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In search of “Favorite-Long Shot Bias”: An experimental study of the demand for sweepstakes

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IN SEARCH OF “FAVORITE-LONG SHOT BIAS”:

AN EXPERIMENTAL STUDY OF THE DEMAND FOR SWEEPSTAKES

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Abstract

This paper studies experimentally the demand for a variable-prize sweepstakes in which a single winner receives 90% of the total receipts, and whether such demand would exhibit the favorite-longshot bias (FLB) widely reported in the racetrack betting literature. We find significant incidence of sweepstakes purchase over population sizes ranging from 2 to 141, a greater tendency for FLB among those who exhibit longshot preference (LSP) over fixed-odds lotteries, but mixed support for FLB per se. In particular, the demand on average for 28-subject sweepstakes exceeds that of the largest one with 141 subjects including those who are averse to taking even-chance bets. Further and intriguingly, we observe significant demands for 2-person sweepstakes even among risk adverse subjects. Taken together, our observations reveal an incremental demand for sweepstakes arising from its interactive nature that can reinforce the effects of LSP as well as counter the effects of risk aversion.

Keywords: auction, experiment, Allais paradox, preference

JEL classification number: A10, C91, D44, D81

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"*It is usually agreed that casinos should, in the public interest, be inaccessible and expensive. And perhaps the same is true of stock exchanges.*"

– Chapter 12, in Keynes (1936) –

1. Introduction

The purchase of lottery tickets is ubiquitous in the modern economy. According to the US Census Bureau, state revenues from lottery tickets amounted to $77.3 billion in 2008. The heat of the moment in a racetrack may bring people to rush for longshots bets. This phenomenon of higher demand for higher odds bet (= longshot) is well known as the *favorite-longshot bias* (FLB). At the same time, the percentage of people without health insurance is 16.3 in 2010 by the US Census Bureau[1]. These phenomena eloquently tell of people's attraction to taking a risk when they join the others in a game setting. Yet, they are generally prudent in protecting themselves via purchasing insurance. What prompts regular people who are ordinarily cautious to take a chance when facing a longshot bet?

A classical attempt to explain such concurrence of such risk aversion and proneness to take a risk with a large prize with a tiny probability lies in the well-known reverse S-shape utility function suggested by Friedman and Savage (1948) under expected utility theory. Clotfelter and Cook (1990) examine survey data on the sales of state lotteries and consider them as evidence of the utility of a preference for skewness which relates to a reverse S-shape utility (See Kearney, 2005, for details on state lotteries). This is echoed in Golec and Tamarkin (1998) which uses a 3-moment expected utility model to model skewness preference in accounting for data from racetrack betting. But it is also well known that a reverse S-shape utility function has unappealing risk preference properties since it would imply that people become unconditionally risk seeking towards lotteries involving large outcomes in the convex region regardless of the probability of winning. In Conlisk (1993), a

[1] "Income, Poverty, and Health Insurance Coverage in the United States: 2010." U.S. Census Bureau, September 2011. (http://www.census.gov/prod/2011pubs/p60-239.pdf)

utility of gambling is appended to what is otherwise an expected utility specification with a concave utility function. This model can accommodate concurrent risk-aversion and skewness-seeking when the weight attached to the utility of gambling is sufficiently small.

A number of studies attribute the demand for lottery to cognitive biases that lead people to overweight small probabilities in risks they face, e.g., the idea of overweighting of small probability events in Kahneman and Tversky's (1979) prospect theory.[2] In the context of FLB in a financial market, Barberis and Huang (1998) investigate the overpricing of positively skewed securities, a commonly observed anomaly in the asset market, and showed that it can be explained by the cumulative prospect theory.

Chew and Tan (2005) proposed a property called *preference for long shots* (LSP) which characterizes risk taking behavior in the sense that people are willing to take a risk instead of sure outcome worth its expected value when the prize is large enough and its associated probability is small enough. They examined the condition for an individual to exhibit LSP while maintaining local aversion to a change in income distribution which involves symmetric outward shift of probabilities which we call *a symmetric risk*. Aversion to a symmetric risk is equivalent to risk aversion in the sense of Arrow and Pratt. Thus, it is clear that an expected utility (EU) maximizer cannot have LSP. They prove that the concurrency of LSP and global aversion to small symmetric risks is consistently explained by a class of non-expected utility preferences called the *weighted utility* (WU) (Chew 1983; Fishburn, 1983). In particular, they show that under constant absolute risk aversion, i.e., a negative exponential utility function together with an exponential weight function, the equilibrium demand for sweepstakes tickets rises as the population size of sweepstakes increases.

This paper reports the demand behavior observed in experimental pari-mutuel sweepstakes markets where both a prize and winning probability are endogenous. We run an incentivized sweepstake experiment where the prize is 95% of the ticket sale revenue and one

[2] The studies of risk-taking behavior based on the other psychological bias include those on the issue of over confidence (Camerer and Lovallo 1999, Daniel, et al. (2001).

winning ticket is randomly drawn out of all tickets sold. Most of our test hypotheses follow immediately from the theoretical work by Chew and Tan (2005) which consider sweepstakes provided by the state as a monopoly supplier.

One novelty of our study is in the two-stage-design of our experiments which enables us to systematically compare risk attitude between non-market risks and market risks. In the first stage, we examine subjects' risk attitude including aversion to symmetric risks and LSP within a non-market individual choice setting. In the second stage, the same subjects have an option to participate in experimental sweepstake markets.

Another novelty of our study is in designing experimental sweepstake markets with a wide range of population size, ranging from two to over a hundred, in order to examine the market implication of LSP in conjunction with aversion to symmetric risks. We run an experiment with one large session of 142 subjects and four small sessions of 32 subjects. In each session, subjects are offered sweepstakes of different population sizes. In four small sessions, minimum of the difference sizes is two-person sweepstake. The prize size of the sweepstakes being 95% of the ticket sale revenue naturally increases with the population size while the winning probability decreases.

The observed choice behavior confirmed FLB, i.e., significantly positive demand for sweepstake by subjects including those who are identified locally averse to symmetric risks. We also observed higher demand by subjects identified as LSP than those identified as not. This establishes a link between sweepstakes-market-level FLB and individual-level LSP. The link between LSP and FLB gives us a reason to expect theoretically to confirm the monotonicity, however, the results provide a mixed support: The monotonicity is confirmed in the small population sessions of 32 subjects, but not in the large population session where a contradictory result is obtained.

A particularly intriguing finding of our experiment involves subjects who are identified as averse to symmetric risks for individual choice task concurrently exhibit positive demand for two-person sweepstake. Moreover, subjects who generally forego lotteries in favor of receiving their expected payoffs for sure also exhibit positive demand for sweepstakes for every population size larger than the two-person . At the same time, their demand remains to be less than that of those who are identified not averse to symmetric risks.

To account for the preceding observations, it seems natural to consider the possibility of an additional motive for the purchase of sweepstakes, that they derive incremental enjoyment from taking a risk when it results from participation with other subjects. We label such risk as "*interactive risk*". Not to our surprise, Keynes has already noticed this curious nature of risk that generated out of people's interaction. This intuition appears related to the epigraph from Keynes who expresses a concern for the heat and ambience of casinos and conceivably stock markets in enhancing the appeal of risk taking. In the context of human versus computer, it is reported in Camerer and Karjalainen (1994) that people appear to be averse to the strategic uncertainty generated by playing matching pennies with a human opponent compared to playing it when the opponent is required to use a randomization device. Relatedly, Chark, and Chew (2015) report that their subjects are willing to pay in order to participate in a coordination game – either both win or both lose – against a real person more than a game against a computer. Relating to the bystander effect in social psychology, we posit a dilution hypothesis in which the additional utility from interactive risks decreases in population size n. In our sweepstake setting, this hypothesis can account for LSP type subjects exhibiting strong demand for the moderate-population sweepstakes but shy away from the large-population sweepstakes.

Section 2 states the test hypotheses. Section 3 covers the first part of our experiments where we describe the experimental design and present the experimental results regarding our subjects' preferences. The second part of our experiments is explained in Section 4 which describes how the sweepstakes of various sizes are designed and sold. Section 5 is devoted to the theoretical background of the test hypotheses. Discussion and conclusion appear in Section 6.

2. Test Hypotheses

Our test hypotheses are divided into two groups. The first group consists of four hypotheses that immediately follow from the theoretical implications of Chew and Tan (2005). There are two main testable implications; the one is that there exists a symmetric equilibrium with positive demand for lottery tickets when consumers are globally averse to symmetric risks and have LSP at the same time (based on the class of double exponential WU preferences). Whereas, there is no equilibrium with positive demand when globally risk averse consumers have EU or RDEU preferences. The other is that the average equilibrium demand (in terms of number of lottery tickets purchased) increases in the size of population (in terms of the number of consumers n) when consumers have LSP. This is called *monotonicity property of LSP*. The second group consists of the hypotheses based on our conjecture that individuals derive additional utility from participating in an interactive risk and such utility decreases in population size n.

2.1 Test Hypotheses

A natural starting point is to distinguish the risk-taking motive based on LSP from that based on the risk-loving preference in the sense of Arrow-Pratt. For that purpose, we focus on the sweepstake ticket demand behavior of subjects who are averse to symmetric risks.

Hypothesis 1 (H1): There is positive demand for sweepstakes by subjects averse to symmetric risks.

The corresponding null hypothesis is zero demand, which is consistent with EU and RDEU preferences. When subjects are locally averse to symmetric risks, the null hypothesis is consistent only with EU.

The next hypothesis provides the base for our analyses, establishing a link between individual level LSP and market level FLB.

Hypothesis 2 (H2): LSP subjects exhibit positive demand for sweepstakes.

In this paper, we consider subjects with *single-peaked LSP*, i.e., among lotteries with the same mean, they prefer a lottery with particular skewness most, which we formally define in Section 3. Specifically we consider three LSP types; *strong LSP* (SLSP), *moderate,* and *weak LSP* (MLSP and WLSP) classified according to the extent to how skewed lottery (i.e., with the smaller probability associated with the larger prize) they prefer. We refer to all three types by just LSP whenever there is no need to distinguish among three types.

Since the prospect generated in a symmetric equilibrium in a sweepstake market gets more skewed as its population size n increases, there should be the optimum sweepstake population size n^* for individuals with singe-peaked LSP where they exhibit the highest demand for sweepstake tickets. Then, n^* is bigger for the stronger LSP type. We call such demand behavior as *single-peaked FLB*. The following hypothesis extends the monotonicity property of LSP of Chew and Tan (2005) to accommodate single-peaked FLB.

Hypothesis 3 (H3): (i) In terms of total ticket demand for all population sizes available for each subject, subjects with stronger LSP have higher demand than those with less strong LSP. (ii) Subjects with stronger LSP have higher demand than those with less strong LSP for the sweepstake for larger population size, while the opposite holds for the smaller population size sweepstake. (iii) Subjects with strong LSP exhibit increasing demand in n, while subjects with weaker LSP may exhibit decreasing demand in n when n is large, and increasing demand in n when n is small.

H3(i) tests a link between single-peaked LSP and single-peaked FLB by checking the consistency between the order of propensity of ticket demand and the strength order of LSP. Since subjects are required to allocate their demand over sweepstakes with different population sizes within their maximum allowance, H3(ii) follows from H3(i). The same allocative decision reduces the test of the monotonicity property of single-peaked LSP to H3(iii).

The common ratio effect, eloquently described by the Allais Paradox, also captures the individual choice pattern that becomes less risk averse at a decision point first order stochastically dominated prospect generating gain with small probability. Let us call the type of individuals whose choices are consistent with the Allais Paradox as *Allais type*. There is a logical connection between LSP and Allais type, especially when LSP type individuals are WU maximizers[3]. Then, it is meaningful to check whether the demand behavior by LSP type subjects who are also Allais type confirms H2 and H3.

Hypothesis 4 (H4): The demand by Allais type decision makers with LSP is more likely to satisfy H2 and H3.

H1 to H4 form the first group of hypotheses focusing on the demand behavior of LSP individuals. The next two hypotheses form the second group which concerns the effect of interactive risk. Both LSP type and non LSP type are, in principle, subject to this effect. Let us label individuals who choose sure outcome over any risky alternative with equal mean as CRA, certainty preferring risk aversion. CRA subjects have no inclination to take a risk and can be regarded as opposite of LSP. And note that if a subject is CRA type, she should be ERA.

Hypothesis 5 (H5): (i) There is positive demand for two-person sweepstake by ERA subjects. (ii) There is positive demand for sweepstake of population size more than two by CRA subjects.

Individuals who are averse to symmetric risks should not buy any ticket in two-person sweepstake, because a symmetric equilibrium generates symmetric risk. Thus, H5(i) is to detect the effect of interactive risk on risk taking behavior. H5(ii) further tests the effect of interactive risk on CRA type of individuals who belong to the subset of individuals averse to symmetric risks.

Since it is generally easier to recognize the interactive nature of risk when the

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3 Those with WU preferences can only be either Allais type or its reverse. See Chew (1989) for reference.

number of participants is small, the positive effect of interactive risk on demand for sweepstake tickets is expected to diminish as the population size increases. This implies that the demand of CRA individuals decreases in population size. On the other hand, the demand of LSP buyers for the smallest population size, two-person, sweepstake is subject to two effects of opposite direction; one is demand inducing effect of value from interactive risk and the other is the effect of LSP which shifts demand away from two-person size toward larger size sweepstake. This tendency must be most likely to be observed in the case of strong LSP individuals.

