offer. Now you have only one Selling Decision Card. It makes a pair with the Desired Purchasing Card. For the experiment you will have twenty cards. For each round you will fill in one of them, remove and turn it over on the right hand side of your desk. The experimenter will collect it.

Overview of this Experiment is the summary of what the participants are to do in this experiment. Refer to it when necessary.

From now on we will give you the instructions of this experiment.

Before we begin this experiment, we assign one of the participants to the Buyer and twenty to Sellers by lottery. In this experiment, whether you will be the Buyer or a Seller does not matter for the opportunity of earning money. The amount of the reward depends only on your decision and luck.

<u>Buyer (one person)</u>

Let us give the instructions to the Buyer. To begin with, put on your desk Buyer's Record Sheet, Buyer's Payoff Sheets 1 and 2, and the Desired Purchasing Card (The pink one in a pair of small pieces of paper). The Buyer will use the pink sheets.[30]

Now you do not have any units of a commodity, and you are thinking of purchasing 10 units.[31] The value (Z) of the commodity per 1 unit varies from 0 to 200, at intervals of every 10 (0, 10, 20, 30, …, 180, 190, 200). From among these values, Z will be determined completely at random. At the beginning of each round, the experimenter will let you know the value of Z with a piece of paper. The value of Z will be revealed only to you, the Buyer, and you are not to show it to anyone. The value of Z may be different in each round.

The value (Z) of the commodity is realized, however, only when you can purchase 10 units, that is, only when you can get the offers of "Sell" from <u>10 Sellers or more</u> out of 20. If you can get the offers only from <u>9 Sellers</u>

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[30] The color of the Buyer's materials is yellow in experiment B.

[31] In experiment B, the Buyer has 5 units of a commodity initially, and he or she is thinking of purchasing 8 more units.

or less, the commodity has no value for you, and you are to stop purchasing it.[32]

Looking at the value of Z revealed by the experimenter, you will enter your "desired purchasing price" or the price at which you would like to purchase one unit of the commodity, in your Desired Purchasing Price Card. Then you will show the card to the experimenter. You can offer the value from 0 to 200, at intervals of every 10 (0, 10, 20, 30, …, 280, 290, 300). Referring to your offer, each Seller will choose either "Sell" or "Not Sell". And your payoff will depend on whether 10 Sellers or more would choose "Sell" or "Not Sell".[33]

The way the Buyer's (your) payoff will be determined is summarized in Buyer's Payoff Sheet 1 on your desk. Let us explain how to use it. Suppose that more than 10 Sellers agreed to "sell", and let this case be "Case 1". Then your payoff will be:

$$(Z - \text{desired purchasing price}) \times 10.$$ [34]

For example, if Z is 150 and the desired purchasing price you offer is 100, then your payoff will be:

$$(150 - 100) \times 10 = 500.$$ [35]

Your payoff in this "Case 1" is shown in Buyer's Payoff Sheet 2 as well. Looking at Buyer's Payoff Sheet 2, you will find your payoff 500 at the box where the column of Z 150 and the row of the desired purchasing price 100 intersect.

On the other hand, suppose only 9 Sellers or less agreed to "sell", and let this case be "Case 2". In this case, the commodity will have no value for you. Therefore you will stop purchasing the commodity. You can see in Buyer's Payoff Sheet 1, your payoff will be zero.[36]

We will explain the Buyer's payoff patterns with some simple examples.

Example 1 Suppose that the value of Z you were shown (the value of the commodity for you) was 130, that then you offered 90 as your desired purchasing price, and that 15 Sellers agreed to "sell" referring to your offer. This case is "Case 1", since 10 Sellers or more agreed to sell the commodity. Therefore your payoff would be, according to Buyer's Payoff Sheet 1,

$$(130 - 90) \times 10 = 400.$$

This can also be confirmed with Buyer's Payoff Sheet 2. On Buyer's Payoff Sheet 2, you will find your

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[32] In experiment B, the value (Z) of the commodity is realized only when 8 sellers or more agree to sell their units of commodity at the Buyer's offering price, while the Buyer stops purchasing any units when 7 sellers or less agree to sell.

