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The Spite Dilemma Revisited: Comparison between Chinese and Japanese

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【要約】This paper studies Chinese choice behavior in the provision of public goods via the voluntary contribution mechanism. The laboratory experiment conducted in China adopts the same design as the one used in Saijo and Nakamura (1995), i.e. either cooperating (full contribution) or free riding (no contribution) is predicted as the unique Nash equilibrium with a high (larger than one) or low (smaller than one) marginal return of contribution. Comparing the results of Chinese subjects with their Japanese counterparts, we find significant differences between these two countries in terms of their choice behavior, despite the similarities in their cultures and the proximity in geographical positions. Japanese subjects are more likely to act spitefully, and, in contrast, Chinese subjects are more likely to perform cooperatively. In addition, concerning the deviations from the Nash equilibria with different marginal returns, the statistical results indicate that Chinese subjects behave more consistent with the theoretical prediction in the high marginal return case, while Japanese choice behavior seems less different from the theoretical expectation in the low marginal return case.

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1. Introduction

A large part of experimental literature studies the voluntary provision of a public good through a voluntary contribution mechanism. Public goods experiments usually study how the randomly recruited subjects make decisions on dividing their initial endowment between private saving and public investment. Most of the previous studies in this field have applied a linear n-person design, given the marginal return from public investment being smaller than that from private saving (Anderson and Putterman, 2006; Chaudhuri et al., 2006; Cinyabuguma et al., 2005; Cookson, 2000; Fischbacher et al., 2001; Gächter et al., 2006). Under such situation, especially in the case where subjects participate repeatedly with the same group of people, the data do not support the theoretical prediction of no voluntary contributions.

Explanations on this phenomenon include the existence of altruism or a warm glow from giving in the preferences of at least some subjects or notions of inherent cooperative values, which lead individuals to make contributions that appear to be inconsistent with individual rationality, but are consistent with maximizing the payoff of the group (Brunton et al., 2001; Fischbacher et al., 2001). Alternatively, in another environment where the marginal return from public investment is larger than that from private saving, which predicts the full contribution of initial endowments being the dominant strategy, Saijo and Nakamura (1995) have reported that Japanese subjects were found to deviate from standard behavior in a surprising manner due to their spiteful motivation. To examine this issue, Brunton et al. (2001) have applied the same experimental design and procedure as those of Saijo and Nakamura (1995) in their study, but they did not find the spiteful behavior in Canadian subjects.

The seeming differences of choice behavior across countries have inspired experimental economists to study via international comparisons. Cason et al. (2002) apply a non-linear two-stage[1] experiment to compare the choice behavior between American and Japanese subjects. They document that Japanese subjects are more likely to act spitefully than their US counterparts. However, in another study on international comparison by Brandts et al. (2004), the authors report that differences in choice behavior across four countries (Japan, Netherlands, Spain and USA) are minor.

[1] The two-stage refers to a way where the individual subject has an additional choice on whether or not participating in the next step for choosing public investment amount.

Most of the microeconomic theories are based on the fundamental assumption that individual is rational and self-interested.[2] However, the above two phenomena (i.e. altruistic and spiteful behaviors) found in laboratory experiments of public good provision imply that the rationality and self-interest assumptions seem inconsistent with the behaviors of a wide range of subjects. The existence of altruistic or spiteful motivation demonstrates that an economic man cannot be viewed as representing individuals in a society like ours, and irrational and /or nonself-interested behaviors should be expected (Frohlich and Oppenheimer, 1984).

In this paper, we investigate Chinese choice behavior in the provision of public goods and compare that with the Japanese data in Saijo and Nakamura (1995), with an aim to identify Chinese choice behavior in public goods contribution so to include China in the international comparison pool. The reasons why we select China as the country to compare with Japanese data include a number of considerations. First, China and Japan have similar geographical positions and traditional cultures. This is important since culture and national character have played a central role in explaining differences in business management and performance across countries, both in the popular press and in management research (Cason et al., 2002). Second, to date, there is no published literature examining Chinese choice behavior in the field of public goods experiment. We believe that this void in international comparison pool should be filled. The third reason for studying China is that previous public goods provision experiments are conducted almost exclusively in developed countries and rarely in developing countries. As the largest developing country in the world, China could act, to some extents, as a typical country of less developed countries.

The rest of the paper proceeds as follows. In Section 2, we review the voluntary contribution mechanism and spite dilemma. In Section 3, we describe the experimental design and procedures. We report statistical results in Section 4, and summarize our findings and provide concluding comments in Section 5.

2. The Voluntary Contribution Mechanism and Spite Dilemma

The voluntary contribution mechanism (VCM) gives individuals the choices of

[2] Rationality refers to the individual's capacity to choose so as to maximize relative to a given set of preferences, and self-interest refers to the conjecture that the welfare of others is not an element in those preferences (Frohlich and Oppenheimer, 1984).

whether or not to contribute to a public good and, if choose to contribute, how much to contribute. In a VCM game, there are n subjects, and subject i has w_i units of initial endowment or money. Each subject faces a decision of splitting w_i between saving (x_i) and investment (y_i). The subject keeps the saving and receives $g(y)$ from the investment, where $y = \sum y_i$ and g is the investment function. Indeed, $g(y)$ is the production function of the public good, and hence it is the level of public good when the sum of all participants' investments is y. In the following, we assume that $g(y) = \alpha y$ with $\alpha \geq 0$. Here, α is the marginal return from one unit of an investment to the public good. Therefore, subject i's payoff function is given as:

$$w_i - y_i + g(y) = x_i + \alpha y \,. \tag{1}$$

Assuming that the utility function of each subject is strictly monotonic in payoff, we can write subject i's utility function as:

$$u(x_i, y) = x_i + \alpha y \tag{2}$$

Hence each subject's decision problem is

$$\max u(x_i, y) \text{ subject to } x_i + y = w_i + \sum_{j \neq i} y_j \tag{3}$$

Consider the case with $1 > \alpha > 0$, which we call the *low* marginal return case. It is well known that no contribution to the investment is the dominant strategy for every subject in the one-shot game. Although there is no dominant strategy in the repeated game, no investment in all periods for every subject is a unique sub-game perfect equilibrium. Consider the case with $\alpha > 1$, which we call the *high* marginal return case. Regardless of the total investments of other subjects, investing all of his or her money is the individual subject's dominant strategy. Hence full investment of the initial endowment in all periods for every subject is the unique dominant strategy equilibrium, which is different from that in the former case.

However, if the assumption of the utility function of each subject being strictly monotonic in money is broken, i.e. the utility function of at least several subjects is not monotonic in money but related to their ranking against the opponents, it is necessary to

reconsider the dominant strategy equilibrium in both *low* and *high* marginal return cases[3]. Saijo and Nakamura (1995) have shown that, in this ranking maximization case[4], no contribution is still the unique dominant strategy equilibrium in the *low* marginal return case. However, comparing to full investment in the payoff maximization case, zero contribution turns out to be the dominant strategy of those subjects whose purposes are to defeat other subjects in the *high* marginal case. In other words, to make money, the subject should invest all of his or her initial endowment; and to maximize ranking, the subject should invest none. In addition, the degree between full investment and no investment should depend on the relative strengths of the profit and spite motives. This phenomenon, which was named as the *spite dilemma* by Saijo and Nakamura, has been well applied to explain why some Japanese subjects did not invest their full initial endowments but chose a *spiteful strategy* in the *high* marginal return case in their study and Cason et al. (2002).

The definition of *spiteful strategy* has been given in Cason et al. (2004): "A subject is said to choose a *spiteful strategy* if she selects a strategy reducing both her own payoff and the other subject's payoff in comparison to the payoffs when she takes an own payoff-maximizing strategy, given an expected strategy of the other subject. It is also useful to distinguish spiteful strategies into two subcategories in our two-stage game. A spiteful strategy is called 'punishably spiteful' if the other subject pre-commits to contributing nothing, while it is called 'rivalistically spiteful' otherwise." To illustrate this definition in our case of marginal return being larger than 1, consider the situation with only two subjects *i* and *j*, as shown in Figure 1. The horizontal axis is the investment for private goods or saving by subject k $(k = i, j)$, while the vertical axis stands for the sum of public goods investment made by subjects *i* and *j*. Assume I_i and I_j are indifferent curves of subjects *i* and *j* respectively when both of them choose to contribute all the endowments to public goods. Suppose that subject *i* reduces her contribution from point *a* to point *b*, then the indifferent curve going through *b* is I_i'. Due to the reduction of contribution to public goods from subject *i*, the sum of investment for public goods is dropped to point *c*.

[3] In a slightly different context, Ito, Saijo, and Une (1995) identified over exploitation of the commons as ranking maximization behavior.

[4] Ranking maximization refers to the situation where individual subject intending to be the winner defeats the other subjects by maximizing his or her ranking in the group.

Therefore, the indifference curve of subject *j* shifts downwards from I_j to I'_j. Although subject *i*' s utility is sacrificed according to her decision of less investment for public goods, it is obvious that this decision makes subject *j*'s utility be reduced more. This phenomenon refers to so-called 'rivalistically spiteful' in Cason et al. (2004).