Hypothesis 6 (H6): (i) The demand for sweepstakes of CRA buyers is not increasing in population size. (ii) The demand of strong LSP buyers for two-person sweepstake is lower than that of CRA buyers.

The next section explains the experiment design. Section 4 describes the results from the first part where subjects' preference types and risk attitudes are identified, followed by Section 5 describing its results from the second part where subjects face with purchasing decisions of sweepstake tickets.

3. Experimental Design

We conducted five experiment sessions with undergraduate students of Shinshu University as subjects, except one session (S1) which was also conducted in Japan but the subjects are all PRC nationals who are either post-graduate students or research fellows at Osaka University. Session "Large" has 141[4] subjects, and the remaining four experiments (from S1 to S4) have 32 subjects each. A start-up payment of 1,000 yen is paid to each subject at the beginning of the experiment. In each session, we run the preference identification part first, and the sweepstake ticket purchasing part second.

Next subsection describes the design of the first part of experiments which aims to

4 The number recruited for the experiment was 142, but one of them did not submit his/her answer to the choice questionnaires for the preference type identification part.

identify subjects' individual level preference types, followed by the subsection describing the design of the second part of experiments which aims to measure the demand behavior for sweepstakes. Since risk averse individuals are not allowed to purchase sweepstake tickets under the expected utility preferences, our preference identification process must involve a possibility of non-expected utility preferences. In Appendix A, we formally state the characteristics of LSP and briefly discuss specific classes of possible non-expected utility preferences consistent with LSP, risk aversion, and other related risk attitude such as Allais type behavior.

3.1 Identifying Preference Types

Subjects are asked to make choice decisions via answering four "real questions" (Questions 1, 2, 3, 4 under "Real Choice Situation" of the instruction example in Appendix) which entail real monetary payoff and five "hypothetical questions" (Questions 1, 2, 3, 4, 5 under "Hypothetical Choice Situation"). The real and hypothetical questions (Questions 1, 2, 3, 4) are identical pair-wise except that each outcome in the hypothetical questions is 100 times of that in the real questions.

These questions can be divided into three groups, with Question1 alone being the first group, Question 5 (consisting of five sub-questions) being the second group, and Questions 2, 3 and 4 making up the third group.

Question 1 is to identify if the subject is averse to symmetric risks by using an even-chance risk. We call those subjects averse to the given even-chance risk as ERA. The reverse type who seeks even-chance risk is labeled as ERS. We adapt the even-chance lottery to sort subjects into those who are averse to symmetric risks and those who are not, since even-chance lotteries are the simplest form of the symmetric risks. Question1 asks the subjects to choose between two alternatives, say S (for Status quo) and R (for Risk). (Note that S and R are not the labels used in the experiment.) Alternative S is a degenerate distribution δ_0 offering the sure outcome of zero yen. In contrast, alternative R is a lottery of the form $\frac{1}{2}\delta_x + \frac{1}{2}\delta_{-x}$ which means gaining a positive prize *x* with probability 0.5 and losing the same amount *x* with probability 0.5. Lottery R represents an even-chance risk with zero mean. If a subject chooses S over R, she is said to be averse to the even-chance risk. In our experiments, two such questions are asked. The one with smaller outcome values is for real monetary payoff. The other, with outcome values 100 times larger, is hypothetical. The values of *x* used for this question in our experiments are given in Table 1.

Question 5 consisting of five sub-questions is to identify if the subjects have LSP and its extent. Question 5 concerns hypothetical tasks with no actual monetary payoffs. Subjects are presented with five lotteries, labeled A, B, C, D and E as summarized in Table 2, all sharing the same expected value zero. Subjects are asked to pick the best among five lotteries.[5] We focus on LSP type of three different extents, *strong LSP* (*SLSP*) choosing E as the best, *moderate LSP* (*MSLP*) choosing D, and *weak LSP* (*WSLP*) choosing C. Those subjects who pick A as the best are averse to any risk with mean-preserving spread among four lotteries including symmetric risk B. We label them as *CRA*, *certainty preferring risk averse*, being totally opposite to LSP type. If a subject is CRA type, she must be ERA as well, but not vice versa. We label those subjects of reverse of CRA who name A as the least preferred as *certainty-alleviating risk seeker* CRS.

The third group of questions (Questions 2 – 4) is designed to classify subjects into four preference types – EU, Allais, reverse Allais, and others. Three questions are asked with each question involving one pair of lotteries. The design of choice questions can be illustrated in a probability triangle shown as Figure 1. A point (p_ℓ, p_h) in the triangle represents a three-outcome lottery of the form, $p_\ell\delta_{x_\ell} + p_m\delta_{x_m} + p_h\delta_{x_h}$ such that $p_\ell + p_m + p_h = 1$, where δ_{x_j}, $j = \ell, m, h$, denotes receiving outcome x_j ($x_\ell < x_m < x_h$) with certainty. In Figure 1, a point located in the southeast of the triangle is first order stochastically dominated by a point located in the northwest. Consider the three pairs of lotteries A_i vs. B_i (i = 1,2,3) indicated in

[5] We asked our subjects to pick the worst among five lotteries as well, however, we sort our subjects by their best choices to retain a reasonable sample size.

Figure 1. They are constructed such that the three line segments [A_i, B_i], i = 1,2,3, are parallel to each other. The parameters for probabilities and outcomes of three pairs of lotteries are summarized in Table 3.

Given the three pairs of choices A_i vs. B_i (i = 1, 2, 3), there are eight possible choice patterns. Among these, {A_1, A_2, A_3} and {B_1, B_2, B_3} are consistent with EU. The Allais type will allow another two patterns, {A_1, A_2, B_3} and {A_1, B_2, B_3}. Choice patterns {B_1, B_2, A_3} and {B_1, A_2, A_3} are consistent with reverse Allais type, while patterns {B_1, A_2, B_3} and {A_1, B_2, A_3} are labeled as "Other".

For EU preferences, the indifference curves will appear as parallel lines in the probability triangle. WU generalizes EU by allowing the indifference curves to be not necessarily parallel to each other while maintaining them to be straight lines.[6] When the indifference curves of WU *fan out* (*in*) on the probability triangle as in Figure 1, WU can capture (reverse) Allais type behavior which allow risk taking at the very right tip area of triangle where the risky prospects involve small probability of getting the highest outcome x_h.[7] This links to LSP. Thus, it is clear that EU cannot let an individual who is averse to symmetric risks to exhibit LSP, while WU can. The rank dependent expected utility (RDEU) which contains the cumulative prospect theory when the risky prospect can be defined by probability distribution, also generalizes EU via non-straight indifference curves. An individual with RDEU who is locally averse to even-chance risks can still exhibit LSP.[8]

6 WU requires its indifference curves to intersect either to the left or right of the triangle. When the intersection point is located infinitely away from the triangle, WU reduces to EU. When the indifference curves of WU fan out (in) on the probability triangle radiating from their intersection point located to the left (right) of the triangle, as in Figure 1, can capture (reverse) Allais type behavior. An individual with fanning out indifference curves can tolerate an increase in skewness of the probability distribution through shifting probability mass to the lower outcome for lotteries located in the lower right part of the probability triangle. For example in Figure 1, such a shift corresponds to a shift from point A_3 to point B_3. Figure 1 depicts an individual who prefers a lottery B_3 to A_3, having an indifference curve through A_3 going below B_3. This can allow her to exhibit LSP, since she is inclined to choose a lottery with small probability associated with higher outcome.

7 For further discussions on the fanning out map of indifference curves on the probability triangle, see Machina (1982).

8 RDEU does not require indifference curves to have unique intersection point, but does require them to be parallel to each other toward the oblique line of the probability triangle. Thus, it is difficult for individuals who are globally averse to even-chance risks to still exhibit LSP.

3.2 Measuring Demand for Sweepstake

Subjects participate in the sweepstakes experiment after they have completed the preference identification part. However, they do not know the resolution of each alternative involving uncertain outcomes in the first experiment as such resolution (by drawing cards) is done only after the sale of sweepstake tickets is closed. This is to eliminate possible income effect on subjects' demand for tickets.

Sweepstakes of different sizes are offered to subjects. In Large 141-person (141P) size session, two sweepstakes are offered to each subject; the full size sweepstakes with 141 subjects and moderate size sweepstake ranging from 27 to 30, average 28 subjects. Subjects in each group are randomly divided into five groups, with average 28 members. They are eligible to buy tickets for the full size sweepstake as well as a smaller-size sweepstake specifically offered to that group. In other four 32P size sessions S1 to S4, each subject can buy tickets for three different size sweepstakes she is eligible to participate – the big one with 32 subjects, the medium one for the group of eight randomly selected anonymous subjects including her, and the mini lottery exclusively for her and an anonymous subject randomly paired to her. Table 4 summarizes the parameters used in the second part of our experiments.

For each lottery, there is only a single prize for one winner. The size of the prize is variable, being 90% of the sales proceeds. This ratio is set relatively high given the necessarily small size of any lotteries in an experimental setting. The price of each ticket is 50 yen in Large session, and 20 yen for sessions S1 through S4. The lower price is to allow "finer" demand.

The maximum total number of tickets each subject is allowed to buy is carefully calculated based on the unconditional start-up payment, the maximum loss from the four real choices in the first part of the experiment identifying preference types, and the price per ticket. The subject can buy any number of tickets for lotteries he is eligible for as long as the total number of tickets purchased does not exceed the maximum allowed, 13 for Large session and 33 for each of 32P sessions. Subjects are adequately assured that they have the option not to buy any ticket at all.

All experiments are conducted anonymously in the sense that subjects are identified only by randomly assigned codes. They do not know who are assigned to the same sweepstake group. This is particularly true for the mini 2-person lotteries. As for the medium-size sweepstakes, even though subjects can tell from the color of the experimental instruments who are in the same group, the assigning of color (hence, group) is random and done by the experimenter. In addition, throughout the experiments, subjects are required not to communicate with each other, in order to preserve a competitive environment.[9]

4 Results from Preference Identification Experiments

In this subsection, we report the results from the first part of experiment identifying our subjects' preference types based on individual choice exercise which does not involve any element of game. This part of our experiments needs to accomplish four tasks: (i) sort subjects into the group that are averse to even-chance risks (ERA) and the group that are not (ERP); (ii) classify subjects into the groups that displays LSP with various degree and the group preferring certainty (CRA) as being opposite of LSP; (iii) identify each subject's preference type – EU type, Allais type, reverse Allais type, or none of the above; (iv) identify any link between Allais type and LSP.

4.1 Attitudes towards Even-Chance Risks

We start with identifying subjects who are averse to even-chance risks (ERA) and subjects who seek even-chance risks (ERS). As an even-chance risk is the simplest form of symmetric risks, individuals who are averse to symmetric risks must be ERA. Figure 2 summarizes

[9] In our pilot tests, there seemed some evidence that the "glow" of being a winner might have some non-trivial impact on subjects' demand for lottery tickets. Therefore, we have to weigh carefully this "publicity" effect against credibility (that the lotteries are for real). For the Large size experiment and session S2, even though the winning ticket numbers are announced on spot, subjects have been previously requested not to react visibly to the announcement. For all other experiments, we have reason to believe that credibility is not an issue. Drawing of the winning tickets is done at the end of the experiments. The result is announced via electronic announcement channel as well as the old fashion announcement board.

distribution of these two types according to two kinds of Question 1, involving real payments labeled “*real*“ (the inner circle) and hypothetical payments labeled “*hypothetical*”(the outer circle).

The percentage numbers in Figure 2 are all significantly different from random choice rate of 50% at less than 5% significance level. And there is no significant difference in preference distribution between 141P large session and 32P small four sessions combined[10] by chi-square goodness of fit test.

It is interesting to note that the real choice situations and the hypothetical choice situations show a reverse pattern. The real choices situation indicates more subjects preferring even-chance risk, whereas the hypothetical choices situation indicates the opposite, more subjects showing aversion to even-chance risk. Table 4 shows the map of ERA and its reverse, ERS, across real and hypothetical choice situations. Recall that the outcomes used in hypothetical choice situation is 100 times that in the real situation. Noting that the number of subjects who prefer hypothetical even-chance risk yet being averse to real even-chance risk is significantly small, the fact that subjects are more risk averse in hypothetical situations leads us to believe that the reverse patterns are a result of difference in payoff scale.

4.2 Preference for Long Shots

Subjects with LSP are identified based on their answers to Question 5. They are asked to choose the most preferred choice (best choice) and the least preferred choice (worst choice) out of five equal-mean alternatives summarized in Table 2. Figure 3 shows the distribution of the best choice and the worst choice from Large session and four small sessions combined. We sort subjects into the following three LSP types based on their best choices; strong LSP for subjects whose best choices are E, moderate LSP for subjects whose best choices are D, weak LSP for subjects whose best choices are C. We also identify subjects opposite of LSP who choose A as the best, and label them CRA (certainty risk-averse.)

[10] We observe session variation in the real choice situation but not in the hypothetical situation, and the variant session was S4 using Japanese students not S1 with Chinese students.