[33] In experiment B, the Buyer's payoff depends on whether 8 sellers or more sell their units of commodity or not.

[34] In experiment B, the Buyer's payoff formula is $Z \times 5+(Z - \text{desired purchasing price}) \times 8$.

[35] In experiment B, this example was written as $150\times5+(150-100)\times8=1150$.

[36] In experiment B, this case is when 7 sellers or less agree to sell.

payoff 400 at the box where the column of Z 130 and the row of the desired purchasing price 90 intersect.[37]

Example 2 Similarly, suppose that the value of Z was 130 and that you offered 90 as your desired purchasing price. Then, suppose also that 10 Sellers agreed to "sell". This case is "Case 1" as well, since 10 Sellers or more agreed to sell the commodity. Therefore your payoff would be 400, as in *Example 1*. The result is recorded at Example 2 on Sellers' Record Sheet.[38]

Example 3 Next, suppose that the value of Z was 80, that your desired purchasing price was 140 and that 11 Sellers agreed to "sell". This case is also "Case 1", since 10 Sellers or more agreed to sell. Then your payoff would be, according to Buyer's Payoff Sheet 1,

$$(80 - 140) \times 10 = -600,$$

so that you would lose 600. This can be confirmed with Buyer's Payoff Sheet 2. On the Payoff Sheet of Buyer 2, you will find your payoff – 600 at the box where the column of Z 80 and the row of the desired purchasing price 140 intersect. The result is recorded at Example 3 on Sellers' Record Sheet.[39]

Example 4 Suppose that the value of Z was 190, that your desired purchasing price was 100 and that 7 Sellers agreed to "sell". [40]This case is "Case 2", since 9 Sellers or less agreed to sell. Therefore, according to Buyer's Payoff Sheet 1, your payoff would be zero. As an exercise, record the result of *Example 4* in Sellers' Record Sheet.

Taking these things in to account, in each round you will decide at what price you would like to purchase the commodity or your "desired purchasing price". Then you will enter it into the Desired Purchasing Card, and hand the card to the experimenter.

The above is the instructions for the Buyer in one round. You may see the sheets for the Sellers as well. However, make sure that you will not confuse the sheets for you with those for the Sellers.

<u>Sellers (20 persons)</u>

Now let us give the instructions to the Sellers. To begin with, put on your desk Sellers' Record Sheet, Sellers' Payoff Sheet, and the Selling Decision Card (the green one in a pair of small piece of paper). The Sellers will

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[37] In example 1 in the experiment B instructions, 12 sellers agree to sell. The value of Z and the buyer's purchasing price are the same. Therefore the buyer's payoff in this example is $130\times 5+(130-90)\times 8=970$.

[38] In example 2 in the experiment B instructions, 8 sellers agree to sell. The value of Z and the buyer's purchasing price are the same.

[39] In example 3 in the experiment B instructions, 10 sellers agree to sell. The value of Z and the buyer's purchasing price are the same. Therefore the buyer's payoff in this example is$80\times5+(80-140)\times 8 = -80$.

[40] In example 4 in the experiment B instructions, 5 sellers agree to sell.

use the green sheets.[41]

If you are a Seller, you have one unit of a commodity. You will choose either “Sell” or “Not Sell”, referring to the “desired purchasing price” offered by the Buyer.

Your payoff depends not only on your decision as to “Sell” or “Not Sell”, but also on those of the other Sellers. However, you will not know the other Sellers’ decisions when you make your own decision.

As for how your payoff will be determined, see Sellers’ Payoff Sheet. Now we will explain how to use this sheet. If 10 Sellers or more other than you agreed to “sell” ([Case A] in Sellers’ Payoff Sheet), your payoff will be determined as follows.[42] If you choose “Sell”, your payoff will be the “desired purchasing price” offered by the Buyer. Instead, if you choose “Not Sell”, your payoff will be “the value of Z for the Buyer”. At the beginning of this experiment, the experimenter will reveal the value of Z to the Buyer, but not to you. At the end of each round, however, the experimenter will announce the value of Z to all of the participants.