3. Experimental Design and Procedures

We conducted non-computerized classroom experiments on September 14 and 15 of 2006 by using 56 inexperienced undergraduates at Shanghai Jiao Tong University in China.[5] The format of our experiments is based on Saijo and Nakamura (1995) who conducted the same experiments at the University of Tsukuba in Japan.[6] The instructions and forms were translated from Japanese to Chinese by a bilingual co-author. Like the experiments in Japan, communication among the subjects was prohibited, and we declared that the experiments would be stopped if communication among the subjects was observed. This never happened in either Chinese experiment or Japanese experiment. It took approximately 70 minutes to conduct one session. The mean payoff per subject was \$11.13 (89RMB if \$1.00=8.00RMB). The maximum payoff among these subjects was \$13.88 (111RMB), and the minimum payoff was \$7.75 (62 RMB).[7]

The initial endowment, w_i, is 10 for all *i*, and the number of subjects in a session, *n*, is 7. There are two cases in our experiments: (1) the low marginal per-capita return from the investment ($\alpha = 0.7$) and (2) the high marginal per-capita return from the investment ($\alpha = 1/0.7$). Each group in a session faced two experiments according to the value of α consecutively. Hence there are two types of experiments: (*L*,*H*) and (*H*,*L*).[8] For example, (*L*,*H*) represents a type in which a low marginal return experiment is carried out first and a high marginal return experiment later. We repeated each type of experiment four times. The assignments of subjects to various conditions were random.

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[5] We applied the same experimental design and procedures as those for the experiments conducted during the fall of 1991 at the University of Tsukuba in Japan. By using the same design and procedures, we were able to have direct and meaningful comparison of results in China and Japan.

[6] The effect of payoff information (detailed table vs. rough table) on investment has also been examined in Saijo and Nakamura (1995). In the case of experiments in China, however, we just applied the detailed payoff table.

[7] For the experiments in Japan, the mean payoff per subject was \$10.55 (1371.8 yen if \$1.00=130 yen). The maximum payoff was \$13.90 (1806 yen), and the minimum payoff was \$8.24 (1071 yen).

[8] The conducted (*L*,*H*) and (*H*,*L*) sessions in China correspond to the (*DL*,*DH*) and (*DH*,*DL*) sessions in Saijo and Nakamura's study in Japan.

Let us describe a (*L*,*H*) experiment. Seven subjects and two experimenters gathered in a classroom at Shanghai Jiao Tong University. At the beginning of the experiment, experimenters distributed an experimental instruction sheet, a record sheet, a dividend table, 20 investment sheets, and 3 practice investment sheets.[9] Each instruction was given by a tape recorder to minimize the interaction between subjects and experimenters. We carefully avoided the use of words such as "contribution", "public", and "group" so to eliminate the possibility of such words drastically influencing the amount of investment because of the connotations of these words. First, each subject read the experimental instruction sheet while listening to the tape recorder. In the instruction sheet, subjects were notified that there were two stages of experiments. In each stage, each subject faced 10 investment decisions. For each of these decisions, each subject had 10 units of initial holding that was nontransferable between periods. In each period, each subject decided how many units of initial holding he or she should contribute based on the dividend table distributed. Once a subject had decided the investment from his or her initial holding, the subject circled the number on an investment sheet and handed it to an experimenter. One of the experimenters collected all the investment sheets from 7 subjects and wrote the total sum of investment on the blackboard. Each subject computed the payoff of the period based on the interaction of the subject's own investment and the total sum of other subjects' investment in the dividend table. This decision was repeated 10 times. Then, each subject received a new dividend table, and 10 decision makings were completed in a similar manner. The first 10 decision makings corresponded to a low marginal experiment and the second 10 to a high marginal return experiment.

The (*H*,*L*) experiment was conducted completely as same as the (*L*,*H*) procedure, except for the first 10 decisions corresponded to $\alpha = 0.7$ and the second 10 decisions corresponded to $\alpha = 1/0.7$.

4. Results

4.1 *Statistical tests of investments*

Hypothesis 1. Investments are the same across two countries.

[9] Three practices were conducted to ensure that each subject would understand the procedure of the experiment.

Result 1. The subjects' mean investments with both low and high marginal returns for both countries are plotted by periods in Figures 2 and 3. As shown from the figures, in both (*L,H*) and (*H,L*) experiments, Chinese subjects contributed differently from their Japanese counterparts regardless of low or high marginal return. Actually, the mean investment lines of Chinese subjects with both high and low marginal returns are always higher than those of Japanese subjects. To provide statistical supports on this issue, we apply a number of tests. First, as a preliminary check, we list the descriptive statistics of subjects' investment in Table 1a. From the table, it is easy to find that mean of Chinese investments is higher than that of Japanese subjects. Second, the nonparametric Wilcoxon rank-sum test (Wilcoxon, 1945), which is also known as Mann-Whitney U test (Mann and Whitney, 1947), is performed for testing both Chinese and Japanese data from populations with the same distribution. The results listed in Table 1b indicate that Chinese data have significantly different distribution from Japanese data with a wide margin, implying that there is statistical difference in the behavior of public goods contribution between Chinese and Japanese. Third, the results of *t* test suggest that the mean investment of Chinese subjects with either low or high marginal returns in both (*L,H*) and (*H,L*) experiments is significantly larger than that of Japanese subjects (see the final row in Table 1b).[10] In addition, to examine how close the mean investments of Chinese and Japanese subjects are to the theoretical predictions, we estimate the lowest contribution value for supporting the alternative hypothesis that mean investment is larger than the critical value in the low marginal return case based on the 5% statistical significance level. The same approach is also applied in the high marginal return case, but with the highest contribution value being estimated for supporting the alternative hypothesis that mean investment is smaller than the critical value. The correspondent values in the low marginal return case of *(L,H)* and *(H,L)* sessions are estimated as 3.7 and 3.3 for Chinese subjects, and 1.6 and 1.9 for Japanese subjects, respectively. Meanwhile, in the high marginal return case of *(L,H)* and *(H,L)* sessions, these values are 9.3 and 7.7 for Chinese subjects, and 7.7 and 6.1 for Japanese

[10] The Wilcoxon test and *t* test have also been applied to examining the similarity of investments across two countries in each period. Based on 5% significance level, both tests significantly reject the hypothesis of equal investment in 8 of 10 periods (periods 1-5 and 7-9) in (*L,H*) sessions with low marginal return, in 6 of 10 periods (periods 2 and 5-9) in (*L,H*) sessions with high marginal return, 7 of 10 periods (periods 1-6 and 8) in (*H,L*) sessions with low marginal return, and 7 of 10 periods (periods 2-8) in (*H,L*) sessions with high return, respectively. These results are not listed here but available upon request.

subjects, respectively. These critical values imply that Chinese subjects behave relatively more consistent with the theoretical prediction in the high marginal return case (i.e. full contribution or any contributions being close to the initial endowment), while Japanese choice behavior seems relatively more consistent with the theoretical expectation in the low marginal return case (i.e. zero contribution or any contributions being close to zero).

Hypothesis 2. There is no 'order effect' on investment between (*L*,*H*) and (*H*,*L*) sessions in both countries.[11]

Result 2. Both results of the Wilcoxon rank-sum test and *t* test in Table 2 indicate that there is no 'order effect' in low marginal return experiment due to the evidence that the null hypotheses of no difference between distribution and no difference between mean investments cannot be rejected in both Chinese and Japanese data. In contrast, the 'order effect' is found in both data with high marginal return (significant at 1% level), suggesting that we should separate rather than simply pool the (*L*,*H*) and (*H*,*L*) data for our later analyses.

Hypothesis 3. There is no effect of marginal return (α) on subjects' mean investment in both countries.

Result 3. One-tailed *t* tests are applied for alternative hypothesis that mean investment with high marginal return is higher than that with low marginal return. All the statistical results listed in Table 3 strongly exhibit that the investments of both Chinese and Japanese under a high marginal return are significantly higher than those under a low marginal return. Considering the magnitude of these two marginal returns, this result is not surprising.

Hypothesis 4. There is no difference of marginal return (α) effect on the deviations from theoretical equilibrium in both countries.

[11] The so-called 'order effect' denotes the effect of changing the experimental orders (first 10 *L*s then 10 *H*s or first 10 *H*s then 10 *L*s) on subjects' investments.

Result 4. The *t* test results provided in Table 4 exhibit a substantial difference of a marginal return effect on mean investment between two countries. According to the one-tailed *t* test results in the second column of Table 4, mean saving with a high marginal return in Chinese data (i.e. the deviation from equilibrium in a high marginal return case) is significantly smaller than mean investment with a low marginal return (i.e. the deviation from equilibrium in a low marginal return case). In contrast, the one-tailed *t* test results in the third column imply that mean saving with a high marginal return in Japanese data is significantly larger than mean investment in a low marginal return case. Note that saving with a high marginal return implies the degree of spiteful motivation, while investment with a low marginal return indicates the degree of altruistic motivation. Therefore, the relatively less spiteful motivation and more altruistic motivation of Chinese subjects, combined with the relatively less altruistic motivation and more spiteful motivation of Japanese subjects, could be the reason why Chinese investments are always higher than those from Japanese in any cases, as shown in Figures 2 and 3. Meanwhile, we believe that this evidence can be applied also to explain the *t* test results reported in Table 1b.