In Figure 3, three LSP types together claim 63% of our subject pool, and subjects are distributed almost evenly across three variations. CRA type is the minority of 13%, which is smaller than the random occurrence rate 20% at less than 1% significance. The other extreme type of CRA is the type of subjects whose worst choice is A, labeled CRS, claiming 32% of the subject pool, bigger than the random choice rate 20% at less than 1% significance. Theoretically, if an individual is CRA, then she must be ERA, but not vice versa. Similarly, if an individual is CRS, she must be ERS, but not vice versa[11]. Table 5 is a frequency table between ERA/ERS, and CRA/CRS. The distribution pattern is predictably different between the real and hypothetical questions. Based on the answers to the real questions, the share of ERA subjects among CRA subjects is more than 70%, and the share of ERS subjects among CRS subjects is more than 80%. This can be said to be roughly consistent with the theoretical relation between ERA/ERS and CRA/CRS. Based on the answers to the hypothetical questions, the corresponding ratio of ERA is 86% and that of ERS is 53%.

4.3 Choice Patterns – EU, Allais, Reverse-Allais and Other

The third group of questions (Questions 2-4) sorts the subjects' preferences into four types, EU, Allais, Rev-Allais and Other, according to the combinations among three choice pairs (A_1, B_1), (A_2, B_2), and (A_3, B_3). Figure 4 shows the number and percentage of subjects of each type for all sessions combined. The inner circle shows the preference types based on the real choices, while the outer circle is based on the hypothetical choices.

A few points are of interest to note. First, only about 1/4 of the subjects are EU type, and its share coincides with the random occurrence rate among four categories. Second, the modal Allais type accounts for 53%-60% of the subjects[12], and its share is significantly larger than the random occurrence rate. Third, Rev-Allais and Other types are clearly the minority of our subject population. The share of each type is significantly lower than the random

[11] Note that the complement of ERA is ERS, but CRA is not the complement of CRS.

[12] There is no significant difference in preference type distribution detected between Large 141P session and four small 32P sessions combined, by the chi-square goodness of fit test.

occurrence rate.

Our results are overall consistent with the exiting choice experiment literature – Conlisk (1989), Carmerer (1992), Harless and Camerer (1994), and Camerer (1995); but display a stronger prominence of Allais type. The key difference between our experiments and those in the literature is in the selection of the choice pairs. We construct our three pairs of lotteries mapped in a probability triangle with status quo (= payoff zero) being the intermediate outcome[13]. When all three outcomes in a probability triangle are positive payoff, the ratio of Allais type tends to be lower.

4.4 Link between Allais and LSP Types

Table 6 displays a map between four preference types (Allais, EU, Rev-Allais and Other,) and three LSP types and CRA, listing the number of subjects and its percentage in the parenthesis. For each of the four preference types, the upper row corresponds to the case based on choices made in Question 2-4 with real payments and the lower row corresponds to the case with hypothetical payments.

The distribution of three LSP types is not significantly different across four preference types. The only significant case shown in Table 6 is limited to the share of CRA within Allais type under both real and hypothetical choices, and within EU under real choices. In those cases, the share of CRA is less than the random occurrence rate of 0.2, which implies that subjects are unlikely to be CRA, opposite of LSP, when they are of Allais type. This weakly supports a link between LSP and Allais.

5. Analyses of Experimental Results on Demand for Sweepstakes

We report the result from the second part of our experiments on demand behavior for

[13] Chew and Nishimura (2003) reports the preference experiments also using the three-outcome lotteries with the middle outcome being zero payoff and comes up with the quite similar configuration of the revealed preference types.

sweepstakes in conjunction with the preference types identified in the first part of experiment described in Section 4. This section consists of four parts; (a) testing Hypothesis 1, examining demand behavior of ERA subjects, (b) testing Hypothesis 2 and 3, examining demand behavior of LSP subjects, (c) testing Hypothesis 4, checking a positive link between Allais and LSP types, (d) testing Hypothesis 5 and 6, examining the effect of utility from interactive risk.

5.1 Positive Demand for Sweepstakes

The first question is whether the demand for lottery tickets is significantly positive. The main preference types of interest are ERA and LSP. The corresponding test hypotheses are H1 and H2, respectively.

5.1.1 ERA subjects

Table 7 summarizes the number of ERA or ERS subjects purchasing non-zero tickets for sweepstakes of different population sizes except 2-person. ERA type based on Question 1 with real payment is labeled "real ERA", and ERA based on hypothetical Question 1 is labeled "hypo ERA". The same labeling rule applies to ERS type.

In Large session, almost 100% of ERA and ERS subjects[14] purchased at least one ticket of sweepstake of either 141P or 28P population size. In the four small size sessions, more than 73% of subjects of ERA and ERS type exhibit positive demand for either 32P or 8P population size sweepstake. Needless to say, those percentage numbers are significantly greater than 50% of random choice rate.

Pillars in Figure 5a show the averages of tickets purchased by ERA and ERS subjects for each population size sweepstake. The exact number of average and standard deviations are shown at the top of the corresponding pillar, taking account of all ticket purchasing data including those bounded by the maximum number of tickets allowed. Those

[14] The percentage of subjects with positive demand among "Real ERA" type is 98%.

average numbers are significantly greater than zero at less than 5% level by t-test, and this holds equally true for both ERA and ERS subjects across all population sizes. This is a strong supportive evidence of Hypothesis 1 – there is positive demand for sweepstakes by ERA subjects.

The observed demand by ERA subjects is strong enough to produce no significant difference between ERA and ERS subjects for any population size shown in Figure 5a with an exception of 8P where hypo ERS subjects demand more than their ERA counterparts at less than 2% significance by Mann-Whitney test. Figure 5b shows the average of total ticket demand for all population sizes available in sessions (except 2P.) Regarding the total ticket demand in Large session, real ERS subjects demand more than their real ERA counterparts at less than 9% significance by t-test and at less than 5% significance by Mann-Whitney test. The corresponding total demand for all population sizes available in small sessions does not yield significant difference between ERS and ERA subjects.

Observation 1: *ERA subjects who are averse to even-chance risks exhibit positive demand for sweepstakes.*

Observation 2: *Less demand by ERA subjects than ERS subjects is supported in terms of total ticket demand only in Large session but not in small sessions.*

5.1.2 LSP subjects

Figure 6a shows the average numbers of tickets purchased by three types of LSP subjects. Note that the numbers for 141P and 28P size sweepstakes are taken from Large session and the rest comes from four 32P size sessions combined. Figure 6b is a counterpart of Figure 6a when the set of subjects are narrowed to those who are both LSP and ERA.

All three types of LSP subjects in Figure 6a demand significantly positive number of tickets and so do LSP subjects in Figure 6b. It follows that H2 is confirmed.

Observation 3*: LSP subjects exhibit positive demand for sweepstakes.*

5.2 Preference for Long Shots and Demand Monotonicity in Population

This subsection investigates the demand behavior of LSP subjects identified in the first part of experiment. To recap, a subject is said to display strong LSP (SLSP) if she picks alternative E as the most preferred, moderate LSP (MLSP) if she picks D, and weak LSP (WLSP) if she picks C among five pairs of risky choice summarized in Table 2.

5.2.1 Consistency between Relative Strength of LSP and FLB

Before investigating the monotonicity, we need to examine the link between single-peaked LSP and single-peaked FLB, that is, the propensity to purchase tickets of SLSP must be higher than that of weaker LSP subjects (H3(i).) We measure the propensity by total number of tickets a subject purchased in a session.

Table 8 shows the results from tobit and probit regressions in Large 141P session (the left half of Table 8) and in four 32P sessions combined (the right half of Table 8). The dependent variable in the tobit regression is the total number of tickets each subject purchased for all sizes of sweepstake available in the corresponding session. The dependent variable for the probit regression assumes one when the total number is positive. The upper limit for tobit regressions is the maximum number of tickets allowed, namely 13 in Large session and 33 in each of four 32P sessions. The tobit regression Model (1) in the first column utilizes “Real ERA” for a dummy variable for ERA, and Model (2) in the second column uses “Hypo ERA”. The third and fourth columns list results from probit regression analyses where the dependent variable takes value one if the total ticket demand is positive. The lists of variables in Model (3) and (4) are the same as Model (1) and (2), respectively.

For Large session where 141P and 28P size sweepstakes are available, SLSP and WLSP subjects are more inclined to purchase tickets indicated by both tobit and probit regressions. Looking at cross variables, ERA element discourages WLSP subjects but not SLSP subjects. Thus, SLSP subjects are most inclined to purchase sweepstake tickets in Large session. The results from 32P sessions do not indicate any significant inclination for demand by SLSP subject. Model (4) shows significant inclination by MLSP and WLSP subjects, but together with cross effect with ERA, combined effects of MLSP and WLSP subjects are negative. Thus, SLSP subjects under ERA tend to demand relatively more than other LSP subjects. Lastly, the coefficient associated with CRA is not significant. In sum, H3(i) is overall supported.

Observation 4*: In terms of total number of purchased tickets across different sizes of sweepstakes available for each subject, LSP type subjects demand more than other type subjects. And the demand by strong LSP subjects is the highest among three LSP types of different strength.*

5.2.2 Link between single-peaked LSP and single-peaked FLB

From Figure 6a, we can tell that the case where SLSP subjects shows the largest demand among three LSP types is limited to the case of moderate size (32P or 28P) sweepstakes. For 32P size sweepstake, SLSP type subjects demand more tickets than MLSP type subjects at less than 4% significance level by t-test and at less than 10% significance level by Mann-Whitney test. They demand more tickets than WLSP type subjects at less than 4% significance level by t-test but not significant by Mann-Whitney test. For 28P size sweepstake, SLSP subjects demand more tickets than MLSP subjects at 8% significance by t test and at 6% significance by Mann-Whitney test, but there is no significant difference in demand between SLSP and WLSP subjects. For either 32P or 28P size sweepstake, no significant difference is observed between MLSP and WLSP subjects. For 8P size sweepstake, WLSP subjects demand more tickets than SLSP at less than 2% significance level by t-test and at less than 8% significance level by Mann-Whitney test. The demand by WLSP subjects is higher than that by MLSP subjects at less than 1% significance by t-test as well as Mann-Whitney test. There is no significant difference in demand is observed between SLSP and MLSP subjects. Finally, there is no significant difference in demand for 141P size sweepstake among three variants of LSP type subjects. Furthermore, as indicated by Figure

6b capturing more clearly the property of Figure 6a, the statistical examination of the demand behavior of ERA subjects generate the results similar to that described in the preceding paragraph[15].

In sum, we can conclude that H3(ii) is overall confirmed with respect to SLSP subjects and WLSP subjects except for 141P size sweepstake. The ranking between MLSP and WLSP subjects in terms of ticket demand is not clear.

Observation 5*: For 32P size sweepstake, strong LSP subjects demand more than other LSP type subjects. For 28P size sweepstake, strong LSP subjects demand more than moderate LSP subjects. Whereas for 8P size sweepstake, weak LSP subjects demand more than other LSP type subjects. Regarding the largest 141P size sweepstake, however, no significant difference in demand among three LSP types is observed.*

5.2.3 Preference for Long Shots and Demand Monotonicity in Population

Next, we examine H3(iii), the monotonicity property modified for single-peaked LSP subjects. In 32P size sessions where 32P and 8P size sweepstakes are available, Figure 6a and 6b show that the demand of SLSP subjects is increasing, while the demand of WLSP subjects is decreasing in population size. This can be confirmed by descriptive statistical analyses that SLSP subjects demand more for 32P than for 8P at less than 1% significance level by t-test and less than 2% by Wilcoxon signed ranks test, while subjects with WLSP shows an opposite pattern with 10% significance level by t-test. There is no statistically significant monotonicity in demand observed for MLSP subjects. This result indicates that the optimal population size n^* for SLSP subjects is larger than that of WLSP subjects, which is consistent

15 It is only the case of 32P size sweepstake where strong LSP demand more tickets than weak LSP type subjects, at 2% significance by t-test and 8% significance by Mann-Whitney test). There is no significant difference in demand between strong and moderate LSP subjects for 32P size sweepstake tickets. In the case of 8P size sweepstake, it is weak LSP subjects whose demand is the largest. Their demand is higher than that of strong LSP at 4% significance by t-test and 9% significance by Mann-Whitney test, and also than that of moderate LSP at 1% significance level by t-test and at 2% significance level by Mann-Whitney test. The demand by strong LSP subjects is more than that by moderate LSP subjects at 2% significance by t-test, and 10% significance by Mann-Whitney test. There is no significant difference in demand for 141P size and 28P sweepstake among three variations of LSP type subjects.

with H3. However, in the large 141P session where 141P and 28P size sweepstakes are available, subjects with SLSP demands less for 141P size sweepstake than for 28P size at less than 1% significance level by both t-test and Wilcoxon signed ranks test. The demand by MLSP and WLSP subjects shows nominally the same pattern with SLSP subjects as we can see from Figure 6a, but not statistically significant. The corresponding analyses for the case focusing on subjects with ERA (by real choices) generate the similar results as we can tell from Figure 6b.