Next, if 9 Sellers or less other than you agreed to “sell” ([Case B] in Sellers’ Payoff Sheet), your payoff will be zero, regardless of your choice of “Sell” or “Not Sell”.[43]

In order to make sure, we will explain the payoff patterns of Sellers with three simple examples.

Example 5 Suppose that you chose “Sell” at the desired purchasing price 130 offered by the Buyer, and that 15 Sellers agreed to “sell” at the same time.[44] In this case, the number of Sellers other than you who sold the commodity is 14. This is [Case A], since 10 Sellers or more other than you agreed to “sell”. Since you chose “Sell”, according to Sellers’ Payoff Sheet, your payoff would be the “desired purchasing price offered by the Buyer”, that is, 130. The result is recorded at Example 5 of Sellers’ Record Sheet. There “the value of Z announced by the experimenter” is 80, but it has nothing to do with your payoff in the case of Example 5.

Example 6 Suppose that you chose “Not Sell” at the desired purchasing price 120 offered by the Buyer, and that 12 Sellers agreed to “sell”. In this case, the number of Sellers other than you who sold the commodity is 12. This is [Case A], since 10 Sellers or more other than you agreed to “sell”. However, your payoff would be, according to Sellers’ Payoff Sheet, Z (the value of the commodity for the Buyer), because you chose “Not Sell”. The value of Z will be announced at the end of each round. If Z is 100 then your payoff would be 100, and if Z is 150 then your payoff would be 150. The result is written at Example 6 of Sellers’ Record Sheet.

Example 7 Suppose that you chose “Sell” at the desired purchasing price 80 offered by the Buyer, and that 6 Sellers agreed to “sell”. In this case, the number of Sellers other than you who sold the commodity is 5. This

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41 The color of a seller’s materials is blue in experiment B.

42 In experiment B, this is the case when 8 sellers or more other than the seller agree to sell.

43 In experiment B, this is the case when 7 sellers or less other than the seller agree to sell.

44 In example 5 in the experiment B instructions, 14 sellers agree to sell. The value of Z and the buyer’s purchasing price are the same.

is [Case B], since 9 Sellers or less other than you agreed to "sell". Therefore, according to Sellers' Payoff Sheet, your payoff would be 0. Suppose the value of Z announced at the end of the round was 140. However, in this *Example*, the value of Z has nothing to do with your payoff. As an exercise, record the result of Example 7 in Sellers' Record Sheet.[45]

Taking into account the instructions mentioned so far, in each round the Sellers will choose either "Sell" or "Not Sell", referring to the desired purchasing price offered by the Buyer that the experimenter will announce, and fill in the Selling Decision Card with a circle.

The above is the instructions for the Sellers in one round. You may see the sheets for the Buyer as well. However, make sure that you will not confuse the sheets for you with those for the Buyer.

These are the instructions for one round. At the end of each round, the experimenter will announce to all the participants the value of Z and the number of the Sellers who agreed to "sell" the commodity. Based on the announcement, confirm your payoff and record it in the Record Sheet.

How to fill in Record Sheet

Buyer

i. Enter the value of Z revealed by the experimenter in Buyer's Record Sheet.

ii. Choose your desired purchasing price from 0 to 300 at the intervals of every 10 (0, 10,20, …, 280, 290, 300).

iii. Enter the desired purchasing price in the Desired Purchasing Price Card, remove, and hand it to the experimenter.

iv. Enter the desired purchasing price also in Buyer's Record Sheet.

v. Enter the number of the Sellers who agree to "sell" the commodity, which will be announced by the experimenter, in Buyer's Record Sheet.

vi. Enter your payoff in Buyer's Record Sheet (see Buyer's Payoff Sheet 1 and Buyer's Payoff Sheet 2).

Sellers

i. Enter the Buyer's desired purchasing price announced by the experimenter in Sellers' Record Sheet.

ii. Choose either "Sell" or "Not Sell" and enter it in Sellers' Record Sheet and the Selling Decision Card.

iii. Remove the entered Selling Decision Card, and hand it to the experimenter

iv. Enter the value of Z and the number of the Sellers who agree to sell the commodity, which will be announced by the experimenter, in Sellers' Record Sheet.