4.2 *Fraction analysis*

The purpose of fraction analysis is twofold. First, it allows us to examine how the same individual subject behaves when faced with different marginal returns. Second, it enables us to test the likelihood of subjects being located in which fraction according to our definition (see below). In order to conduct fraction analysis, we create the mean investment distribution box as shown in Figure 4.[12] The horizontal axis is for the investment with α = 0.7, and the vertical axis is for the investment with $\alpha = 1/0.7$. When $\alpha = 0.7$, the left vertical axis (i.e. the zero investment side) corresponds to the free-riding side, whereas the right vertical axis (i.e. the full investment side) corresponds to the altruism side. Similarly, when $\alpha = 1/0.7$, the upper horizontal axis (i.e. the full investment side) corresponds to the non-spite side, which we call the pay-riding side, whereas the lower horizontal axis (i.e. the zero investment side) corresponds to the spite side. The box is further divided into four areas. Because the theoretical solution predicted by the dominant strategy is the upper-left corner of the box – that is (0,10), the area that are close enough to (0,10) is called the theoretical region. Although the choice of two numbers *a* (mean investment with low

[12] The description about the mean investment box is based on Saijo and Nakamura (1995).

marginal return) and *b* (mean investment with high marginal return) is arbitrary, we define

$$FP = \{(a,b) \mid 0 \le a < 4 \text{ and } 6 < b \le 10\},\ AP = \{(a,b) \mid 4 \le a < 10 \text{ and } 6 < b \le 10\},$$
$$FS = \{(a,b) \mid 0 \le a < 4 \text{ and } 0 \le b \le 6\}, \text{ and } AS = \{(a,b) \mid 4 \le a < 10 \text{ and } 0 \le b \le 6\} \quad (4)$$

Where *FP* stands for the free-riding and pay-riding region, which is the theoretical region, *AP* stands for the altruistic and pay-riding region, *FS* stands for the free-riding and spiteful region, and *AS* stands for the altruistic and spiteful region. We can easily predict that there will be fewer subjects in *AS* region because it is hard to imagine a subject who invests a lot in the free-riding situation and spites other subjects when she can earn more from her investment. The focal point is, therefore, the distribution of subjects among the remaining three regions. Figure 5 shows the distribution of Chinese and Japanese subjects for both (*L*,*H*) and (*H*,*L*) sessions. From the figure, we can observe that (i) Chinese subjects are more likely to locate in *FP* and *AP* regions, while their Japanese counterparts are more likely to locate in *FP* and *FS* regions. (ii) More Chinese subjects are at or close to the pay-riding side, while more Japanese subjects are at or close to free-riding side. This observation may indicate that Chinese behavior is consistent with theoretical prediction in a high marginal return case, while Japanese behavior is consistent with theoretical prediction in a low marginal return case.[13]

In order to get some statistical supports for the above observations, we apply a number of proportion tests and present the results in Table 5. Some notations defined as: $P_{FP,China}$, $P_{AP,China}$, $P_{FS,China}$,$P_{AS,China}$ and $P_{FP,Japan}$, $P_{AP,Japan}$, $P_{FS,Japan}$, $P_{AS,Japan}$ correspond to the proportions of Chinese and Japanese subjects in *FP*, *AP*, *FS* and *AS* regions, respectively. From the second to fifth rows of Table 5, we may conclude that (i) Chinese subjects are more likely to locate in region *AP* and less likely to locate in region *FS* than their Japanese counterparts (see results of tests (1) and (2)). (ii) More Chinese subjects locate in region *AP* than *FS* in (*L*,*H*) sessions (see result of test (3)), while more Japanese subjects locate in region *FS* than *AP* in both (*L*,*H*) and (*H*,*L*) sessions (see result of test (4)). In addition, results of tests (5) − (8) suggest that whether (*L*,*H*) sessions or (*H*,*L*) sessions, Chinese subjects are likely to locate in regions *FS* and *AP*, while Japanese subjects are likely to locate in regions *FP* and *FS*. Therefore, the observations from Figure 5 are well supported by these tests.

4.3 *A random effects Tobit model of investments*

[13] This observation is quite consistent with the evidence from critical value estimates reported in Result 1.

We consider a model with a linear time trend and one period lag of other subjects' investment to examine their effects on the individual subject's own contribution. The effect of lag of others' investment on the individual subject's own contribution has been examined and found to exist in several previous studies (Chaudhuri et al., 2006; Fischbacher et al., 2001). Because the possible investment levels are bounded by 0 and 10, the dependent variable (i.e. investment) is censored and ordinary least squares will therefore yield biased estimates. Hence, following the methodology of Anderson and Stafford (2003) and Solow and Kirkwood (2002), we estimate the model by applying a random effects Tobit model.[14] In addition, we create two dummy variables as follows: in low marginal return case, $d_{>=4}$ =1 if investment is higher than or equal to 4, =0 otherwise; and in high marginal return case, $d_{<=6}$ =1 if investment is lower than or equal to 6, =0 otherwise. Consequently, in order to examine the responses of those subjects whose behaviors are quite against the theoretical prediction to other subjects' previous contribution, we interact these two dummy variables with one period lag of others' investment and add the two interaction terms into low and high marginal return models, respectively.

The estimated results of random effects Tobit model are provided in Table 6. We note that there are three main differences between Chinese and Japanese data. First, in both (*L*,*H*) and (*H*,*L*) sessions with low marginal return, although the estimated coefficient of one period lag of others' investment is insignificant in both Chinese and Japanese data, the interaction term of $d_{>=4}$ and one period lag of others' contribution is estimated with a significant and positive sign in Chinese data but not significant in Japanese data at 5% significance level. This evidence implies that relative to their Japanese counterparts, those Chinese who are revealed as altruistic subjects in low marginal return are more likely to be conditionally cooperative.[15] Second, in both (*L*,*H*) and (*H*,*L*) sessions with high marginal return, the coefficient of one period lag of others' investment is estimated with significant and positive sign in both Chinese and Japanese data[16], indicating that the more of other subjects invested in each previous period, the more individual subject would contribute. It

[14] For the detailed issues on random effects Tobit model, see Baltagi (2005).
[15] Fischbacher et al. (2001) also presents the evidence of conditional cooperation. They document that about 50% of the subjects are found to be conditional cooperative in the public goods experiment conducted in the University of Zurich.
[16] There is an exception of being insignificant for (*H*,*L*) sessions in Japanese data.

seems that conditional cooperation is a plausible strategy for both countries' subjects when faced with the situation where the marginal return from public goods contribution is larger than that from private goods. However, when looking at the coefficient of interaction terms of $d_{<=6}$ and one period lag of others' contribution, the significant and negative sign is estimated in Japanese data, which implies that those Japanese subjects with contribution being quite below the theoretical equilibrium do have a tendency to spite others. This evidence supports the findings in Saijo and Nakamura (1995) and Cason et al. (2002), which document that several Japanese subjects behave spitefully. In contrast, the spiteful behavior seems unlikely to occur in Chinese subjects because the coefficient in both sessions is not significant.[17] Third, there is no time trend effect found to influence individual subject's investment in almost all the cases for both Chinese and Japanese data, except that in (*H*,*L*) sessions under low marginal return, there is a decreasing effect of time trend on the contribution found in Chinese data.

Finally, as an alternative methodology to confirm the above differences from the random effects Tobit estimates, we produce the Spearman rank correlation coefficients (Spearman, 1904; Conover, 1999) of two interaction terms and linear time trend with subject's own investment. From the results in Table 7, we find that all of the Spearman rank correlation coefficients are strongly consistent with the random effects Tobit estimates, as expected.

5. Summary and Conclusion

Our results can be summarized as follows. The Chinese data are roughly consistent with the theoretical prediction in the high marginal return case, while the Japanese data are generally consistent with the theoretical expectation in the low marginal return case. The choice behavior of Chinese and Japanese subjects under voluntary contribution mechanism is typically different. Compared with their Chinese counterparts, Japanese subjects tend to invest less in both marginal return cases. Why does this happen? The statistical tests, fraction analysis, and random effects Tobit estimation provide a detailed examination. As discussed in the previous section, the differences between two countries' subjects in the

[17] There is a consideration that Chinese subjects probably have not realized that reducing their investments can defeat others. However, from the questionnaire we took after the experiments, it is clear that more than half of the subjects realized the *spite dilemma* but did not behave spitefully since their motivations were to maximize their earnings from the experiments.

propensity to act altruistically or spitefully can explain their behavior difference. Indeed, the implication behind it should correspond to the difference between monetary maximization and ranking maximization.

The spiteful tendency of Japanese subjects has been reported in several previous public goods experiments (e.g. Saijo and Nakamura, 1995; Cason et al., 2002). Although China and Japan have similar traditional cultures, the recent wave of Western culture's influence over Chinese youth since the implementation of *Economic Reform and Opening Policy* in 1979 leads to a possible gap in current cultures between China and Japan. Therefore, from this point of view, it is not surprising that Chinese subjects behave significantly different from their Japanese counterparts. We plan to let Japanese and Chinese subjects attend the same sessions under the environments such as this or a two-stage game. We believe that this will produce more fruitful results for the sake of comparison across countries.

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Appendix 1. Instruction of the Experiment

In each period, you will receive 10 units of money. This money is not real money, but please imagine that you have 10 units of money. First, you decide how many units of this money to invest. Your payoff is determined by the total amount of units invested by all participants. This is one period. One experiment consists of 10 periods and you will do two experiments.

There are three sheets of papers called the “Record Sheet”, the “Investment Sheet” and the “Dividend Table”. First, please take a look at the “Record Sheet”. This “Record Sheet” is for the record of your information regarding your units of investments, the sum of all participants’ investments, other participants’ units of investments (the sum of all participants’ investment except for your investment) and your dividend. Second, please take a look at the “Investment Sheet”. This sheet is to inform your unites of investment to the experimenter. Finally, please take a look at the “Dividend Table”. This sheet indicates your dividend from the investment. Please note that every participant in the experiments has the same table. The horizontal axis is for your investment number and the vertical axis is for the sum of others’ investment.