Alternatively, we examine H3(iii) via regression analyses and the results based on the data from Large session and the results based on the data from four 32P sessions combined are summarized in the left half of Table 9a and Table 9b, respectively. The first two columns of Table 9a use the difference in ticket demand between 141P size and 28P size sweepstakes as a dependent variable, and the first two columns of Table 9b use the difference in ticket demand between 32P and 8P size sweepstakes as a dependent variable. The third and fourth columns show the results from probit regression whose dependent variable is one if the dependent variable used in the first two columns is positive, otherwise zero. The right half of each table uses the data from those subjects who are also identified as Allais type. The selected variables of Model (1) to (4) in Table 9a and 9b are the same as those in Table 8.

First thing to note about the left half of Table 9a is that the coefficient associated with a dummy variable of SLSP has significant negative sign in every model. Other LPS dummies do not produce any significant effect except in Model (4). The second thing to note is that the coefficient associated with the cross variable between SLSP and ERA has positive sign in every model and significant in all modes except Model (2). The second thing to note is that the coefficient associated with the cross variable between SLSP and ERA has positive sign in every model and significant in all models except Model (2). The total effect of SLSP combining coefficients associated with single and cross variables of SLSP become positive in all models except Model (2). This is consistent with the monotonicity property by recalling that these subjects being both SLSP and ERA types are close approximation of the underlying preferences assumed in Chew and Tan (2005). But more importantly, the fact that the effect of single SLSP variable has significantly negative sign which is opposite to the monotonicity property also indicates that some element other than the theoretical implication of LSP may be at work in determining the demand for tickets.

The left half of Table 9b tells a different story. The effect of single SLSP variable is significantly positive in all models except Model (2). The effect of cross variable of SLSP and ERA is not significant. Thus, the property of demand behavior of SLSP is consistent with the monotonicity property of LSP. In Model (3) and (4) of probit regressions, the effect associated with WLSP has significantly positive sign. And the effect combined single WLSP and cross between WLSP and ERA variables is also positive and remains to be consistent with the monotonicity of LSP. This result is in conflict with the result from descriptive statistical analyses which shows that their demand is higher for 8P size sweepstake than for 32P size sweepstake.

Observation 6*: In four 32P size sessions, subjects with strong LSP demand more for 32P size sweepstake than for 8P size sweepstake. Thus their demand behavior is consistent with the monotonicity property of LSP. In contrast, we obtain a dichotomous observation of demand behavior of subjects with weak LSP, where the descriptive statistical analyses supports the higher demand for 8P size sweepstake than for 32P size sweepstake while the probit regression analyses detects higher frequency of greater demand for 32P size than 8P size sweepstake.*

As summarized above, we obtain two kinds of dichotomous result which may suggest the existence of additional element working in the opposite direction to the monotonicity property of LSP.

5.2.4 Demand Monotonicity in Population under Allais type Preference

Lastly, we briefly mention the result of demand behavior of those subjects who are identified as the Allais type based on their answers to Q2-4 in the part of our preference identification experiment. The corresponding regression results are shown in the right half of Table 9a and 9b. The data conditional on the Allais type seems to retain the same result as the unconditional data for Large session and strengthen the effect of SLSP subjects confirming monotonicity in population size for the 32P size sessions[16]. This goes along with the theoretical implication that a decision maker with LSP is likely to be Allais type if she has WU preference. This is also consistent with the coefficient associated with the cross variables being significantly positive while that of ERA being negative in Model (3) in Table 11b. Consequently, we conclude that H4 is supported.

5.3 Demand for Two-person Sweepstakes

This subsection investigates the possible effect of interactive risk, stated in H5 and H6. If our subjects find an intrinsic value from taking part in an interactive risk, there should be positive demand for two-person sweepstake even by ERA type subjects who exhibit averse to even-chance risks (Q1) in an isolated individual choice situation in part 1, H5(i). (Note that logically CRA subjects are ERA.) Alternatively, the intrinsic value of interactive risk may induce even CRA subjects, who chose a sure outcome among five equal-mean risky prospects with various extents of longshot in an isolated individual choice situation (Q5), to demand positive number of tickets for any size of sweepstakes including 141P-size, H5(ii). Furthermore, since it is easier to sense the interactive nature of risk when the population size is small, the value of interactive risk should diminish as population size rises. Then, the effect of interactive risk should produce a negative effect of population size on demand across all subject types (H6).

[16] In Table 11a, Models (1) and (2) in the right half shows only negative effect of SLSP unlike its left counterpart. Again, there is no significant effect observed of other weaker LSPs subjects. The probit regression does not perform well due to many variables of multi-colinearity. For 32P size sessions summarized in Table 11b, compared to the left half which is the case not conditional on the Allais type, the effect of WLSP becomes significantly positive in addition to the effect of SLSP in Model (1). The effect of SLSP in Model (2) is nominally positive but not significant, and the combined effect of WLSP is even negative. In contrast to Model (1), the result of Model (2) in both halves seems not clear. Model (3) of probit regression shows positive effect for all three LSP types, while Model (4) shows the combined positive effect for two weaker LSP types.

5.3.1 ERA Subjects

Figure 7a is a reproduction of Figure 5a depicting the average demand of ERA and ERS subjects excluding the case of 141P and 28P population sizes but adding the case of 2P sweepstake. From the table adjacent to Figure 7a, it is easily checked that the number of ERA subjects with positive demand for two-person sweepstake is significantly different from zero. From figure 7a, we can also tell that the number of tickets they demanded is significantly greater than zero. Consequently, H5(i) is supported. T-test does not detect any significant difference in the demand for two-person sweepstake between ERA and ERS subjects, but Mann-Whitney test reveals that hypo ERS subjects demand more than their ERA counterparts at less than 2% significance. Thus, the underlying relative risk attitude is maintained in the relative magnitude in demand between ERS and ERA.

Since the interactive risk affects all type of subjects, it is of interest to investigate whether H6 holds for ERA subjects. Both ERA and ERS subjects demand significantly more for 28P than 141P size sweepstake (at less than 1% by t-test as well as Wilcoxon signed-ranks test, except for the case of hypo ERA subjects whose significance level is 2%.) Neither ERA nor ERS subjects in small 32P population sessions exhibit significantly different demand across different population sizes. There is no significant difference in demand by either ERA or ERS subjects between 28P size sweepstake in Large session and 32P size sweepstake in each of four small 32P size sessions, though the maximum number of tickets allowed is difference between large and small sessions.[17] Consequently, it seems that the demand behavior is stable within the cases of moderate size population across Large and small sessions. The demand for 32P size sweepstake is significantly more than that for 141P size sweepstake (at less than 4% by t-test). T-test does not detect any significant difference between the demand for 28P size and 8P size sweepstakes or between 28P size and 2P size sweepstakes for either ERA or ERS subjects. But Mann-Whitney test and Median test find

[17] Out of 141 subjects, demand by 28 subjects hit the maximum number of tickets allowed, in the large session. Among 128 subjects in four small sessions combined, 16 demanded the maximum number of tickets.

more demand for 8P size than 28P size sweepstake at less than 5% significance by hypo ERA subjects, and more demand for 28P size than 2P size at less than 1% significance. Consequently, we observed a negative population size effect between 141P-size and other smaller size sweepstakes, but not among smaller size sweepstakes, thus H6 is partially confirmed with respect to ERA subjects.

Observation 7*: (i) ERA subjects exhibit significantly positive demand for the two-person size sweepstake. (ii) ERA subjects demand less of two-person size sweepstake than ERS subjects. (iii) There is a negative population effect in Large session, but no effect of population is observed in small sessions.*

5.3.2 CRA Subjects

Figure 7b is a reproduction of Figure 6 plus the case of two-person sweepstake and also adding the data from CRA subjects. Recall that CRA subjects are those who chose a sure outcome as the best averting to all other equal-mean risks in Q5 of individual choice tasks. It is clear from Figure 7b that the demand by CRA subjects is significantly positive for every population size sweepstake. Especially, neither t-test nor Mann-Whitney test detects any significant difference between LSP subjects and CRA subjects in their demand for two-person sweepstake. This is also true for the case between LSP subjects conditional on ERA and CRA subjects. These findings support H5(ii).

Figure 7b at the same time shows that the demand by LSP subjects is not smaller than CRA subjects in every population size sweepstake, reflecting the relative propensity to take a risk between LSP and CRA. This indicates that the basic linkage between the underlying preference types (LSP and CRA) and demand behavior is kept consistent, though CRA subjects purchase significantly positive number of tickets. In Large session, the demand by CRA subjects is smaller than that by WLSP subjects at 7% significance by t-test and 9%by Mann-Whitney test. In small 32P sessions, the demand by CRA subjects is smaller than the demand by SLSP subjects at less than 3% significance by t-test as well as Mann-Whitney test for 32P size sweepstake, and smaller than the demand by WLSP subjects at less than 10% significance level by Mann-Whitney test.[18]

Next, we proceed to examine H6. If the effect of interactive risk is decreasing with population size, the demand behavior by LSP subjects across different population sizes must be a product of two conflicting effects, the positive effect of the increase in population size via LSP and the negative effect via interactive risk. Table 10, summarizing tobit and probit regression analyses on the demand behavior for two-person sweepstake, provides some support for this conjecture. Recall that we have already observed significantly positive demand for two-person sweepstake by LSP type subjects as well as CRA subjects. The only explanatory variable of preference types generating statistically significant effect on demand for two-person sweepstake in Table 10 is the variable SLSP. The effect of SLSP is consistently negative across Model (3) and (4) using all demand data and Model (1) and (3) using demand data conditional on being Allais type. This can be thought as the result of SLSP subjects' shifting their demand from two-person size sweepstake to larger size sweepstake, since they are under the heaviest influence of LSP property so that their propensity to purchase tickets for riskier sweepstake with larger population size overcomes the weakening purchase inducement from the interactive risk effect.

It follows that we should focus on CRA subjects to extract the effect of interactive risk, since LSP subjects are under two kinds of different influence with opposite direction as just described. However, the number of CRA subjects is rather small to carry out any descriptive statistical tests with reasonable power. In order to alleviate this problem, we combined two data sets, one from Large session and the other from the four small sessions, to run regression analyses summarized in Table 11. In the left half of Table 11, we utilize the difference in ticket demand between 141-person size and 28-person size sweepstakes and the

[18] The similar results are obtained for the case between ERA subset of LSP subjects and CRA subjects. SLSP subjects demand more than CRA subjects for 32P size sweepstake at less than 2% significance level by t-test and at less than 3% level by Mann-Whitney test. WLSP subjects demand more than CRA subjects for 8P size sweepstake at less than 8% significance by t-test and at less than 6% by Mann-Whitney test.

difference in ticket demand between 32-person size and 8-person size sweepstakes as the dependent variable for OLS regression, shown in the left two columns under Model (1) and (2). For probit regression analyses, shown in the right two columns under Model (3) and (4), the dependent variable assumes one if the number of tickets demanded for 141-person size sweepstake exceeds that for 28-person size sweepstake or if the number of tickets demanded for 32-person size sweepstake exceeds that for 8-person size sweepstake. The right half of Table 11 corresponds to the case where we use the difference in demand between 32-person size and 2-person size sweepstake in the place of the difference in demand between 32-person size and 8-person size in the left half.

As a default selection of explanatory variables, we start with three LSP types (SLSP, MLSP, and WLSP) and Session (which is one when the data are from the four small 32 person sessions combined,) in addition to CRA which is our main concern, and then drop some LSP type variables for their insufficient contribution detected by partial F-test. We also show the regression results using only CRA and Session as the explanatory variables.

The coefficient associated with CRA variable is nominally negative in every model in Table 11. Due to the difference in scale and the maximum number of tickets allowed to purchase between large and small sessions, it is more appropriate to employ probit analyses for our purpose of examining H6. There, the negative coefficient associated with CRA is significant except in Model (3) in the right half. This implies that CRA subjects' demand for sweepstake is least likely to increase in population size among other types, which mildly supports H6.

Observation 8*: (i) CRA subjects exhibit significantly positive demand for the two-person size sweepstake as well as other larger pollution sizes. (ii) CRA subjects' demand is not more than that of LSP subjects for any population size sweepstake. (iii) The demand by CRA subjects is least likely to increase in population size.*

In probit regressions in both halves of Table 11, the coefficients associated with

SLSP and WLSP are significantly positive. This implies the frequency of demanding more for larger population size sweepstakes is higher for LSP type subjects than non-LSP type subjects, though we have already observed that their average ticket number demanded is significantly less for 141-person size is less than for 28-person size explained in the preceding subsection. This is consistent with our conjecture that LSP subjects experience two conflicting forces, one from LSP promoting subjects to seek risk in larger population size sweepstake and the other from interactive aspect in risk inducing subjects less to seek risk in larger population size sweepstake.

6. Discussion and Conclusion

This paper makes an attempt to find a motive other than pure risk-seeking behind the *favorite-longshot bias* (FLB) phenomenon, widely reported in the racetrack betting literature where longshots are overbet, while faviortes are underbet. We investigate demand behavior in an experimental sweepstake market awarding a large prize with a small probability. In particular, we focus on a pari-mutuel sweepstake in which a single winner receives 90% of the total receipts and one winning ticket is randomly drawn from all tickets sold. We offer sweepstake markets with various population sizes, such as small size of 2-person and 8-person, moderate size of about 30-person (varying from 28 to 32), and large size of more than 140-person. The expected payoff from purchasing a ticket is negative in every market, so that any expected utility maximizing individual who is risk averse in a usual sense would not participate in a sweepstake market. Before the sweepstake market experiment is conducted, we run the choice experiment where subjects are asked to answer to various individual choice questions to identify their underlying preferences under risks.