[45] In example 7 in the experiment B instructions, the buyer's purchasing price is 180.

v. Enter the number of the Sellers other than you who sold the commodity in Sellers' Record Sheet.

vi. Enter your payoff in Sellers' Record Sheet (see Sellers' Payoff Sheet).

*In Sellers' Record Sheet, how your payoff will be determined is mentioned on the right hand side of the column in which you will fill in each round. This is the same as Sellers' Payoff Sheet. Refer to it when you record your payoff.

Finally, we will explain how the amount of money you receive is determined. The amount of money depends on "Your Payoff" in each round. It is calculated as follows.

The Buyer's monetary reward is:

1,000 + (the sum of "Your Payoff") yen.[46]

For example, if the sum of "Your Payoff" in all of the rounds is 3,000 you will receive:

1,000 + 3,000 = 4,000 yen.

Next, a Seller's monetary reward is:

1,000 + 3× (the sum of "Your Payoff") yen.[47]

For example, if the sum of "Your Payoff" in all of the rounds is 1,000 you will receive:

1,000 + 3× 1,000 = 4,000 yen.

This is the end of the instructions of this experiment. If you have questions, raise your hand quietly. The experimenter will come to your desk.

[46] The buyer's monetary reward formula in experiment B is (1000+0.5× (the sum of payoffs throughout the experiment)) yen.

[47] The monetary reward formula for a seller in experiment B is (1000+2× (the sum of payoffs throughout the experiment)) yen.

Buyer’s Record Sheet for experiment A

Your Individual Number ___________

Example 1

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
130	90	15	“Case 1” The number of Sellers announced is <u>10 or more</u> →	See Buyer’s Payoff Sheet 2	400
			“Case 2” The number of Sellers announced is <u>9 or less</u> →	0	

Example 2

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
130	90	10	“Case 1” The number of Sellers announced is <u>10 or more</u> →	See Buyer’s Payoff Sheet 2	400
			“Case 2” The number of Sellers announced is <u>9 or less</u> →	0	

Example 3

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
80	140	11	“Case 1” The number of Sellers announced is <u>10 or more</u> →	See Buyer’s Payoff Sheet 2	−600
			“Case 2” The number of Sellers announced is <u>9 or less</u> →	0	

Example 4 (Record the result by yourself)

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
			“Case 1” The number of Sellers announced is <u>10 or more</u> →	See Buyer’s Payoff Sheet 2	
			“Case 2” The number of Sellers announced is <u>9 or less</u> →	0	

Sellers' Record Sheet for experiment A Your Individual Number _________

Example 5

The desired purchasing price offered by the Buyer	Your choice (put a circle around either of them)	The number of Sellers announced	The number of Sellers other than you who sold the commodity
130	[Sell] Not Sell	15	14

The value of Z announced by the experimenter	Your payoff
80	130

The way your payoff is determined (see Seller's Payoff Sheet)			
		The number of Sellers other than you who chose "Sell"	
		[Case A] 10 or More	[Case B] 9 or less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	Z	0

Example 6

The desired purchasing price offered by the Buyer	Your choice (put a circle around either of them)	The number of Sellers announced	The number of Sellers other than you who sold the commodity
120	Sell [Not Sell]	12	12

The value of Z announced by the experimenter	Your payoff
100 (150)	100 (150)

The way your payoff is determined (see Seller's Payoff Sheet)			
		The number of Sellers other than you who chose "Sell"	
		[Case A] 10 or More	[Case B] 9 or less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	Z	0

Example 7

The desired purchasing price offered by the Buyer	Your choice (put a circle around either of them)	The number of Sellers announced	The number of Sellers other than you who sold the commodity
	Sell Not Sell		

The value of Z announced by the experimenter	Your payoff

The way your payoff is determined (see Seller's Payoff Sheet)			
		The number of Sellers other than you who chose "Sell"	
		[Case A] 10 or More	[Case B] 9 or less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	Z	0