<Example> Suppose that your investment number is 5 and others’ investment number is 45. Then your dividend is 800 for the practical Dividend Table. Please check the location of 800 in the dividend table.

Your Dividend Table at hand is for practice. Before the first experiment starts, we will distribute the Dividend Table for the first experiment. For the second, we will distribute the Dividend Table for the second experiment after the first experiment.

Let us now consider the detailed procedures of experiment. You have 10 units of money for each period. In each period, you can freely determine the number of units for investment out of 10. You have twenty seconds for your consideration. When you have chosen your number, record this number in the column of “Your Investment” in the “Record Sheet” and then circle the number which you chose in the “Investment Sheet”. An experimenter will collect this sheet.

The experimenter will announce the total sum of investments. Please record this number in the column of “Total Sum of Investments”. Then subtract your investment

number from the total sum of investments and record this number in the column of "Others' investments". Next, please take a look at the Dividend Table and find your dividend. Record this number in the column of "Your Dividend".

Let us do practice following the above example. Please find the example raw in the "Record Sheet". Write 5 in the column of "Your Investment". Suppose that the experimenter collected the investment sheets and then announced 50 as the total number of investments. Then you are supposed to record 50 in the column of "Total Sum of Investments". Now subtract your investment number 5 from 50 and record this difference, 45, in the column of "Others' Investment". Now, take a look at the Dividend Table. Look at 5 in the horizontal axis and 45 in the vertical axis. Then you will find 800. This 800 is your dividend and record this number in the column of "Your Dividend".

This is the end of the first period. The next period will start with your choice of a number from zero to 10.

100 units of dividend is equivalent to 0.5 RMB. That is, the money you will receive is 0.5% of your sum of dividend. For example, if you obtain 16231 units of money, then your dividend is 81 RMB.

Please remember that you cannot talk to other participants during the experiments. If this happens, the experiment will be stopped at that point.

Before the actual experiments, you will do three period practices. You must understand the procedure of the experiments thoroughly. If you have any questions, please raise your hand now.

Appendix 2. Record Sheet

Your ID number

		Your Investment A	Total Sum of Investments B	Others' Investments B−A	Your Dividend C
Example					
Practice	P 1				
	P 2				
	P 3				

1st

	Your Investment A	Total Sum of Investments B	Others' Investments B−A	Your Dividend C
Period 1				
Period 2				
Period 3				
Period 4				
Period 5				
Period 6				
Period 7				
Period 8				
Period 9				
Period 10				

Dividend	#1

Do not fill

2nd

	Your Investment A	Total Sum of Investments B	Others' Investments B−A	Your Dividend C
Period 1				
Period 2				
Period 3				
Period 4				
Period 5				
Period 6				
Period 7				
Period 8				
Period 9				
Period 10				
		Dividend	#1	

Do not fill

Appendix 3. Investment Sheet

Investment Sheet

Your ID number_____

Please circle your investment number

0 1 2 3 4 5 6 7 8 9 10

After circling the number, please put this sheet up-side-down on the table.

Appendix 4. Dividend Tables

Your Investment

Sum of Others' Investments	0	1	2	3	4	5	6	7	8	9	10
0	50	77	98	113	122	125	122	113	98	77	50
1	80	104	122	134	140	140	134	122	104	80	50
2	110	131	146	155	158	155	146	131	110	83	50
3	140	158	170	176	176	170	158	140	116	86	50
4	170	185	194	197	194	185	170	149	122	89	50
5	200	212	218	218	212	200	182	158	128	92	50
6	230	239	242	239	230	215	194	167	134	95	50
7	260	266	266	260	248	230	206	176	140	98	50
8	290	293	290	281	266	245	218	185	146	101	50
9	320	320	314	302	284	260	230	194	152	104	50
10	350	347	338	323	302	275	242	203	158	107	50
11	380	374	362	344	320	290	254	212	164	110	50
12	410	401	386	365	338	305	266	221	170	113	50
13	440	428	410	386	356	320	278	230	176	116	50
14	470	455	434	407	374	335	290	239	182	119	50
15	500	482	458	428	392	350	302	248	188	122	50
16	530	509	482	449	410	365	314	257	194	125	50
17	560	536	506	470	428	380	326	266	200	128	50
18	590	563	530	491	446	395	338	275	206	131	50
19	620	590	554	512	464	410	350	284	212	134	50
20	650	617	578	533	482	425	362	293	218	137	50
21	680	644	602	554	500	440	374	302	224	140	50
22	710	671	626	575	518	455	386	311	230	143	50
23	740	698	650	596	536	470	398	320	236	146	50
24	770	725	674	617	554	485	410	329	242	149	50
25	800	752	698	638	572	500	422	338	248	152	50
26	830	779	722	659	590	515	434	347	254	155	50
27	860	806	746	680	608	530	446	356	260	158	50
28	890	833	770	701	626	545	458	365	266	161	50
29	920	860	794	722	644	560	470	374	272	164	50
30	950	887	818	743	662	575	482	383	278	167	50
31	980	914	842	764	680	590	494	392	284	170	50
32	1010	941	866	785	698	605	506	401	290	173	50
33	1040	968	890	806	716	620	518	410	296	176	50
34	1070	995	914	827	734	635	530	419	302	179	50
35	1100	1022	938	848	752	650	542	428	308	182	50
36	1130	1049	962	869	770	665	554	437	314	185	50
37	1160	1076	986	890	788	680	566	446	320	188	50
38	1190	1103	1010	911	806	695	578	455	326	191	50
39	1220	1130	1034	932	824	710	590	464	332	194	50
40	1250	1157	1058	953	842	725	602	473	338	197	50
41	1280	1184	1082	974	860	740	614	482	344	200	50
42	1310	1211	1106	995	878	755	626	491	350	203	50
43	1340	1238	1130	1016	896	770	638	500	356	206	50
44	1370	1265	1154	1037	914	785	650	509	362	209	50
45	1400	1292	1178	1058	932	800	662	518	368	212	50
46	1430	1319	1202	1079	950	815	674	527	374	215	50
47	1460	1346	1226	1100	968	830	686	536	380	218	50
48	1490	1373	1250	1121	986	845	698	545	386	221	50
49	1520	1400	1274	1142	1004	860	710	554	392	224	50
50	1550	1427	1298	1163	1022	875	722	563	398	227	50
51	1580	1454	1322	1184	1040	890	734	572	404	230	50
52	1610	1481	1346	1205	1058	905	746	581	410	233	50
53	1640	1508	1370	1226	1076	920	758	590	416	236	50
54	1670	1535	1394	1247	1094	935	770	599	422	239	50
55	1700	1562	1418	1268	1112	950	782	608	428	242	50
56	1730	1589	1442	1289	1130	965	794	617	434	245	50
57	1760	1616	1466	1310	1148	980	806	626	440	248	50
58	1790	1643	1490	1331	1166	995	818	635	446	251	50
59	1820	1670	1514	1352	1184	1010	830	644	452	254	50
60	1850	1697	1538	1373	1202	1025	842	653	458	257	50