We find a significant demand for sweepstake tickets, even among subjects who are identified as being averse to even-chance risks in the individual choice experiment (Observation 1). We also find that subjects who are identified as averse to even-chance risks demand less than those who are not (Observation 2).

As a theoretical explanation, we adopt the *preference for longshot* (LSP) hypothesis proposed by Chew and Tan (2005) which can accommodate positive demand for sweepstake in joint with local risk aversion in the usual sense, under some classes of non-expected utility preferences, including weighed utility and rank dependent expected utility which is equivalent to cumulative prospect theory with objective probabilities. The main testable implication based on their work is the *monotonicity* which predicts that LSP type subjects demand more for the larger population size sweepstakes.

In the choice experiment, we classify our subjects into three LSP types with different extent (strong, moderate, and weak), and the opposite of LSP which is CRA type who chooses a sure outcome over equal-mean risky prospects, and the rest. First of all, we confirm that LSP type subjects exhibit positive demand for sweepstake tickets (Observation 3.) Then, in terms of total number of tickets purchased per subject, we confirm that LSP type subjects purchase more sweepstake tickets that those who are not, and that strong LSP type subjects demand more than other weaker LSP type subjects (Observation 4). Thus, the correspondence between market level FLB behavior and individual level LSP is confirmed.

At the same time, however, we observed FLB behavior that is not implied by the individual preferences identified via the non-market choice tasks. First of all, those subjects who are averse to even-chance risks purchase significantly positive number of tickets for two-person sweepstake where participants face an even-chance risk in equilibrium (Observation 7(i)). Secondly, within the moderate population (28 or 32-person) size sweepstake market, the strong LSP type subjects demand more tickets than other LSP types, but this does not hold in the large 141-person size sweepstake (Observation 5). Thirdly, the demand by strong LSP type subjects confirms the monotonicity by being increasing in population for 32-person or smaller size sweepstakes, while it does not for the sweepstake with 141 population, though the strong LSP subjects' choice in the preference test is much riskier than the equilibrium payoff prospect in 141 population sweepstake market (Observation 6). Lastly and more strikingly, CRA subjects exhibit significantly positive demand for sweepstakes with all population sizes including 141-person size (Observation 8(i)).

These observations point to a possibility of an additional motive to take a risk. Specifically, we conjecture that subjects derive additional value from creating a risk jointly with the other participants, which we call as the "*interactive risk*", since the kind of risk that subjects face in a sweepstake market is endogenous and different from the risk they consider in the preference experiment which is exogenous. The plausibility of our conjecture becomes more evident when we compare our findings with the study by Chark, et al. (2014) that reported a straight forward correspondence between LSP and FLB in the non-pari-mutuel sweepstake where the prize and the winning probability is given. Our conjecture is also consistent with the recent study by Chark and Chew (2014) reporting that their subjects are willing to pay for participating in a game against a real person than a game against a computer[19]. Since the element of interaction in an endogenous risk is more recognizable when the number of participants is small, it is reasonable to assume that the value from an interactive risk is decreasing in population size. If so, the LSP type subjects should experience both the growing effect of LSP and the diminishing effect of value from interactive risk, as the sweepstake population size increases. Having such two motives working in the opposite direction with respect to an increase in population size can explain conflicting Observation 3(i) and 3(ii). It is effective to examine the demand behavior of CRA subjects to verify our conjecture because they are not under influence of LSP. Our CRA subjects coherently demand no more than LSP subjects, and they are more likely to demand less for larger population size sweepstake than smaller population size sweepstake, our final observation (Observation 8 (ii) and (iii)).

This view of interactive risk may be thought of a kind of source-dependent preferences which allow an individual to change her choice when the way in which the uncertainty has been generated, (see for example, Heath and Tversky (1991), Fox and

19 Chark et al (2016) do not report the case of two-person sweepstake, since they utilized real lottery market for their experiments.

Tversky (1995), Skiadas (2006), and Chew and Sagi (2008).) The distinct aspect of interactive risk, we think, is that the intentions among participants matter, not just endogeneity of risk. Further investigation for a possible link between intentions and risk attitude will be our future research.

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Tables and Diagrams

Diagrams:

Figure 1: *Choice pairs in the probability triangle*

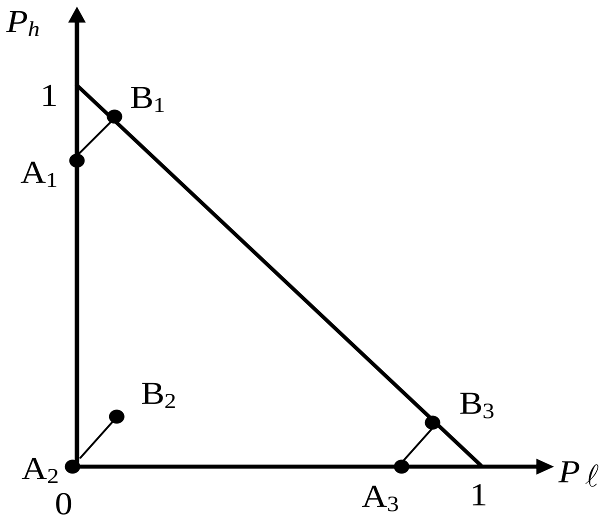


Figure 2: *Distribution of Risk Attitude to Even-Chance Risks*

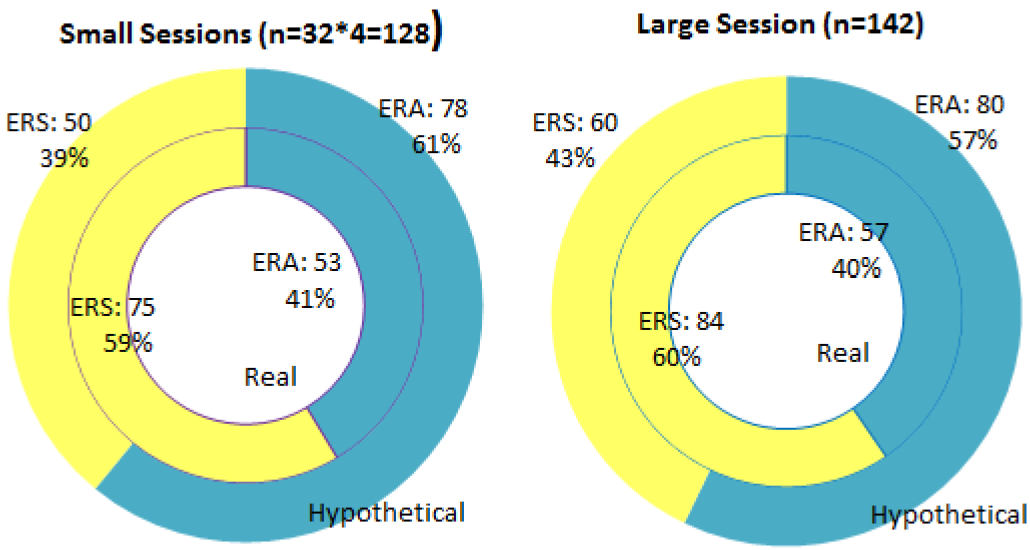
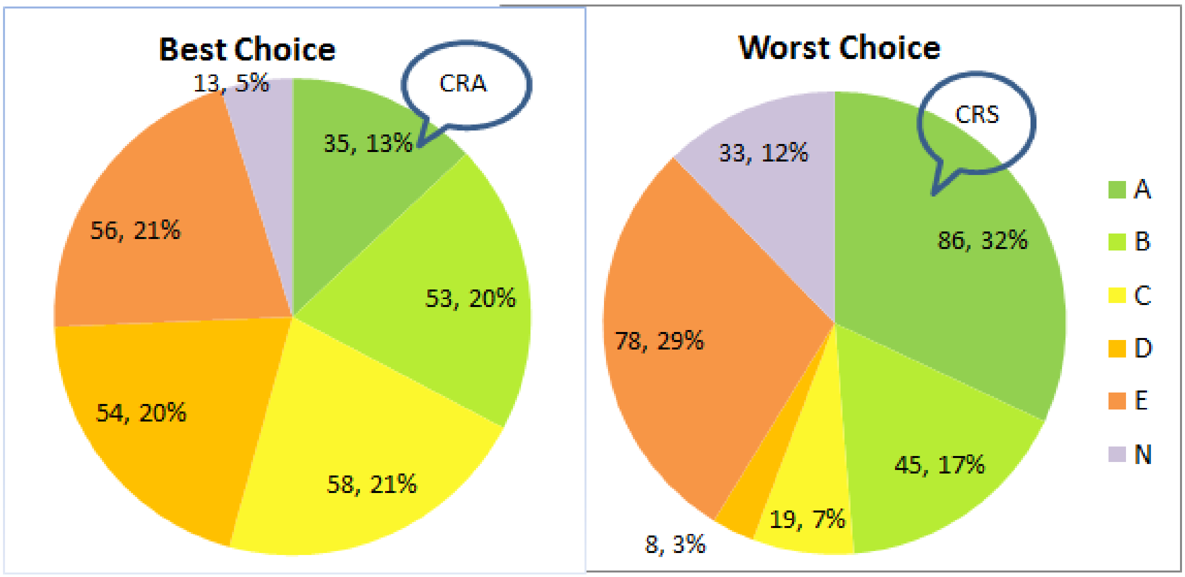


Figure 3: *Preference for Long shots– All Sessions Combined*



N: No answers

Figure 4*: Allais behaviour across samples*

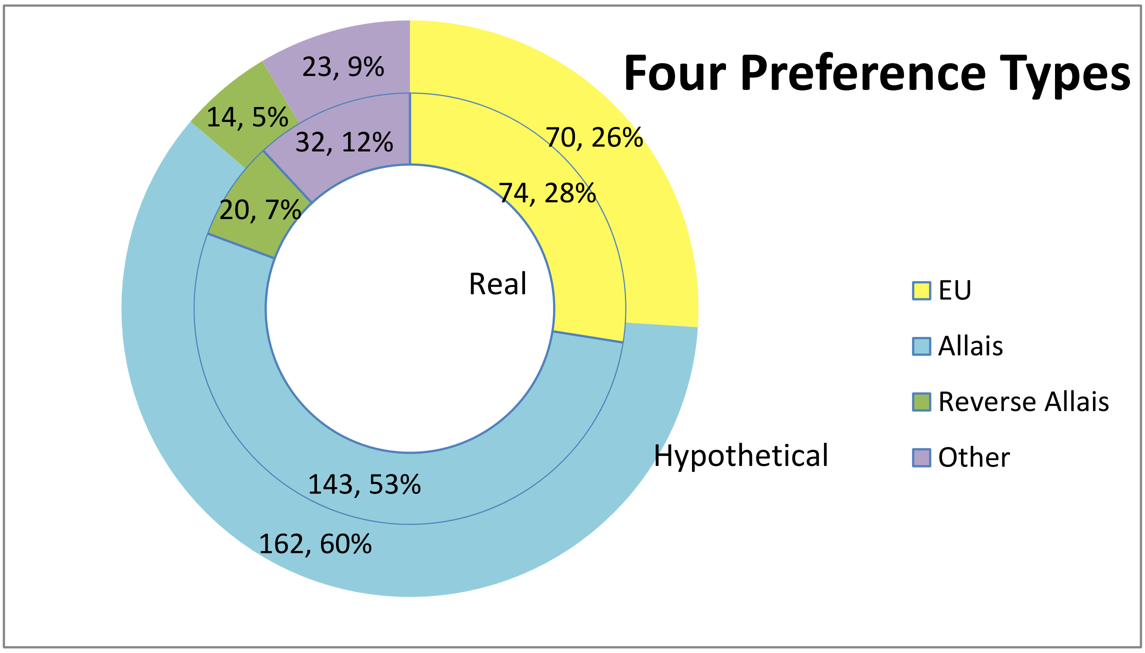


Figure 5a: *Average Number of Tickets Purchased Population Size Wise – All Subjects (ERA/ ERS)*