Buyer's Payoff Sheet 1 for experiment A

The number of Sellers who agreed to sell	
"Case 1" **10 or More**	"Case 2" **9 or Less**
(Z – your desired purchasing price) × 10	0

Sellers' Payoff Sheet for experiment A

		The number of Sellers other than you who chose "Sell"	
		[Case A] 10 or More	[Case B] 9 or Less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	The value of Z	0

Buyer's Payoff Sheet 2 for experiment A

		The value of Z revealed by the experimenter																				
		0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**	**190**	**200**
Your desired purchasing price	**0**	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
	10	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
	20	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
	30	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700
	40	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
	50	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
	60	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400
	70	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300
	80	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100	1200
	90	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000	1100
	100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900	1000
	110	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800	900
	120	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700	800
	130	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600	700
	140	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500	600
	150	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400	500
	160	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300	400
	170	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200	300
	180	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100	200
	190	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0	100
	200	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100	0
	210	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200	-100
	220	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300	-200
	230	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400	-300
	240	-2400	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400
	250	-2500	-2400	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600	-500
	260	-2600	-2500	-2400	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700	-600
	270	-2700	-2600	-2500	-2400	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800	-700
	280	-2800	-2700	-2600	-2500	-2400	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900	-800
	290	-2900	-2800	-2700	-2600	-2500	-2400	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000	-900
	300	-3000	-2900	-2800	-2700	-2600	-2500	-2400	-2300	-2200	-2100	-2000	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000

Desired Purchasing Price Card for both experiment A and experiment B

Your Individual Number _____________ Desired Purchasing Price Card **1st round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number _____________ Desired Purchasing Price Card **11th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number _____________ Desired Purchasing Price Card **2nd round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number _____________ Desired Purchasing Price Card **12th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number _____________ Desired Purchasing Price Card **3rd round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number _____________ Desired Purchasing Price Card **13th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number _____________ Desired Purchasing Price Card **4th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number _____________ Desired Purchasing Price Card **14th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number _____________ Desired Purchasing Price Card **5th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number _____________ Desired Purchasing Price Card **15th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number _____________ Desired Purchasing Price Card **6th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number _____________ Desired Purchasing Price Card **16th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300

Your Individual Number ____________ Desired Purchasing Price Card **7th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number ____________ Desired Purchasing Price Card **17th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number ____________ Desired Purchasing Price Card **8th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number ____________ Desired Purchasing Price Card **18th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number ____________ Desired Purchasing Price Card **9th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number ____________ Desired Purchasing Price Card **19th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Your Individual Number ____________ Desired Purchasing Price Card **10th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300	Your Individual Number ____________ Desired Purchasing Price Card **20th round** You are the Buyer. Put a circle around one of the values below. 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300

Buyer’s Record Sheet for experiment B

Your Individual Number ___________

Example 1

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
130	90	12	“Case 1” The number of Sellers announced is 8 or more →	See Buyer’s Payoff Sheet 2	970
			“Case 2” The number of Sellers announced is 7 or less →	0	

Example 2

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
130	90	8	“Case 1” The number of Sellers announced is 8 or more →	See Buyer’s Payoff Sheet 2	970
			“Case 2” The number of Sellers announced is 7 or less →	0	

Example 3

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
80	140	10	“Case 1” The number of Sellers announced is 8 or more →	See Buyer’s Payoff Sheet 2	−80
			“Case 2” The number of Sellers announced is 7 or less →	0	

Example 4 (Record the result by yourself)

The value of Z (enter the value of Z revealed by the experimenter)	Your desired purchasing price (a value from 0 to 300 at the interval of every 10)	The number of Sellers announced by the experimenter	The way your payoff is determined (see Buyer’s Payoff Sheet 1 and 2)		Your Payoff
			“Case 1” The number of Sellers announced is 8 or more →	See Buyer’s Payoff Sheet 2	
			“Case 2” The number of Sellers announced is 7 or less →	0	

Sellers' Record Sheet for experiment B   Your Individual Number ______________

Example 5

The desired purchasing price offered by the Buyer	Your choice (put a circle around either of them)	The number of Sellers announced	The number of Sellers other than you who sold the commodity
130	[Sell] Not Sell	14	13