a. Practice Dividend Table

Your Investment

Sum of Others' Investments

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
0	300	291	282	273	264	255	246	237	228	219	210
1	321	312	303	294	285	276	267	258	249	240	231
2	342	333	324	315	306	297	288	279	270	261	252
3	363	354	345	336	327	318	309	300	291	282	273
4	384	375	366	357	348	339	330	321	312	303	294
5	405	396	387	378	369	360	351	342	333	324	315
6	426	417	408	399	390	381	372	363	354	345	336
7	447	438	429	420	411	402	393	384	375	366	357
8	468	459	450	441	432	423	414	405	396	387	378
9	489	480	471	462	453	444	435	426	417	408	399
10	510	501	492	483	474	465	456	447	438	429	420
11	531	522	513	504	495	486	477	468	459	450	441
12	552	543	534	525	516	507	498	489	480	471	462
13	573	564	555	546	537	528	519	510	501	492	483
14	594	585	576	567	558	549	540	531	522	513	504
15	615	606	597	588	579	570	561	552	543	534	525
16	636	627	618	609	600	591	582	573	564	555	546
17	657	648	639	630	621	612	603	594	585	576	567
18	678	669	660	651	642	633	624	615	606	597	588
19	699	690	681	672	663	654	645	636	627	618	609
20	720	711	702	693	684	675	666	657	648	639	630
21	741	732	723	714	705	696	687	678	669	660	651
22	762	753	744	735	726	717	708	699	690	681	672
23	783	774	765	756	747	738	729	720	711	702	693
24	804	795	786	777	768	759	750	741	732	723	714
25	825	816	807	798	789	780	771	762	753	744	735
26	846	837	828	819	810	801	792	783	774	765	756
27	867	858	849	840	831	822	813	804	795	786	777
28	888	879	870	861	852	843	834	825	816	807	798
29	909	900	891	882	873	864	855	846	837	828	819
30	930	921	912	903	894	885	876	867	858	849	840
31	951	942	933	924	915	906	897	888	879	870	861
32	972	963	954	945	936	927	918	909	900	891	882
33	993	984	975	966	957	948	939	930	921	912	903
34	1014	1005	996	987	978	969	960	951	942	933	924
35	1035	1026	1017	1008	999	990	981	972	963	954	945
36	1056	1047	1038	1029	1020	1011	1002	993	984	975	966
37	1077	1068	1059	1050	1041	1032	1023	1014	1005	996	987
38	1098	1089	1080	1071	1062	1053	1044	1035	1026	1017	1008
39	1119	1110	1101	1092	1083	1074	1065	1056	1047	1038	1029
40	1140	1131	1122	1113	1104	1095	1086	1077	1068	1059	1050
41	1161	1152	1143	1134	1125	1116	1107	1098	1089	1080	1071
42	1182	1173	1164	1155	1146	1137	1128	1119	1110	1101	1092
43	1203	1194	1185	1176	1167	1158	1149	1140	1131	1122	1113
44	1224	1215	1206	1197	1188	1179	1170	1161	1152	1143	1134
45	1245	1236	1227	1218	1209	1200	1191	1182	1173	1164	1155
46	1266	1257	1248	1239	1230	1221	1212	1203	1194	1185	1176
47	1287	1278	1269	1260	1251	1242	1233	1224	1215	1206	1197
48	1308	1299	1290	1281	1272	1263	1254	1245	1236	1227	1218
49	1329	1320	1311	1302	1293	1284	1275	1266	1257	1248	1239
50	1350	1341	1332	1323	1314	1305	1296	1287	1278	1269	1260
51	1371	1362	1353	1344	1335	1326	1317	1308	1299	1290	1281
52	1392	1383	1374	1365	1356	1347	1338	1329	1320	1311	1302
53	1413	1404	1395	1386	1377	1368	1359	1350	1341	1332	1323
54	1434	1425	1416	1407	1398	1389	1380	1371	1362	1353	1344
55	1455	1446	1437	1428	1419	1410	1401	1392	1383	1374	1365
56	1476	1467	1458	1449	1440	1431	1422	1413	1404	1395	1386
57	1497	1488	1479	1470	1461	1452	1443	1434	1425	1416	1407
58	1518	1509	1500	1491	1482	1473	1464	1455	1446	1437	1428
59	1539	1530	1521	1512	1503	1494	1485	1476	1467	1458	1449
60	1560	1551	1542	1533	1524	1515	1506	1497	1488	1479	1470

b. Low Marginal Return Dividend Table

Your Investment

Sum of Others' Investments	0	1	2	3	4	5	6	7	8	9	10
0	120	125	130	135	141	146	151	156	161	166	171
1	137	142	147	153	158	163	168	173	178	183	189
2	154	159	165	170	175	180	185	190	195	201	206
3	171	177	182	187	192	197	202	207	213	218	223
4	189	194	199	204	209	214	219	225	230	235	240
5	206	211	216	221	226	231	237	242	247	252	257
6	223	228	233	238	243	249	254	259	264	269	274
7	240	245	250	255	261	266	271	276	281	286	291
8	257	262	267	273	278	283	288	293	298	303	309
9	274	279	285	290	295	300	305	310	315	321	326
10	291	297	302	307	312	317	322	327	333	338	343
11	309	314	319	324	329	334	339	345	350	355	360
12	326	331	336	341	346	351	357	362	367	372	377
13	343	348	353	358	363	369	374	379	384	389	394
14	360	365	370	375	381	386	391	396	401	406	411
15	377	382	387	393	398	403	408	413	418	423	429
16	394	399	405	410	415	420	425	430	435	441	446
17	411	417	422	427	432	437	442	447	453	458	463
18	429	434	439	444	449	454	459	465	470	475	480
19	446	451	456	461	466	471	477	482	487	492	497
20	463	468	473	478	483	489	494	499	504	509	514
21	480	485	490	495	501	506	511	516	521	526	531
22	497	502	507	513	518	523	528	533	538	543	549
23	514	519	525	530	535	540	545	550	555	561	566
24	531	537	542	547	552	557	562	567	573	578	583
25	549	554	559	564	569	574	579	585	590	595	600
26	566	571	576	581	586	591	597	602	607	612	617
27	583	588	593	598	603	609	614	619	624	629	634
28	600	605	610	615	621	626	631	636	641	646	651
29	617	622	627	633	638	643	648	653	658	663	669
30	634	639	645	650	655	660	665	670	675	681	686
31	651	657	662	667	672	677	682	687	693	698	703
32	669	674	679	684	689	694	699	705	710	715	720
33	686	691	696	701	706	711	717	722	727	732	737
34	703	708	713	718	723	729	734	739	744	749	754
35	720	725	730	735	741	746	751	756	761	766	771
36	737	742	747	753	758	763	768	773	778	783	789
37	754	759	765	770	775	780	785	790	795	801	806
38	771	777	782	787	792	797	802	807	813	818	823
39	789	794	799	804	809	814	819	825	830	835	840
40	806	811	816	821	826	831	837	842	847	852	857
41	823	828	833	838	843	849	854	859	864	869	874
42	840	845	850	855	861	866	871	876	881	886	891
43	857	862	867	873	878	883	888	893	898	903	909
44	874	879	885	890	895	900	905	910	915	921	926
45	891	897	902	907	912	917	922	927	933	938	943
46	909	914	919	924	929	934	939	945	950	955	960
47	926	931	936	941	946	951	957	962	967	972	977
48	943	948	953	958	963	969	974	979	984	989	994
49	960	965	970	975	981	986	991	996	1001	1006	1011
50	977	982	987	993	998	1003	1008	1013	1018	1023	1029
51	994	999	1005	1010	1015	1020	1025	1030	1035	1041	1046
52	1011	1017	1022	1027	1032	1037	1042	1047	1053	1058	1063
53	1029	1034	1039	1044	1049	1054	1059	1065	1070	1075	1080
54	1046	1051	1056	1061	1066	1071	1077	1082	1087	1092	1097
55	1063	1068	1073	1078	1083	1089	1094	1099	1104	1109	1114
56	1080	1085	1090	1095	1101	1106	1111	1116	1121	1126	1131
57	1097	1102	1107	1113	1118	1123	1128	1133	1138	1143	1149
58	1114	1119	1125	1130	1135	1140	1145	1150	1155	1161	1166
59	1131	1137	1142	1147	1152	1157	1162	1167	1173	1178	1183
60	1149	1154	1159	1164	1169	1174	1179	1185	1190	1195	1200

c. High Marginal Return Dividend Table

Appendix 5. Data of Chinese subjects

(L, H) experiment																				
S1	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	10	0	0	0	2	0	9	8	6	2	10	10	10	10	8	10	10	10	10	10
Sub.2	10	10	10	7	8	4	4	6	8	0	10	10	10	9	10	10	10	10	10	10
Sub.3	9	9	7	7	7	5	10	8	8	9	10	10	10	10	10	10	10	10	10	10
Sub.4	9	0	4	0	2	2	0	7	0	0	10	10	10	10	10	10	10	10	10	10
Sub.5	1	10	10	10	10	0	0	10	10	10	10	10	10	10	10	10	10	10	10	10
Sub.6	10	1	4	3	2	2	3	1	6	1	10	0	2	2	1	10	10	10	2	10
Sub.7	1	10	10	0	0	6	0	10	10	10	10	10	10	10	10	10	10	10	10	10
S2	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	10	8	9	3	10	9	8	3	0	0	10	10	10	10	10	10	10	10	10	10
Sub.2	10	10	10	0	0	10	10	10	0	0	10	10	10	10	10	10	10	10	10	10
Sub.3	5	6	6	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Sub.4	5	6	0	5	10	8	7	4	8	1	10	10	10	10	10	10	10	10	10	10
Sub.5	0	0	0	2	1	0	0	2	0	0	10	10	9	9	10	10	10	10	9	10
Sub.6	4	5	5	4	4	4	5	5	4	0	10	10	10	10	10	10	10	10	10	10
Sub.7	10	5	5	5	2	2	3	3	1	10	10	10	10	10	10	10	10	10	10	10
S3	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	0	10	4	2	5	5	7	7	0	0	10	10	10	10	10	10	10	10	10	10
Sub.2	0	0	0	3	0	0	0	0	0	0	0	10	5	0	0	3	7	1	8	10
Sub.3	0	2	1	1	10	0	3	9	5	0	10	10	10	9	10	9	0	1	10	4
Sub.4	7	5	5	2	3	6	6	2	4	1	10	10	10	10	9	9	10	9	10	10
Sub.5	5	5	0	5	10	10	0	0	0	0	10	10	10	10	10	10	10	10	10	10
Sub.6	5	5	4	5	7	4	8	2	2	2	8	2	3	2	8	8	8	10	10	5
Sub.7	0	0	5	6	1	4	3	10	0	0	0	3	2	0	4	8	10	0	0	10
S4	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	3	1	5	4	0	1	3	4	5	0	10	10	10	10	10	10	10	10	10	10
Sub.2	10	10	0	0	0	0	0	0	0	0	10	10	10	10	8	10	10	9	10	0
Sub.3	5	5	6	1	2	1	3	4	4	0	10	10	10	10	10	10	10	10	10	10
Sub.4	7	7	6	7	7	6	7	0	0	0	6	7	8	8	9	9	9	10	9	0
Sub.5	0	1	0	0	0	1	1	0	0	1	10	10	10	10	10	10	10	10	10	8
Sub.6	10	0	0	0	0	10	10	10	10	0	10	10	10	10	10	10	10	9	5	0
Sub.7	5	0	3	7	4	0	0	9	1	2	10	10	9	10	10	10	10	10	10	10