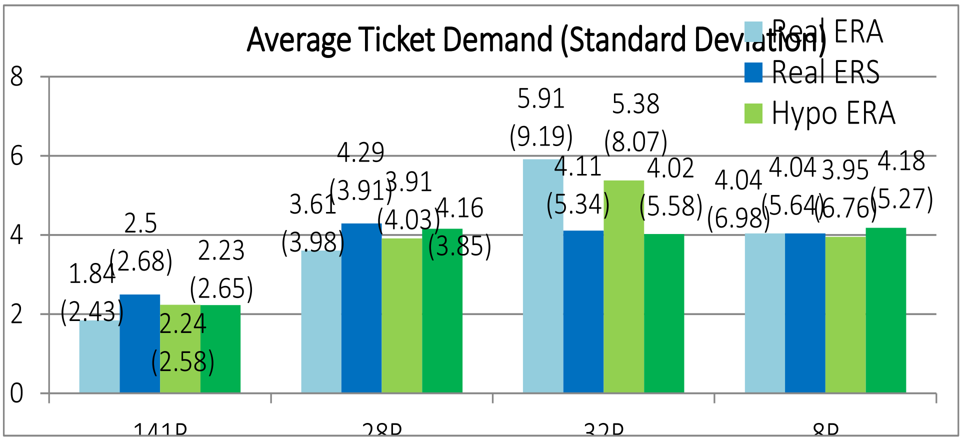


Figure 5b: *Average Number of Total Tickets Purchased – All Subjects (ERA/ ERS)*

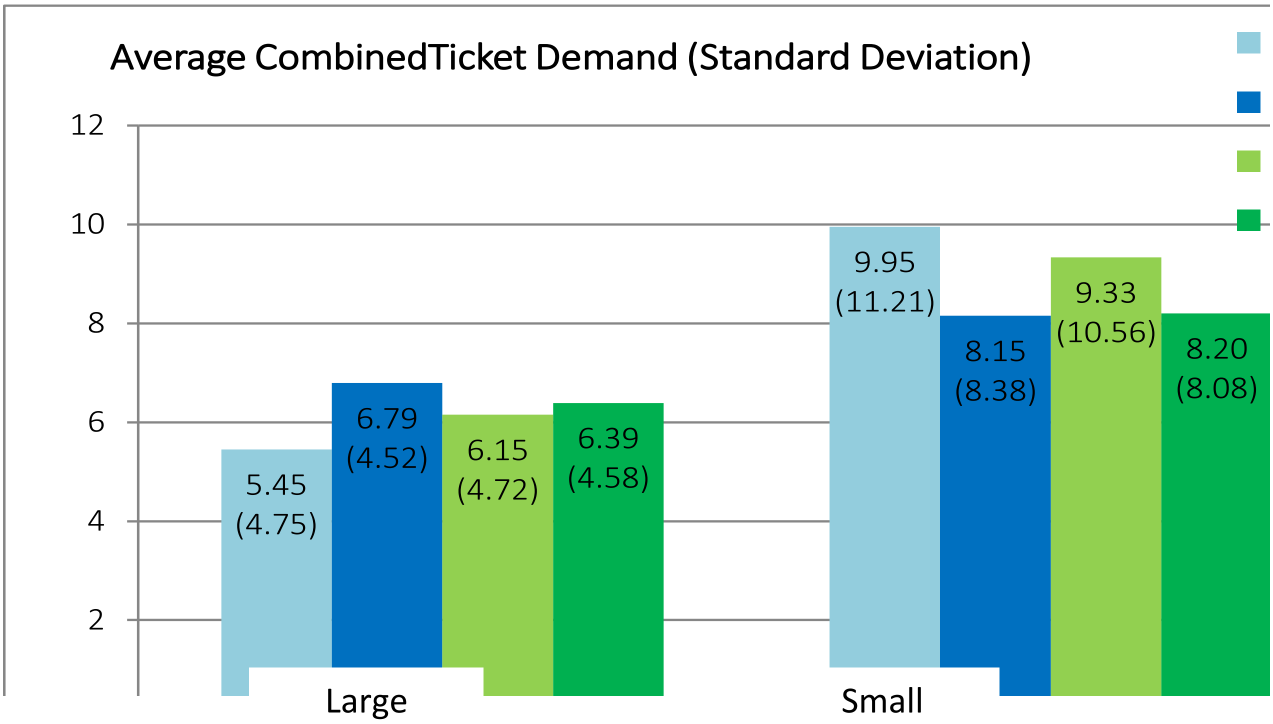
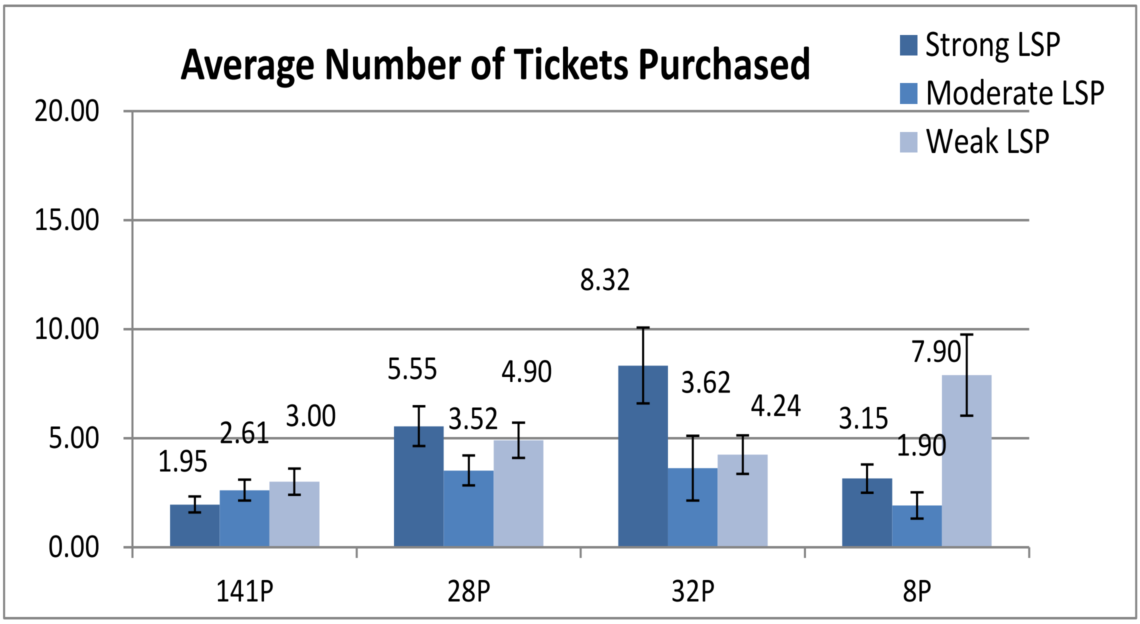


Figure 6a: *Average Number of Tickets Purchased – LSP Subjects*

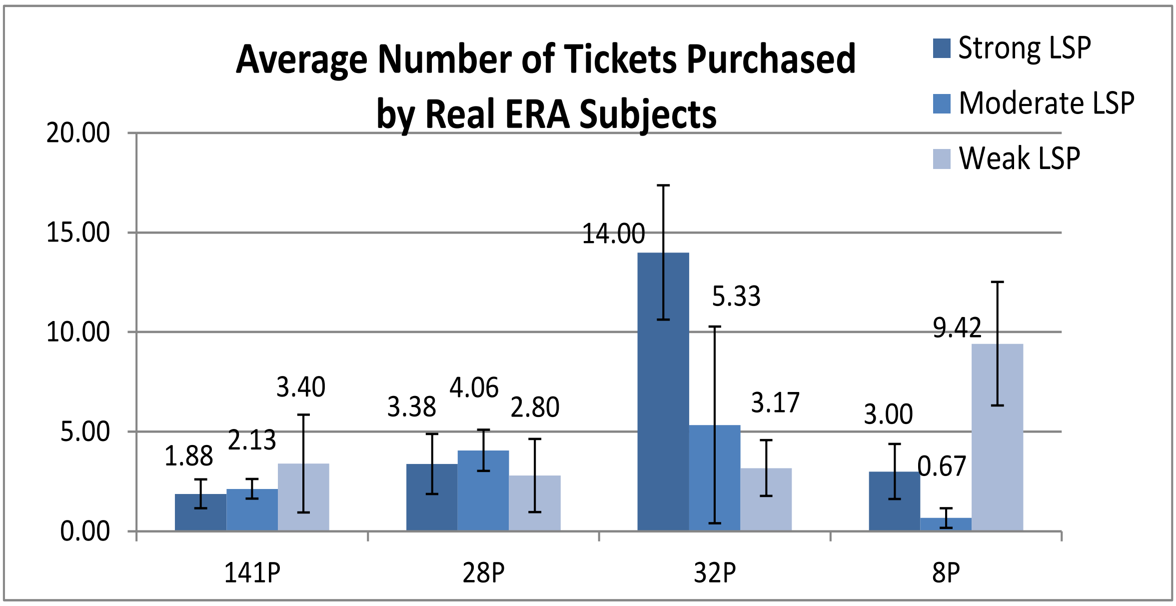


Number of Observations:

Strong LSP: 22, Moderate LSP: 33, Weak LSP: 29 in 141P session

Strong LSP: 34, Moderate LSP: 21 , Weak LSP: 29 in 32P x 4 sessions

Figure 6b: *Average Number of Tickets Purchased – LSP and ERA Subjects*

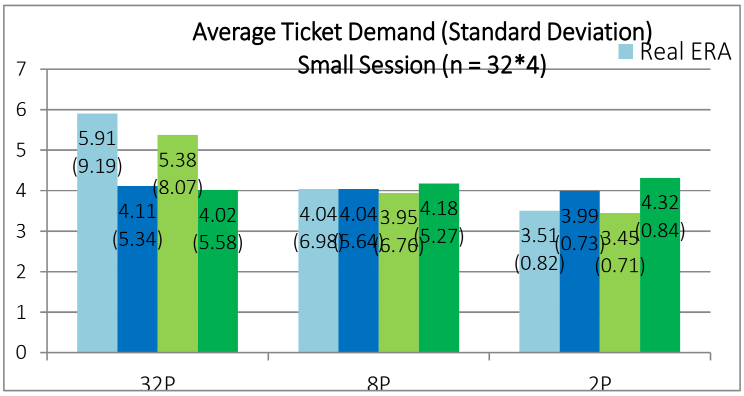


Number of Observations:

SLSP: 8, MLSP: 16 , WLSP: 5 in 141P session

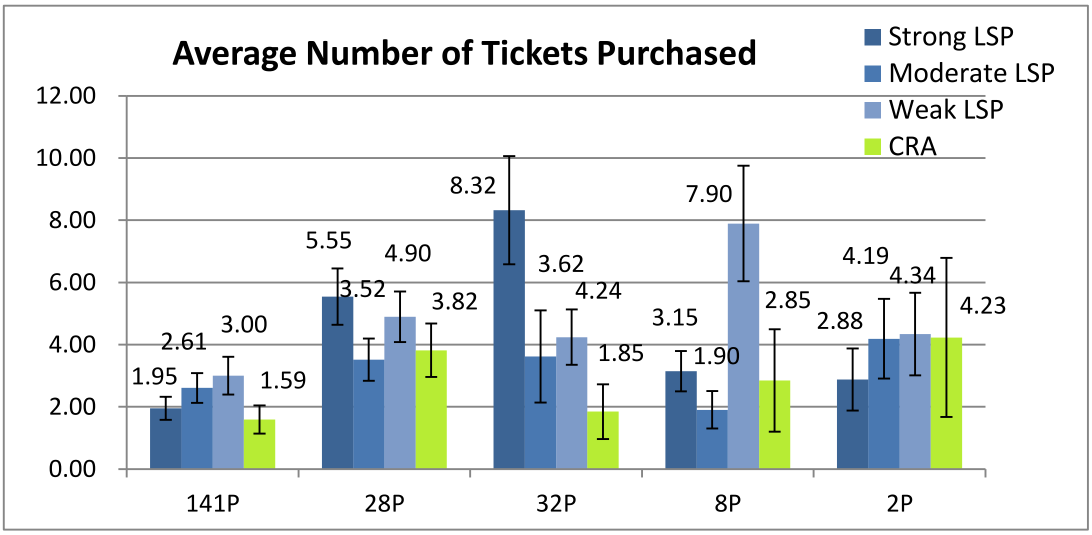
SLSP: 11, MLSP: 6 , WLSP: 12 in 32P x 4 sessions

Figure 7a: *Average Number of Tickets Purchased – ERA and ERS Subjects*

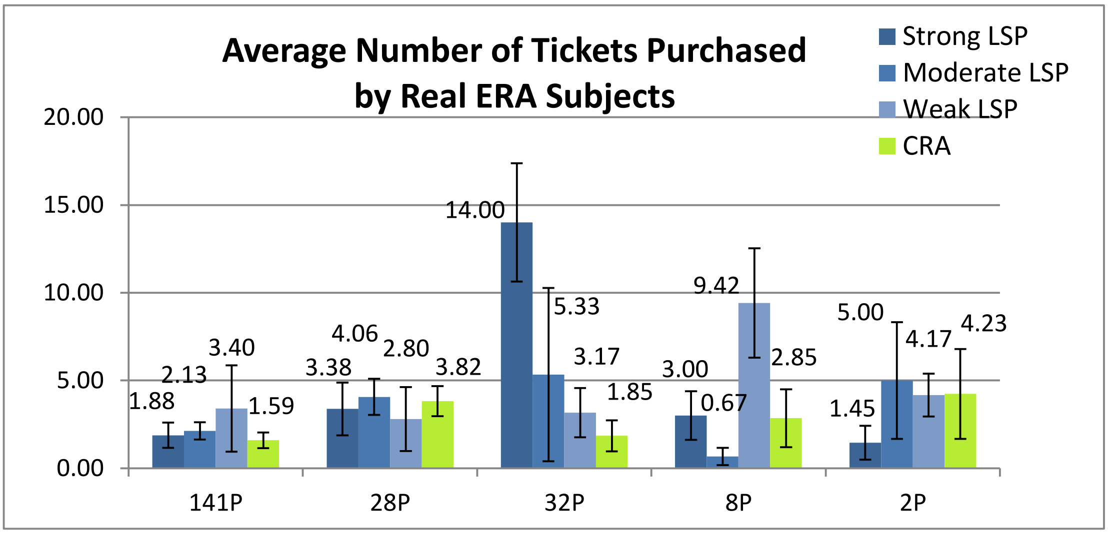


# of subjects	All	2p>0
Real_ERA	53	28
Real_ERS	75	50
Hypo_ERA	78	39
Hypo_ERS	50	39

Figure 7b: *Average Number of Tickets Purchased – LSP and CRA Subjects*



Number of Observations: SLSP: 22, MLSP: 33 , WLSP: 29 , CRA: 22 in 141P session
SLSP: 34, MLSP: 21 , WLSP: 29 , CRA: 13 in 32P x 4 sessions



Number of Observations: SLSP: 22, MLSP: 33 , WLSP: 29 , CRA: 22 in 141P session
SLSP: 34, MLSP: 21 , WLSP: 29 , CRA: 13 in 32P x 4 sessions

Tables:

Table 1: *Probabilities and outcomes in Question 1*

Lottery	Probability	Receiving	Probability	Paying
Sr	1	0		
Rr	½	100 yen	½	-100 yen
Sh	1	0		
Rh	½	10,000 yen	½	-10,000 yen

r represents choices entailing real outcome.
h represents choices entailing hypothetical outcome.