The value of Z announced by the experimenter	Your payoff
80	130

The way your payoff is determined (see Seller's Payoff Sheet)			
		The number of Sellers other than you who chose "Sell"	
		[Case A] 8 or More	[Case B] 7 or less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	Z	0

Example 6

The desired purchasing price offered by the Buyer	Your choice (put a circle around either of them)	The number of Sellers announced	The number of Sellers other than you who sold the commodity
120	Sell [Not Sell]	12	12

The value of Z announced by the experimenter	Your payoff
100 (150)	100 (150)

The way your payoff is determined (see Seller's Payoff Sheet)			
		The number of Sellers other than you who chose "Sell"	
		[Case A] 8 or More	[Case B] 7 or less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	Z	0

Example 7

The desired purchasing price offered by the Buyer	Your choice (put a circle around either of them)	The number of Sellers announced	The number of Sellers other than you who sold the commodity
	Sell Not Sell		

The value of Z announced by the experimenter	Your payoff

The way your payoff is determined (see Seller's Payoff Sheet)			
		The number of Sellers other than you who chose "Sell"	
		[Case A] 8 or More	[Case B] 7 or less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	Z	0

Buyer's Payoff Sheet 1 for experiment B

The number of Sellers who agreed to sell	
"Case 1" **8 or More**	"Case 2" **7 or Less**
$Z \times 5 + (Z -$ your desired purchasing price$) \times 8$	0

Sellers' Payoff Sheet for experiment B

		The number of Sellers other than you who chose "Sell"	
		[Case A] 8 or More	[Case B] 7 or Less
Your Choice	Sell	The desired purchasing price offered by the Buyer	0
	Not Sell	The value of Z	0