(to be continued)

(H, L) experiment																				
S5	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	10	10	10	10	10	10	10	10	10	10	0	7	10	5	5	10	8	8	5	0
Sub.2	6	5	6	7	7	6	7	6	8	6	6	5	6	6	8	7	8	10	2	0
Sub.3	10	9	10	10	10	10	10	10	10	10	9	7	6	6	0	1	1	2	4	0
Sub.4	10	10	10	10	10	10	10	10	10	10	1	2	0	0	5	1	2	0	1	0
Sub.5	10	10	10	10	10	10	10	10	10	10	10	6	7	0	5	7	7	7	5	8
Sub.6	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	0	0
Sub.7	10	10	10	10	7	10	10	10	9	9	8	6	8	9	5	7	10	3	5	10
S6	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	10	10	10	10	10	10	10	10	10	10	4	4	6	8	8	9	7	7	6	10
Sub.2	8	9	2	2	3	10	0	0	3	0	4	0	3	4	4	0	0	1	0	0
Sub.3	10	10	10	10	10	10	10	10	10	10	0	0	3	2	2	0	5	0	0	0
Sub.4	7	3	3	1	4	5	8	2	1	3	0	1	0	1	1	2	0	0	1	0
Sub.5	6	10	4	10	10	10	10	10	7	10	0	0	10	0	0	10	0	0	0	0
Sub.6	10	10	8	8	9	5	4	5	7	3	0	0	3	3	2	0	0	1	0	0
Sub.7	10	10	10	10	8	9	10	9	6	10	9	6	8	9	7	9	5	10	5	4
S7	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	0	2	6	10	0	2	9	1	0	9	8	9	6	7	2	3	9	9	6	0
Sub.2	10	10	10	10	10	10	10	10	10	10	0	5	8	0	5	5	0	0	0	5
Sub.3	9	10	0	7	9	7	10	3	10	9	4	3	4	3	6	1	3	2	4	0
Sub.4	10	1	5	10	10	0	10	10	0	0	8	10	0	0	0	0	10	0	4	0
Sub.5	9	10	10	8	9	10	10	9	9	10	1	2	0	3	0	0	8	0	0	10
Sub.6	10	9	0	5	6	5	0	4	5	7	0	3	10	0	0	3	4	5	0	0
Sub.7	3	3	3	10	8	4	4	4	8	3	3	8	4	3	10	0	0	0	1	1
S8	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Sub.2	10	9	6	8	3	6	9	6	3	10	2	0	0	1	1	3	1	2	1	2
Sub.3	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub.4	0	0	0	0	0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Sub.5	9	8	6	6	5	2	3	4	2	3	2	1	3	2	4	0	1	7	5	2
Sub.6	10	10	9	10	10	10	10	10	10	10	5	8	3	0	4	2	0	7	0	0
Sub.7	10	10	10	10	10	10	10	10	10	10	5	3	2	7	0	1	3	1	2	0

Appendix 6. Data of Japanese subjects

(L, H) experiment																				
S1	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	5	4	3	0	0	4	1	0	2	3	4	3	3	1	6	5	2	6	3	4
Sub.2	0	0	0	0	0	0	0	0	2	1	10	0	5	8	1	0	0	3	0	0
Sub.3	8	5	3	3	1	2	3	2	2	2	0	1	2	2	1	4	1	1	5	2
Sub.4	3	1	3	3	2	3	4	5	5	1	10	10	10	10	10	5	10	5	5	7
Sub.5	0	0	0	0	1	1	2	1	1	2	10	7	7	5	6	2	4	0	3	8
Sub.6	0	2	0	1	5	3	0	2	7	1	3	0	5	2	7	3	2	1	10	5
Sub.7	0	0	0	0	0	0	0	0	0	0	10	10	9	5	10	10	10	10	10	10
S2	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	0	0	0	0	1	0	0	0	0	0	10	5	10	10	5	8	5	5	5	0
Sub.2	0	0	2	0	10	9	1	0	0	0	10	10	9	0	1	5	0	10	3	10
Sub.3	5	5	3	0	2	3	4	0	0	1	8	8	7	7	6	8	7	7	7	8
Sub.4	1	1	0	1	0	1	1	0	1	0	7	8	6	5	6	6	4	5	3	6
Sub.5	1	0	0	0	0	0	0	0	0	0	10	0	10	10	0	0	5	0	10	10
Sub.6	0	1	0	5	2	4	0	1	0	2	10	9	10	10	8	10	9	0	0	0
Sub.7	1	1	0	0	0	0	0	0	0	0	5	10	10	10	10	10	10	10	10	10
S3	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	1	1	1	2	1	0	1	2	1	1	10	10	10	10	10	10	10	10	8	9
Sub.2	3	2	2	5	0	10	8	0	1	0	10	10	10	10	10	10	10	10	10	10
Sub.3	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10	10	10	10	10
Sub.4	3	4	5	4	5	10	7	8	10	10	10	10	10	10	10	10	10	10	10	10
Sub.5	5	10	2	1	0	2	5	2	0	2	10	10	10	10	10	10	10	5	10	5
Sub.6	0	0	0	0	0	5	0	0	0	0	10	10	10	10	10	10	0	10	0	0
Sub.7	2	0	5	2	1	9	0	3	7	0	10	10	10	10	10	10	10	10	10	10
S4	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Sub.1	0	1	10	0	0	4	5	0	0	10	6	0	10	10	10	10	9	10	10	10
Sub.2	5	5	6	6	5	7	0	3	5	0	8	8	8	10	10	10	9	9	10	10
Sub.3	3	3	1	0	2	0	0	3	0	0	6	8	8	8	9	9	9	9	9	9
Sub.4	10	0	0	0	5	0	0	0	0	0	0	0	10	10	10	10	10	10	10	10
Sub.5	1	0	0	5	0	0	3	0	0	0	10	10	10	10	10	10	10	10	10	10
Sub.6	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10	10	10	10	10
Sub.7	7	3	2	5	2	2	4	1	1	2	10	10	10	10	10	10	10	10	10	10

(to be continued)

(H, L) experiment																				
S5	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	10	7	9	5	10	8	10	1	0	10	0	0	0	0	5	10	5	0	7	0
Sub.2	8	9	7	8	5	7	6	6	5	7	0	0	2	3	2	2	3	4	2	2
Sub.3	10	10	0	0	3	0	10	5	10	10	1	0	0	0	0	0	0	0	0	0
Sub.4	9	10	6	10	8	2	7	3	1	0	3	0	2	1	0	4	0	1	2	0
Sub.5	0	0	0	4	5	6	10	8	2	0	0	0	0	0	0	0	0	0	0	0
Sub.6	10	10	0	0	10	0	0	10	10	10	0	3	10	6	0	8	5	0	0	0
Sub.7	8	0	3	3	7	3	4	5	8	8	0	5	2	1	6	0	1	7	0	0
S6	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	5	6	2	3	2	1	0	2	3	3	0	3	0	0	0	0	0	0	0	0
Sub.2	1	0	5	1	2	3	0	2	1	4	0	1	1	6	0	2	0	1	0	3
Sub.3	10	10	10	10	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0
Sub.4	1	0	1	0	6	10	1	0	1	0	0	0	0	1	6	0	8	1	0	0
Sub.5	10	8	10	10	8	8	10	8	10	10	5	4	5	0	4	5	3	3	3	3
Sub.6	8	5	2	3	0	9	10	0	10	10	0	1	0	0	2	0	1	0	0	0
Sub.7	3	0	1	1	8	7	0	0	10	9	8	0	3	1	4	0	4	4	0	3
S7	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	4	3	4	5	5	4	4	5	6	7	5	2	2	1	0	1	1	3	3	3
Sub.2	7	6	10	5	6	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Sub.3	1	4	4	6	8	4	6	8	9	10	8	4	0	2	1	8	1	2	6	2
Sub.4	5	2	3	1	4	6	0	2	4	5	1	1	2	2	2	2	2	0	0	0
Sub.5	10	0	4	7	0	3	1	10	9	5	0	0	0	0	0	0	0	7	2	0
Sub.6	10	10	7	7	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0
Sub.7	9	6	4	8	1	2	10	5	5	4	5	2	4	1	7	0	2	4	8	7
S8	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Sub.1	10	9	8	10	10	3	5	8	7	10	0	0	0	0	0	3	0	0	0	0
Sub.2	8	10	6	0	4	2	10	10	6	0	0	10	8	0	6	0	8	10	10	0
Sub.3	8	9	9	7	10	6	7	3	9	9	3	7	5	5	4	2	10	9	10	10
Sub.4	8	7	6	8	7	10	6	7	6	10	3	0	3	10	0	4	4	2	10	0
Sub.5	5	7	10	8	5	0	3	2	1	0	5	1	0	1	0	1	0	0	0	0
Sub.6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Sub.7	9	10	10	10	2	10	5	6	8	10	0	0	0	0	0	0	10	0	0	0