Table 2: *Probabilities and outcomes along constant EV line in Question 5*

Lottery	Probability	Receiving	Probability	Paying
A	1	0		
B	½	50 yen	½	50 yen
C	1/10	450 yen	9/10	50 yen
D	1/100	4,950 yen	99/100	50 yen
E	1/1000	49,950 yen	999/1000	50 yen

Table 3: Outcome and probability parameters in the probability triangle

	x_h	x_m	x_ℓ
Real	100 yen	0	-80 yen
Hypothetical	10,000 yen	0	-8,000 yen
Choice	p_h	p_m	p_ℓ
A_1	0.8	0.2	0
B_1	0.9	0	0.1
A_2	0	1	0
B_2	0.1	0.8	0.1
A_3	0	0.2	0.8
B_3	0.1	0	0.9

Table 4: *Map of Attitude towards Even-Chance Real Risk and Hypothetical Risk*

			Real	
			ERA	ERS
Large	Hypo	ERA	46	34
		ERS	10	49
S1-S4 Combined	Hypo	ERA	51	27
		ERS	2	48
Total	Hypo	RA	97	61
		RP	12	97

Table 5: *Map of CRA/CRS and ERA/ERS– All Sessions Combined*

	CRA	CRS	others	Total
Real ERS	10	70	80	160
	(29%)	(80%)	(54%)	(59%)
Real ERA	25	17	67	109
	(71%)	(20%)	(46%)	(41%)
Total	35	87	147	269
	(13%)	**(32%)**	**(55%)**	**(100%)**
Hypo ERS	5	46	60	111
	(14%)	(53%)	(41%)	(41%)
Hypo ERA	30	41	87	158
	(86%)	(47%)	(59%)	(59%)
Total	35	87	147	269

Table 6: *Linking Allais to LSP*

Number of subjects (ratio of each column within the same row)

	All	Strong LSP	Moderate LSP	Weak LSP	**CRA**
Allais	128	24(0.19)	26(0.20)	30(0.23)	16(0.13)**
	144	30(0.21)	31(0.22)	30(0.21)	17(0.12)***
EU	71	14(0.20)	18(0.25)	17(0.24)	7(0.10)**
	66	12(0.18)	12(0.18)	19(0.29)**	9(0.14)
Reverse Allais	35	9(0.26)	5(0.14)	7(0.20)	6(0.17)
	32	8(0.25)	6(0.19)	6(0.19)	4(0.13)
Others	35	9(0.26)	5(0.14)	4(0.11)	6(0.17)
	27	6(0.22)	5(0.19)	3(0.11)	5(0.19)

#: The upper row of each preference type is based on the real choice situations, and the lower row on the hypothetical choice situations
**: Different from random occurrence rate 0.2 at less than 5% significance level by binomial test.
***: Different from random occurrence rate 0.2 at less than 1% significance level by binomial test.

Table 7*: Number of Subjects with Positive Demand*

		Large Session				Small Sessions		
	N	141P > 0	28P > 0	141P+28P >0	N	32P > 0	8P > 0	32P+8P > 0
Real ERA	57	36	40	56	53	33	25	39
Real ERS	84	57	71	84	75	51	52	60
Hypo ERA	80	52	61	80	78	49	40	57
Hypo ERS	60	41	50	60	50	35	37	42

N: total number of subjects of each preference type.

Table 8*: Tobit Regression Analyses with robust standard errors on Total Ticket Demand for Sweepstakes*

	Tobit (UL = 13)		Probit		Tobit (UL = 33)		Probit	
Dependent Var.	141P + 28P		=1, if 141P+ 28P >0		32P + 8P + 2P		=1, if 32P+8P+2P >0	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(3)	(4)
SLSP	4.89***	4.39**	4.65***	0.63	0.43	3.66	-0.01	0.53
	(1.86)	(1.98)	(0.27)	(0.60)	(3.26)	(4.59)	(0.52)	(0.68)
MLSP	1.28	1.51	-0.09	0.51	-2.20	0.36	0.18	4.58***
	(1.64)	(1.50)	(0.43)	(0.51)	(2.91)	(3.38)	(0.63)	(0.46)
WLSP	4.36***	6.69***	4.65***	4.70***	6.32*	5.58	0.38	4.49***
	(1.61)	(1.91)	(0.27)	(0.28)	(3.62)	(4.50)	(0.62)	(0.45)
CRA	0.84	0.18	-0.25	-0.30	-2.46	-3.27	-0.57	-0.79
	(1.46)	(1.59)	(0.38)	(0.41)	(4.72)	(4.38)	(0.56)	(0.54)
Real ERA	-0.11		-0.16		-1.05		0.01	
	(1.38)		(0.37)		(3.53)		(0.55)	
SLSP*Real ERA	-4.31		-4.15***		5.92		0.08	
	(2.80)		(0.68)		(6.19)		(0.85)	
MLSP*Real ERA	0.26		0.97		1.59		-0.65	
	(2.24)		(0.70)		(7.11)		(1.09)	
WLSP*Real ERA	-2.61		-5.05***		-2.89		-0.26	
	(3.37)		(0.68)		(6.55)		(0.91)	
Hypo ERA		1.77		0.08		1.03		0.51
		(1.44)		(0.41)		(3.18)		(0.55)
SLSP*Hypo ERA		-2.44		0.00		-1.97		-0.90
		(2.90)		--		(5.89)		(0.82)
MLSP*Hypo ERA		-0.69		0.02		-4.28		-5.51***
		(2.24)		(0.69)		(5.59)		(0.83)
WLSP*Hypo ERA		-5.70***		-4.42***		-1.03		-4.77***
		(2.66)		(0.59)		(6.21)		(0.76)
Session1					3.86	4.24*	0.89*	0.98**
					(2.45)	(2.30)	(0.49)	(0.51)
Session2					12.29***	12.10***	0.15	0.14
					(3.48)	(3.51)	(0.35)	(0.40)
Session3					7.27	7.67***	0.44	0.64
					(3.00)	(2.78)	(0.48)	(0.48)
_cons	5.08***	4.24***	0.81***	0.71***	6.76***	5.63**	0.93**	0.64
	(1.01)	(0.88)	(0.27)	(0.28)	(2.15)	(2.40)	(0.41)	(0.47)
Num. of Observation	141	141	141	141	128	128	128	128
R2								
Log Likelihood	-379.18	-378.71	-51.87	-55.67	-453.55	-454.32	-41.97	-39.07

-- : omitted

#: Model (1) and (3) use data which are conditional on Allais type based on choices with real payments, and model (2) and (4) use data conditional on Allais type based on choices with hypothetical payments.

* denotes significantly different from zero at the ten-percent level, ** denotes significantly different from zero at the five-percent level, and *** denotes significantly different from zero at the one-percent level.

*6 denotes significantly different from zero at the six-percent level.

Table 9a*: Regression (OLS) Analyses with robust standard errors on the Difference in Demand between 141P and 28P size Sweepstakes*

	All Data				Conditional on Allais#			
	OLS		Probit		OLS		Probit	
Dependent Var.	141P – 28P		=1, if 141P – 28P>0		141P – 28P		=1, if 141P – 28P>0	
Model	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
SLSP	-4.09***	-3.56**	-4.31***	-3.91***	-4.22*	-4.71***	0.00	0.00
	(1.39)	(1.48)	(0.44)	(0.54)	(2.26)	(1.86)	--	--
MLSP	0.75	0.56	0.40	0.69	1.28	-0.65	-0.68	0.17
	(1.48)	(1.24)	(0.55)	(0.72)	(2.42)	(1.30)	(0.95)	(0.95)
WLSP	-1.72	-2.19	0.60	1.19*	0.15	-1.25	-0.43	1.27
	(1.48)	(1.93)	(0.55)	(0.72)	(2.42)	(2.26)	(0.86)	(1.00)
CRA	-0.91	-0.87	-0.18	-0.34	-1.87	0.01	0.00	0.00
	(0.93)	(1.11)	(0.55)	(0.54)	(1.94)	(1.83)	--	--
Real ERA	-1.05		-0.40		-0.27		-1.50	
	(0.87)		(0.54)		(1.61)		(0.97)	
SLSP*Real ERA	4.34**		4.44***		3.02		0.00	
	(2.13)		(0.82)		(3.47)		--	
MLSP*Real ERA	-0.94		0.44		-0.85		1.75	
	(1.97)		(0.76)		(3.14)		(1.24)	
WLSP*Real ERA	4.07		0.07		-0.59		0.00	
	(3.52)		(0.99)		(2.13)		--	
Hypo ERA		-0.68		0.81		-1.32		0.00
		(0.93)		(0.60)		(1.53)		(0.92)
SLSP*Hypo ERA		2.22		3.50***		2.57		0.00
		(2.17)		(0.86)		(2.77)		--
MLSP*Hypo ERA		-0.36		-0.22		2.51		0.33
		(1.93)		(0.83)		(2.26)		(1.21)
WLSP*Hypo ERA		2.96		-0.77		3.29		0.00
		(2.50)		(0.87)		(3.20)		(1.31)
_cons	-0.69	-0.81*	-0.69*	-1.37***	-1.28	-0.92	0.43	-0.84
	(0.77)	(0.48)	(0.42)	(0.53)	(1.49)	(0.64)	(0.76)	(0.65)
Num. of Observation	141	141	82	82	68	81	31	34
R2	0.08	0.06			0.10	0.14		
Log Likelihood			-44.48	-43.39			-19.24	-20.19

-- omitted

#: Model (1) and (3) use data which are conditional on Allais type based on choices with real payments, and model (2) and (4) use data conditional on Allais type based on choices with hypothetical payments.

* denotes significantly different from zero at the ten-percent level, ** denotes significantly different from zero at the five-percent level, and *** denotes significantly different from zero at the one-percent level.

*6 denotes significantly different from zero at the six-percent level.

Table 9b*: Regression (OLS) Analyses with robust standard errors on the Difference in Demand between 32P and 8P size Sweepstakes*

	All Data				Conditional on Allais#			
	OLS		Probit		OLS		Probit	
Dependent Var.	32P - 8P		=1, if 32P - 8P>0		32P - 8P		=1, if 32P - 8P>0	
Model	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
SLSP	4.26**	3.25	1.31***	1.59**	5.58**	4.97	0.15	0.06
	(1.85)	(2.83)	(0.53)	(0.69)	(2.69)	(5.74)	(0.71)	(1.01)
MLSP	1.85	0.08	1.01*	0.87	1.05	1.76	1.15	5.62***
	(1.43)	(2.09)	(0.57)	(0.70)	(2.30)	(2.04)	(0.94)	(0.64)
WLSP	-0.50	0.28	1.54***	6.22***	4.08**	7.17***	1.28	5.99***
	(2.69)	(3.18)	(0.62)	(0.59)	(1.93)	(2.14)	(0.94)	(0.86)
CRA	-3.32	-1.54	0.04	0.25	-0.42	0.53	7.16***	0.60
	(2.45)	(1.89)	(0.60)	(0.56)	(3.82)	(1.82)	(0.94)	(0.81)
Real ERA	4.67^{*6}		0.57		3.04		-5.80***	
	(2.41)		(0.57)		(3.67)		(0.69)	
SLSP*Real ERA	4.32		-0.31		-0.91		5.69***	
	(5.58)		(0.84)		(6.93)		(1.05)	
MLSP*Real ERA	-0.64		-1.42		3.87		3.78***	
	(5.18)		(0.91)		(7.88)		(1.27)	
WLSP*Real ERA	-8.34*		-1.36		-8.53		4.76***	
	(5.04)		(0.87)		(5.83)		(1.15)	
Hypo ERA		2.36		0.35		2.92*		0.27
		(2.20)		(0.58)		(1.64)		(0.79)
SLSP*Hypo ERA		2.90		-0.66		-1.59		0.26
		(4.15)		(0.83)		(6.86)		(1.23)
MLSP*Hypo ERA		3.06		-0.46		1.58		-5.15***
		(3.88)		(0.92)		(2.79)		(0.99)
WLSP*Hypo ERA		-6.77		-5.80***		-4.71*		-5.32***
		(4.69)		(0.72)		(2.65)		(0.99)
Session 1	-0.36	0.33	0.48	0.49	0.05	-0.23	1.02	0.21
	(1.96)	(1.90)	(0.44)	(0.45)	(2.09)	(2.08)	(0.67)	(0.53)
Session 2	-3.14	-2.40	-0.43	-0.34	-1.07	-1.33	0.00	0.00
	(2.08)	(2.21)	(0.41)	(0.39)	(2.07)	(1.30)	(omitted)	(omitted)
Session 3	-0.63	-0.75	0.04	-0.21	0.55	-3.55**	0.82	-0.40
	(2.15)	(2.04)	(0.49)	(0.50)	(2.08)	(1.69)	(0.71)	(0.67)
_cons	-1.18	-0.66	-0.50	-0.43	-1.76	-1.58	-0.62	-0.38
	(0.75)	(1.73)	(0.37)	(0.43)	(1.37)	(1.83)	(0.64)	(0.67)
Num. of Observation	128	128	90	90	60	63	43	49
R2	0.21	0.18			0.20	0.20		
Log Likelihood			-53.45	-51.78			-22.62	-26.36

#: Model (1) and (3) use data which are conditional on Allais type based on choices with real payments, and model (2) and (4) use data conditional on Allais type based on choices with hypothetical payments.
* denotes significantly different from zero at the ten-percent level, ** denotes significantly different from zero at the five-percent level, and *** denotes significantly different from zero at the one-percent level.