Buyer's Payoff Sheet 2 for experiment B

		The value of Z revealed by the experimenter																				
		0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**	**190**	**200**
	0	0	130	260	390	520	650	780	910	1040	1170	1300	1430	1560	1690	1820	1950	2080	2210	2340	2470	2600
	10	-80	50	180	310	440	570	700	830	960	1090	1220	1350	1480	1610	1740	1870	2000	2130	2260	2390	2520
	20	-160	-30	100	230	360	490	620	750	880	1010	1140	1270	1400	1530	1660	1790	1920	2050	2180	2310	2440
	30	-240	-110	20	150	280	410	540	670	800	930	1060	1190	1320	1450	1580	1710	1840	1970	2100	2230	2360
	40	-320	-190	-60	70	200	330	460	590	720	850	980	1110	1240	1370	1500	1630	1760	1890	2020	2150	2280
	50	-400	-270	-140	-10	120	250	380	510	640	770	900	1030	1160	1290	1420	1550	1680	1810	1940	2070	2200
	60	-480	-350	-220	-90	40	170	300	430	560	690	820	950	1080	1210	1340	1470	1600	1730	1860	1990	2120
	70	-560	-430	-300	-170	-40	90	220	350	480	610	740	870	1000	1130	1260	1390	1520	1650	1780	1910	2040
	80	-640	-510	-380	-250	-120	10	140	270	400	530	660	790	920	1050	1180	1310	1440	1570	1700	1830	1960
	90	-720	-590	-460	-330	-200	-70	60	190	320	450	580	710	840	970	1100	1230	1360	1490	1620	1750	1880
	100	-800	-670	-540	-410	-280	-150	-20	110	240	370	500	630	760	890	1020	1150	1280	1410	1540	1670	1800
	110	-880	-750	-620	-490	-360	-230	-100	30	160	290	420	550	680	810	940	1070	1200	1330	1460	1590	1720
	120	-960	-830	-700	-570	-440	-310	-180	-50	80	210	340	470	600	730	860	990	1120	1250	1380	1510	1640
	130	-1040	-910	-780	-650	-520	-390	-260	-130	0	130	260	390	520	650	780	910	1040	1170	1300	1430	1560
Your desired purchasing price	**140**	-1120	-990	-860	-730	-600	-470	-340	-210	-80	50	180	310	440	570	700	830	960	1090	1220	1350	1480
	150	-1200	-1070	-940	-810	-680	-550	-420	-290	-160	-30	100	230	360	490	620	750	880	1010	1140	1270	1400
	160	-1280	-1150	-1020	-890	-760	-630	-500	-370	-240	-110	20	150	280	410	540	670	800	930	1060	1190	1320
	170	-1360	-1230	-1100	-970	-840	-710	-580	-450	-320	-190	-60	70	200	330	460	590	720	850	980	1110	1240
	180	-1440	-1310	-1180	-1050	-920	-790	-660	-530	-400	-270	-140	-10	120	250	380	510	640	770	900	1030	1160
	190	-1520	-1390	-1260	-1130	-1000	-870	-740	-610	-480	-350	-220	-90	40	170	300	430	560	690	820	950	1080
	200	-1600	-1470	-1340	-1210	-1080	-950	-820	-690	-560	-430	-300	-170	-40	90	220	350	480	610	740	870	1000
	210	-1680	-1550	-1420	-1290	-1160	-1030	-900	-770	-640	-510	-380	-250	-120	10	140	270	400	530	660	790	920
	220	-1760	-1630	-1500	-1370	-1240	-1110	-980	-850	-720	-590	-460	-330	-200	-70	60	190	320	450	580	710	840
	230	-1840	-1710	-1580	-1450	-1320	-1190	-1060	-930	-800	-670	-540	-410	-280	-150	-20	110	240	370	500	630	760
	240	-1920	-1790	-1660	-1530	-1400	-1270	-1140	-1010	-880	-750	-620	-490	-360	-230	-100	30	160	290	420	550	680
	250	-2000	-1870	-1740	-1610	-1480	-1350	-1220	-1090	-960	-830	-700	-570	-440	-310	-180	-50	80	210	340	470	600
	260	-2080	-1950	-1820	-1690	-1560	-1430	-1300	-1170	-1040	-910	-780	-650	-520	-390	-260	-130	0	130	260	390	520
	270	-2160	-2030	-1900	-1770	-1640	-1510	-1380	-1250	-1120	-990	-860	-730	-600	-470	-340	-210	-80	50	180	310	440
	280	-2240	-2110	-1980	-1850	-1720	-1590	-1460	-1330	-1200	-1070	-940	-810	-680	-550	-420	-290	-160	-30	100	230	360
	290	-2320	-2190	-2060	-1930	-1800	-1670	-1540	-1410	-1280	-1150	-1020	-890	-760	-630	-500	-370	-240	-110	20	150	280
	300	-2400	-2270	-2140	-2010	-1880	-1750	-1620	-1490	-1360	-1230	-1100	-970	-840	-710	-580	-450	-320	-190	-60	70	200

Questionnaire

(for both experiment A and experiment B)

Your Individual Number _______

Your role in this experiment (put a circle around the appropriate one) Seller Buyer

The experiment has finished. Finally, please answer the questions below.
This questionnaire is used in order for us to understand how the participants of this experiment made decisions. You have plenty of time to answer the questions. Whenever you have anything unclear, ask the experimenter. When you have finished answering these questions, wait quietly until the other participants finish.

This questionnaire is anonymous, so that you do not have to enter your name. Please answer all the questions below. If you do not answer any one of these questions, we cannot use your questionnaire sheets as proper data. How to answer the questions is as follows. Put a × mark according to your answer.

Example Question:

Was this experiment easy, or difficult?

Very Easy ____ ____ ____ ____ ____ ____ ____ Very Difficult

If you feel the experiment was very easy,

Very Easy _×_ ____ ____ ____ ____ ____ ____ Very Difficult

put × in the most left box. If you feel the experiment was very difficult,

Very Easy ____ ____ ____ ____ ____ ____ _×_ Very Difficult

put × in the most right box. If you feel the experiment was easy,

Very Easy ____ _×_ ____ ____ ____ ____ ____ Very Difficult

put × as above. If you feel the experiment was somewhat easy,

Very Easy ____ ____ _×_ ____ ____ ____ ____ Very Difficult

put × as above. If you feel the experiment was difficult,

Very Easy ____ ____ ____ ____ ____ _×_ ____ Very Difficult

put × as above. If you feel the experiment was somewhat difficult,

Very Easy ____ ____ ____ ____ _×_ ____ ____ Very Difficult

put × as above. If you feel the experiment was neither easy nor difficult,

Very Easy ____ ____ ____ _×_ ____ ____ ____ Very Difficult

put × in the center box as above.