Figure 1. Illustration of spiteful strategy

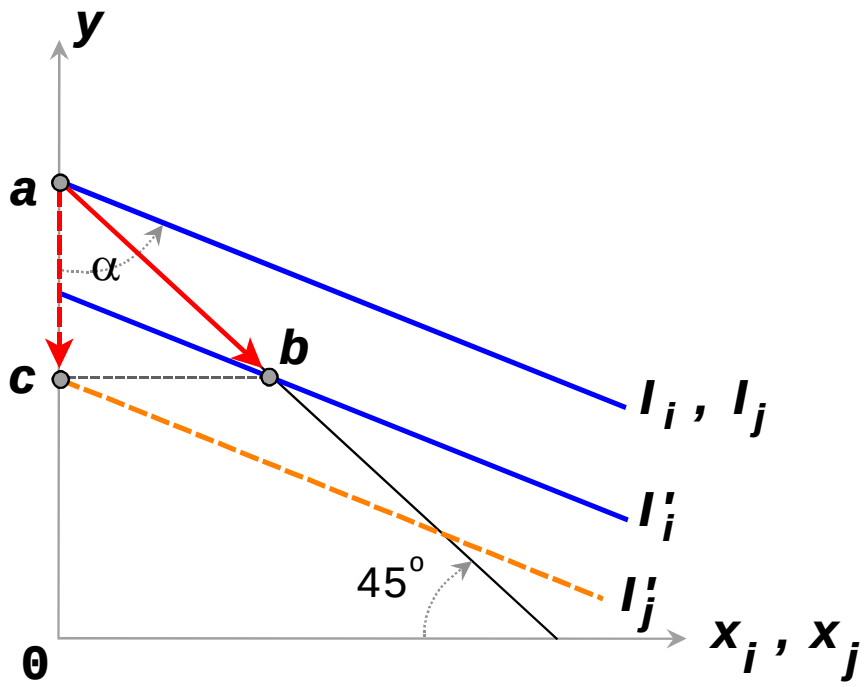


Figure 2. Investment pattern in (*L*,*H*) session

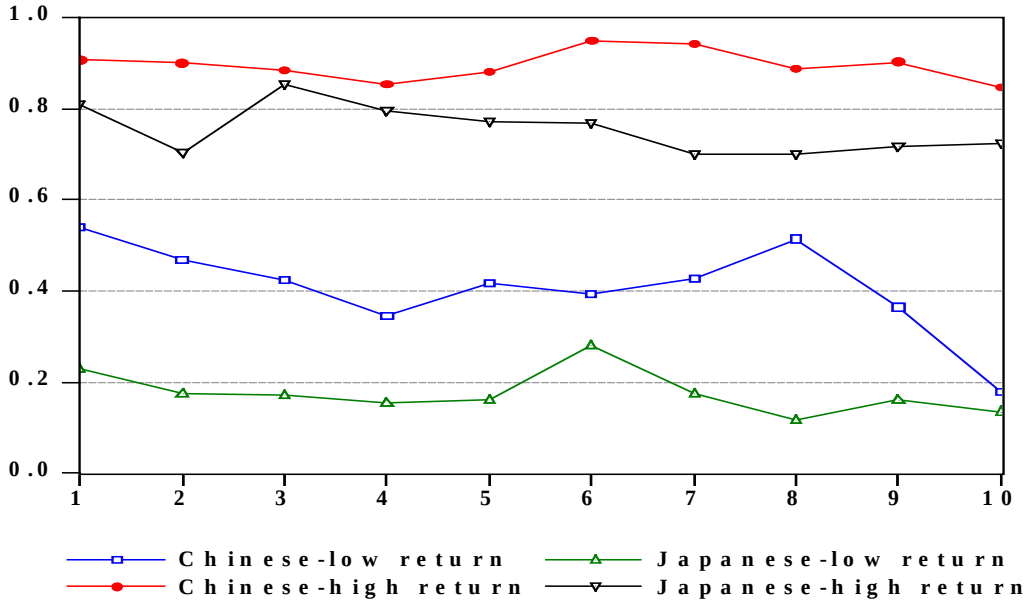


Figure 3. Investment pattern in (*H*,*L*) session

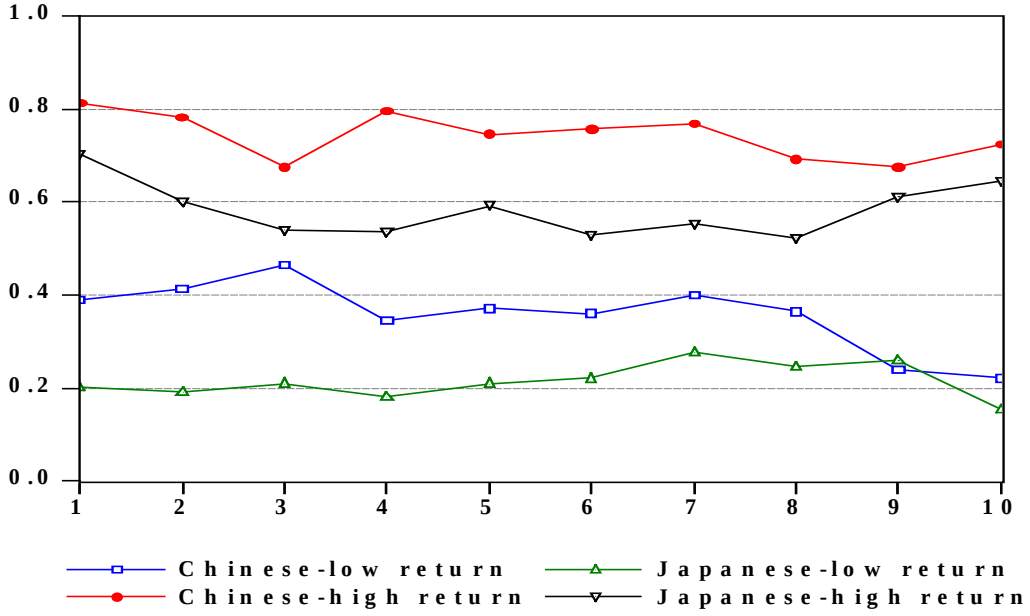


Figure 4. Mean investment distribution box

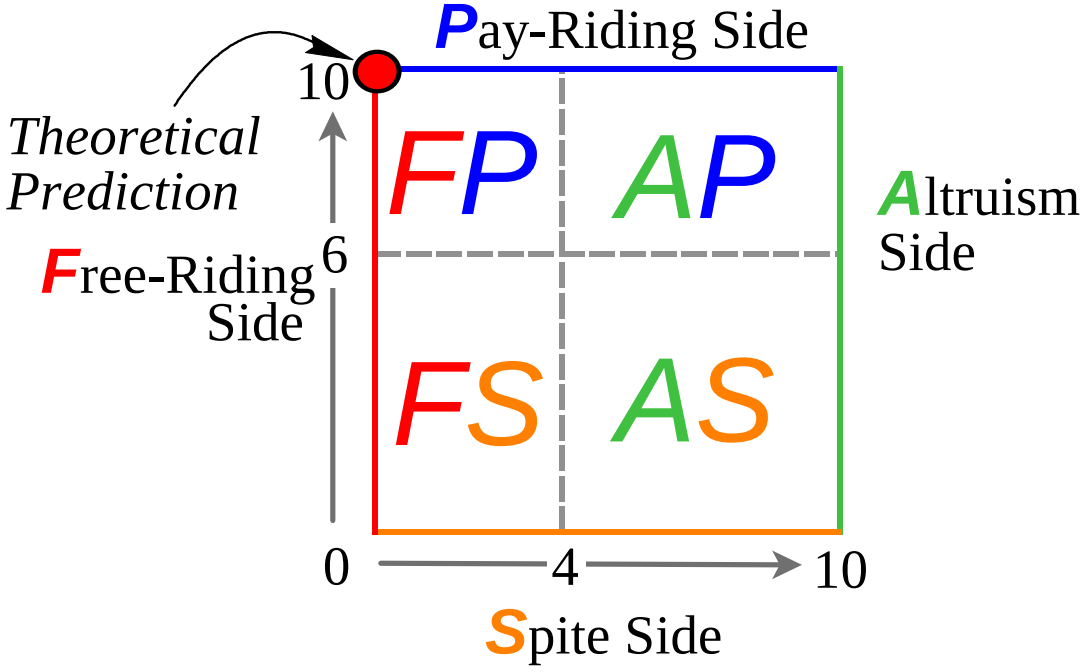
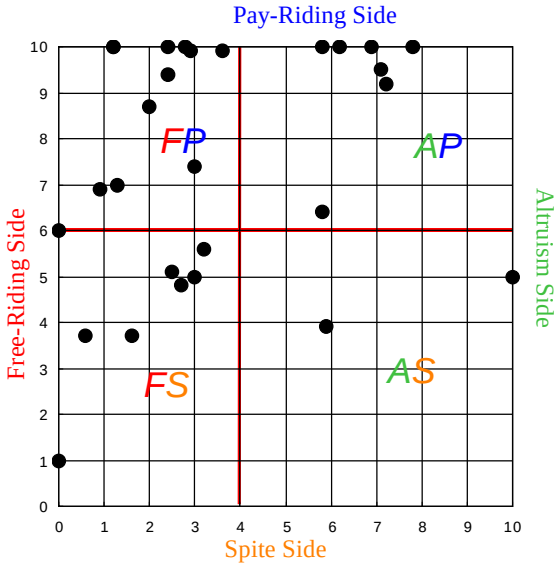
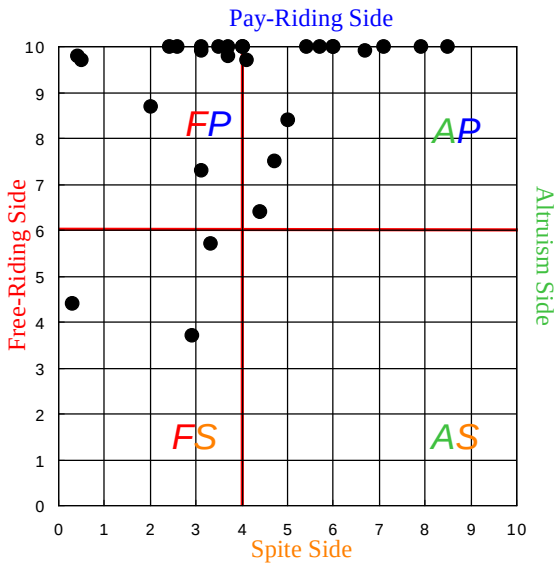


Figure 5. Mean investment distribution box for both types of experiment

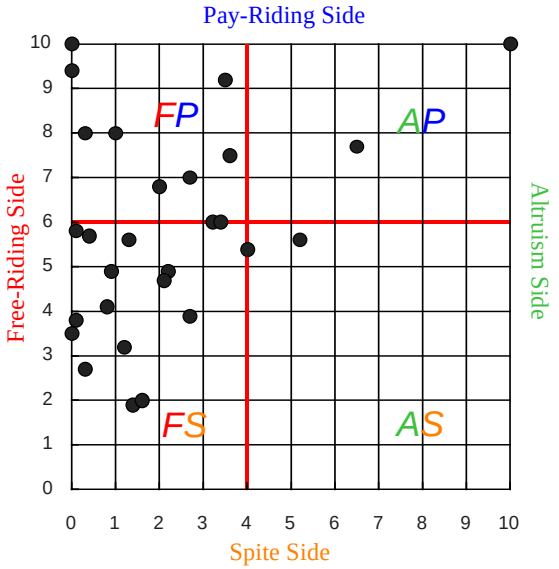


1/0.7 first and 0.7 second sessions

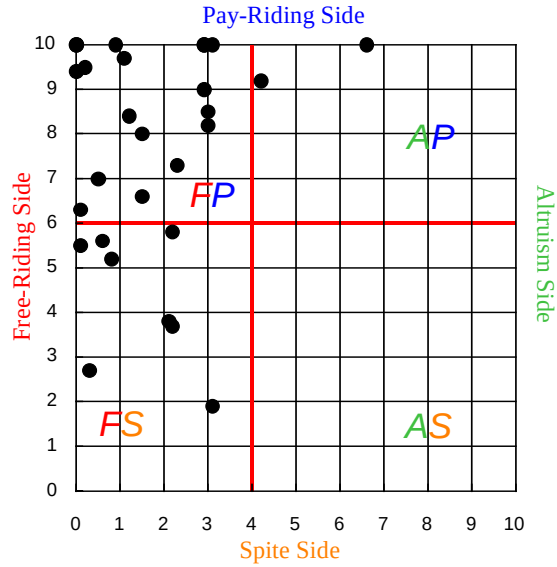


0.7 first and 1/0.7 second sessions

Panel I. Chinese subjects



1/0.7 first and 0.7 second sessions



0.7 first and 1/0.7 second sessions

Panel II. Japanese subjects

Table 1a. Descriptive statistics of investment in Chinese and Japanese data

		Mean	Std. Dev.	Minimum	Maximum	Observations
(*L*,*H*) sessions						
Chinese	Low return	4.075	3.7289	0	10	280
	High return	8.961	2.6182	0	10	280
Japanese	Low return	1.761	2.5194	0	10	280
	High return	7.546	3.4441	0	10	280
(*H*,*L*) sessions						
Chinese	Low return	3.571	3.6232	0	10	280
	High return	7.432	3.5229	0	10	280
Japanese	Low return	2.161	3.1107	0	10	280
	High return	5.832	3.6461	0	10	280

Table 1b. Tests for differences in investment between Chinese and Japanese data

	(*L*,*H*) sessions		(*H*,*L*) sessions	
	Low return	High return	Low return	High return
Wilcoxon rank-sum test for same distribution	7.377**	6.069**	4.864**	5.824**
t test for equality of mean[a]	8.484**	5.152**	5.026**	5.427**

**Significant at 1% level, *Significant at 5% level.

[a] One-tailed *t* test for alternative hypothesis that mean investment in Chinese data is larger than that in Japanese data.

Table 2. Tests for differences in investment between (*L*,*H*) and (*H*,*L*) sessions

	Chinese		Japanese	
	Low return	High return	Low return	High return
Wilcoxon rank-sum test for same distribution	1.723	6.228**	1.054	5.792**
t test for equality of mean[a]	1.684	5.776**	1.576	5.717**

**Significant at 1% level, *Significant at 5% level.

[a] Two-tailed *t* test for alternative hypothesis that mean investment in (*L*,*H*) sessions is not same as that in (*H*,*L*) sessions.

Table 3. Tests for marginal return to mean investment

	Chinese	Japanese
(*L*,*H*) sessions[a]	19.129**	23.156**
(*H*,*L*) sessions[a]	13.683**	13.566**

**Significant at 1% level, *Significant at 5% level.

[a] One-tailed *t* test for alternative hypothesis that mean investment in a high marginal return case is higher than that in a low marginal return case.

Table 4. Tests for marginal return effect on the difference from equilibrium

	Chinese[a]	Japanese[b]
(*L*,*H*) sessions	-10.534**	2.664**
(*H*,*L*) sessions	-3.130**	6.660**

**Significant at 1% level, *Significant at 5% level.

[a] One-tailed *t* test for alternative hypothesis that saving with high marginal return is smaller than investment with low marginal return in Chinese data.

[b] One-tailed *t* test for alternative hypothesis that saving with high marginal return is larger than investment with low marginal return in Japanese data.

Table 5. Tests for the fraction of subjects

	(*L*,*H*) sessions	(*H*,*L*) sessions
(1) $P_{AP,China}= P_{AP,Japan}$ vs. $P_{AP,China}> P_{AP,Japan}$	3.550**	1.819*
(2) $P_{FS,China}= P_{FS,Japan}$ vs. $P_{FS,China}< P_{FS,Japan}$	-1.682*	-2.445**
(3) $P_{AP,China}= P_{FS,China}$ vs. $P_{AP,China}> P_{FS,China}$	3.197**	0.000
(4) $P_{AP,Japan}= P_{FS,Japan}$ vs. $P_{AP,Japan}< P_{FS,Japan}$	-2.094*	-4.006**
(5) $P_{AP,China}+ P_{FP,China}=0.6$ vs. $P_{AP,China}+ P_{FP,China}>0.6$ [a]	3.163**	1.849*
(6) $P_{FS,Japan}+ P_{FP,Japan}=0.6$ vs. $P_{FS,Japan}+ P_{FP,Japan}>0.6$ [b]	3.549**	3.163**
(7) $P_{AP,China}+ P_{FP,China}= P_{AP,Japan}+ P_{FP,Japan}$ vs. $P_{AP,China}+ P_{FP,China}> P_{AP,Japan}+ P_{FP,Japan}$	1.682*	2.144*
(8) $P_{FS,China}+ P_{FP,China}= P_{FS,Japan}+ P_{FP,Japan}$ vs. $P_{FS,China}+ P_{FP,China}< P_{FS,Japan}+ P_{FP,Japan}$	-3.550**	-1.954*

**Significant at 1% level, *Significant at 5% level.

[a]Based on 5% significance level, the maximum of $P_{AP,China}+P_{FP,China}$ is 0.76 in (L,H) session and 0.60 in (H,L) session, respectively.

[b]Based on 5% significance level, the maximum of $P_{FS,Japan}+P_{FP,Japan}$ is 0.8 in (L,H) session and 0.76 in (H,L) session, respectively.

Table 6. Random effects Tobit model estimates

	(*L*,*H*) sessions		(*H*,*L*) sessions	
	Chinese	Japanese	Chinese	Japanese
Low marginal return				
constant	3.308*	0.9943	5.2648**	1.1044
lag of others' investment	-0.0346	-0.0076	-0.0628	-0.0650
$d_{>=4}$ x lag of others' invest.	0.1871**	0.2170	0.1886**	0.3836
linear time trend	-0.2531	-0.0686	-0.3728**	-0.0193
log likelihood	-529.1688	-415.4203	-495.3258	-402.0922
High marginal return				
constant	6.6567	7.6687*	7.5911**	6.6744**
lag of others' investment	0.2345**	0.1532**	0.1201**	0.0393
$d_{<=6}$ x lag of others' invest.	-0.2263	-0.1701**	-0.1867	-0.1579***
linear time trend	-0.1036	-0.2073	-0.2202	0.0986
log likelihood	-230.3804	-378.6994	-388.3304	-537.9391

**Significant at 1% level, *Significant at 5% level.

Table 7. Spearman rank correlation coefficients

Variable correlated with own investment	(*L*,*H*) sessions		(*H*,*L*) sessions	
	Chinese	Japanese	Chinese	Japanese
$d_{>=4}$ x lag of others' invest.	0.4736**	0.0499	0.5962**	0.0728
$d_{<=6}$ x lag of others' invest.	-0.0470	-0.6050**	-0.0647	-0.4787**
linear time trend in low marginal return	-0.0645	-0.0940	-0.1637**	-0.0051
linear time trend in high marginal return	-0.0183	-0.0858	-0.0656	-0.0152

**Significant at 1% level, *Significant at 5% level.