Thank you in advance for your assistance.

Questions on the Instructions of this Experiment

First, we will ask questions about the instructions of this experiment given at the beginning of this experiment. Check (×) one box that applies.

We distributed *Summary*, *Overview of this Experiment* and payoff sheets (*Buyer's Payoff Sheet 1*, *Buyer's Payoff Sheet 2*, *Sellers' Payoff Sheet*). Did you refer to them during this experiment?

Never ____ ____ ____ ____ ____ ____ ____ Very Frequently

Did you have anything unclear in the instructions of this experiment?

Yes ____ No

If your answer is Yes, please specify where in the instructions were unclear.

If you have any idea to improve the instructions of this experiment, please write it down below.

Did anything out of the instructions occur in this experiment?

Yes ____ No ____

If your answer is Yes, what was out of the instructions?

Did you understand the procedure of this experiment before it actually started?

Yes ____ No ____

If No, at which round did you come to understand the procedure?

Questions on Your Decision Making

When you make decisions (your desired purchasing price if you were the Buyer, or whether you would sell or would not sell if you were a Seller), what did you take into account? Explain briefly.

Did your decision making change as this experiment proceeded?

Yes ____ No ____

If Yes, how did your decision making change?

- In general, was your decision making difficult, or easy?

Very Easy ____ ____ ____ ____ ____ ____ ____ Very Difficult

- As this experiment proceeded, did your decision making become easier, or more difficult?

Became Much Easier ____ ____ ____ ____ ____ ____ ____ Became much more Difficult

- To what degree do you think your decision influenced your payoff?

Never ____ ____ ____ ____ ____ ____ ____ Very Much

- To what degree do you think your decision influenced the other participants' payoffs?

Never ____ ____ ____ ____ ____ ____ ____ Very Much

- To what degree do you think the other participants' decisions influenced your payoff?

Never ____ ____ ____ ____ ____ ____ ____ Very Much

- If this experiment had been such that your decision would be known to the other participants, how do you think your decision making would have changed?

Your decision making would have been:

Completely the Same ____ ____ ____ ____ ____ ____ ____ Completely Different

- What would your decision making have been like?

- When you made decisions, to what degree did you consider the influence of your decision on the other participants' payoffs?

Never ____ ____ ____ ____ ____ ____ ____ Very Much

- To what degree do you think the other participants' consider the influence that their decisions would give to your payoff?

Never ____ ____ ____ ____ ____ ____ ____ Very Much

- Did the past results influence your next decision making?

Never ____ ____ ____ ____ ____ ____ ____ Very Much

- If the results in the past rounds influenced your decision making, please specify what.

General Questions on this Experiment

- Next, we will ask general questions about this experiment. To what degree do the following sentences fit the impressions you have.

*This experiment was boring.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*My purpose in this experiment was to earn money as much as possible.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*I came to think about my decision making less, as the experiment proceeded.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*I am satisfied with my payoff.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*My purpose in this experiment was to earn more money than other participants.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*The experiment was carried out smoothly.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*The value of Z was chosen at random.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*This experiment was enjoyable.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*I did not fully understand the procedure of this experiment until the experiment actually started.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*My purpose in this experiment was to earn money as much as possible, together with the other participants.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*(Sellers) I did not find it worthwhile to sell the commodity, because not many Sellers were willing to sell the commodity.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*I was looking forward to the result in each round.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*I thought the experiment was too long.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

*I did not take this experiment as a whole seriously.

Completely False ____ ____ ____ ____ ____ ____ ____ Very True

- Had you heard of this experiment before the experiment began?

  Yes ____ No ____

- If Yes, what did you hear.

- If you have any comments or opinions for future experiments, please write them down below.