Table 10: *Regression (Tobit and Probit) Analyses with robust standard errors on Demand for 2P size Sweepstakes*

	All Data				Conditional on Allais#			
	Tobit 2P		Probit =1, if 2P>0		OLS 2P		Probit =1, if 2P>0	
Model	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
SLSP	-1.37	-0.40	-0.84**	-0.83	-3.03**	-2.00	-0.98*	-0.84
	(1.37)	(2.29)	(0.43)	(0.54)	(1.28)	(1.71)	(0.60)	(0.88)
MLSP	-0.63	1.04	-0.58	0.67	-0.59	-1.35	-0.15	0.83
	(1.64)	(1.94)	(0.48)	(0.67)	(2.51)	(2.43)	(0.64)	(0.83)
WLSP	-0.27	-1.50	-0.66	-0.20	-2.94	-2.69	-0.39	0.06
	(2.17)	(1.76)	(0.46)	(0.60)	(1.80)	(2.21)	(0.61)	(0.82)
CRA	-1.66	-0.82	-0.47	-0.25	-2.43	-1.90	-0.86	-1.55
	(1.31)	(1.33)	(0.47)	(0.48)	(2.23)	(1.15)	(0.76)	(0.80)
Real ERA	-1.25		-0.51		-1.71		-0.32	
	(2.03)		(0.68)		(2.20)		(0.69)	
SLSP*Real ERA	1.45		-0.27		0.63		-0.45	
	(3.60)		(0.83)		(2.75)		(1.16)	
MLSP*Real ERA	-0.38		0.21		-0.47		-0.54	
	(2.73)		(0.69)		(5.60)		(1.17)	
WLSP*Real ERA	0.67		-0.70		0.45		-0.37	
	(2.53)		(0.51)		(3.57)		(1.02)	
Hypo ERA		-1.79		-0.23		-2.01		-0.14
		(2.58)		(0.68)		(1.62)		(0.63)
SLSP*Hypo ERA		-2.63		-2.19***		0.38		-0.20
		(2.87)		(0.88)		(1.91)		(1.07)
MLSP*Hypo ERA		1.59		-0.81		-2.48		-2.19*
		(2.86)		(0.73)		(2.88)		(1.14)
WLSP*Hypo ERA		0.02		-0.98**		-0.39		-1.97*
		(2.47)		(0.49)		(3.28)		(1.12)
Session 1	2.01**	1.64*	0.61*	0.40	2.19	1.66*	0.80*	0.30
	(1.03)	(0.94)	(0.35)	(0.35)	(1.34)	(0.89)	(0.47)	(0.46)
Session 2	5.44***	4.91***	0.89***	0.83**	5.34*	9.41***	omitted	omitted
	(1.91)	(1.74)	(0.34)	(0.36)	(2.97)	(0.79)		
Session 3	4.01***	4.09***	0.89**	1.15***	4.43**	5.59***	0.50	1.76***
	(1.27)	(1.18)	(0.38)	(0.37)	(1.80)	(1.32)	(0.51)	(0.60)
_cons	2.17**	2.22**	0.48	0.51	3.59***	3.60**	0.51	0.50
	(0.94)	(1.14)	(0.37)	(0.44)	(1.10)	(1.52)	(0.47)	(0.62)
Num. of Observation	128	128	128	128	60	63	58	62
R2								
Log Likelihood	-405.46	-405.27	-75.59	-69.80	-177.32	-166.60	-33.84	-31.32

#: Model (1) and (3) use data which are conditional on Allais type based on choices with real payments, and model (2) and (4) use data conditional on Allais type based on choices with hypothetical payments.
* denotes significantly different from zero at the ten-percent level, ** denotes significantly different from zero at the five-percent level, and *** denotes significantly different from zero at the one-percent level.

Table 11*: Regression (OLS and Probit) Analyses with robust standard errors on the Difference in Demand between 8P and 2P size Sweepstakes*

	All Data				All Data			
	OLS		Probit		OLS		Probit	
Dependent Var.	141P-28P data combined with 32P – 8P data		=1, if 141P-28P>0 or 32P – 8P>0		141P-28P data combined with 32P – 2P data		=1, if 141P-28P>0 or 32P – 2P>0	
Model	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
SLSP			0.56**				0.67***	
			(0.28)				(0.23)	
WLSP	-3.23**		0.54**	0.38	-1.16		0.44**	
	(1.33)		(0.28)	(0.25)	(1.16)		(0.22)	
CRA	-1.90**	-1.10	-0.46*	-0.60**	-2.09	-1.80	-0.30	-0.53**
	(0.92)	(0.91)	(0.28)	(0.27)	(1.32)	(1.28)	(0.27)	(0.25)
Session	2.56***	2.54***	-0.35*	-0.29*	2.76***	2.75***	-1.30***	-1.19***
	(0.90)	(0.91)	(0.18)	(0.18)	(0.97)	(0.97)	(0.18)	(0.17)
constant	-0.83	-1.62***	0.92***	1.04***	-1.22***	-1.51***	0.89***	1.08***
	(0.51)	(0.44)	(0.20)	(0.15)	(0.51)	(0.46)	(0.15)	(0.14)
Num. of Observation	269	269	269	269	269	269	269	269
R2	0.06	0.03			0.04	0.04		
F-value	5.69	4.22			3.78	5.51		
Log Likelihood			-123.61	-126.03			-142.59	-148.07

#: Model (1) and (3) use data which are conditional on Allais type based on choices with real payments, and model (2) and (4) use data conditional on Allais type based on choices with hypothetical payments.
* denotes significantly different from zero at the ten-percent level, ** denotes significantly different from zero at the five-percent level, and *** denotes significantly different from zero at the one-percent level.
In Model (1), independent variables SLSP and MLSP cannot survive partial F test
In Model (3), MLSP cannot survive partial F test..

STUDY OF CHOICE UNDER UNCERTAINTY

This is a study on choice under uncertainty. Various institutions have provided funds for the conduct of this research. You are being paid \1000 in cash as start-up money. Earnings (losses) will be added to (deducted from) this amount. The net balance is what you can take home. The instructions are simple. All you have to do is to indicate your preference in each choice situation. In each choice situation, depending on the choice you make and the realization of the uncertainty, you may receive or pay a specified amount of money.

Choice Situations: On the next two pages, you will be presented with 8 pairs of choices involving uncertainty. The 4 pairs on Page 2 are real while the other 4 pairs on Page 3 are hypothetical choice situations. At the end of this experiment, the outcome of each choice in the real situations (i.e., the 4 pairs on Page 2) will be determined by drawing a card from a deck of 10 cards. You will then receive from, or pay to, the experimenter the specified amount in cash according to the card that has been drawn and the choice that you have made.

Example: For Alternative **W**, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10. The same procedure will be done for Alternative **M** independently.

W: **Receiving \100** if #1 to #5 is drawn **Receiving \0** if #6 to #10 is drawn	**M**: **Receiving \200** if #1 to #6 is drawn **Paying \100** if #7 to #10 is drawn

Which would you prefer? Please **circle** your choice.

After all choices are submitted to the experimenter, the outcome of Alternative **W** and Alternative **M** will be independently determined by drawing a card randomly from a deck of 10 cards numbered from 1 to 10. For Alternative **W**, suppose the card drawn is Card #4. Card #4 is then put back to the deck of cards, which are reshuffled. One card is then drawn from the deck for Alternative **M**. Suppose it is Card #10.

Let us say that John has chosen Alternative **W**. Since Card #4 is drawn for Alternative **W**, John will receive \100 in cash from the experimenter. Suppose Mary's choice is Alternative **M**. Since Card #10 is drawn for Alternative **M**, Mary has to pay \100 in cash to the experimenter.

Now, let's have a dry run. In the above example, please circle your preferred alternative.

Then, let’s determine the outcome. (The experimenter draws cards for Alternative **W** and Alternative **M** independently.)

If your choice is **W**, you will ____________________ ________.

(“receive” or “pay”?) (amount)

If your choice is **M**, you will ____________________ ________.

(“receive” or “pay”?) (amount)

Did you figure out the consequence correctly? If not, and you still do not understand how it was determined, please ask the experimenter for clarification.

REAL CHOICE SITUATIONS

1. For Alternative **W**, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving** **0** for sure	**W**: **Receiving \100** if #1 to #5 is drawn **Paying \100** if #6 to #10 is drawn

Which would you prefer? Please **circle** your choice.

2. For either alternative, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving \100** if #1 to #9 is drawn **Receiving** \8**0** if #10 is drawn	**W**: **Receiving \100** if #1 to #8 is drawn **Paying \0** if #9 or #10 is drawn

*Which would you prefer? Please **circle** your choice.*

3. For Alternative **W**, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving** **0** for sure	**W**: **Receiving \100** if #1 is drawn **Receiving** **0** if #2 to #9 is drawn **Paying \80** if #10 is drawn

Which would you prefer? Please **circle** your choice.

4. For either alternative, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving \100** if #1 is drawn **Paying \80** if #2 to #10 is drawn	**W**: **Receiving \0** if #1 or #2 is drawn **Paying \80** if #3 to #10 is drawn

WHICH WOULD YOU PREFER? PLEASE CIRCLE YOUR CHOICE.

HYPOTHETICAL CHOICE SITUATIONS

1. For Alternative **W**, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving 0** for sure	**W**: **Receiving \10,000** if #1 to #5 is drawn **Paying \10,000** if #6 to #10 is drawn

Which would you prefer? Please **circle** your choice.

2. For either alternative, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving \10,000** if #1 to #9 is drawn **Paying \8,000** if #10 is drawn	**W**: **Receiving \10,000** if #1 to #8 is drawn **Receiving** **0** if #9 or #10 is drawn

*Which would you prefer? Please **circle** your choice.*

3. For Alternative **W**, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving** **0** for sure	**W**: **Receiving \10,000** if #1 is drawn **Receiving** **0** if #2 to #9 is drawn **Paying \8,000** if #10 is drawn

Which would you prefer? Please **circle** your choice.

4. For either alternative, a card will be drawn at random from a deck of 10 cards numbered from 1 to 10.

M: **Receiving \10,000** if #1 is drawn **Paying \8,000** if #2 to #10 is drawn	**W**: **Receiving** **0** if #1 or #2 is drawn **Paying \8,000** if #3 to #10 is drawn

WHICH WOULD YOU PREFER? PLEASE CIRCLE YOUR CHOICE.

HYPOTHETICAL CHOICE SITUATIONS (continued)

5. Consider the 5 alternatives below:

A:	**Receiving** 0 for sure

	½ chance of **receiving** \50
B:	
	½ chance of **paying** \50

	1/10 chance of **receiving** \450
C:	
	9/10 chance of **paying** \50

	1/100 chance of **receiving** \4,950
D:	
	99/100 chance of **paying** \50

	1/1000 chance of **receiving** \49,950
E:	
	999/1000 chance of **paying** \50

(a) Is there a **most preferred** alternative (i.e., an alternative which you consider better than each of the other 4 alternatives)? Please circle your answer:

Yes or **No**

If you have circled **Yes** above, please circle your **most preferred** alternative:

A B C D E

(b) Is there a **least preferred** alternative (i.e., an alternative which you consider worse than each of the other 4 alternatives)? Please circle your answer:

Yes or **No**

If you have circled **Yes**, please circle your **least preferred** alternative:

A B C D E

Rules of Our Lotteries

You are one of the **25** participants in **Group A**. These 25 participants are divided equally into five colors: **Blue**, **Grey**, **Orange**, **Pink**, and **Yellow**. Having this sheet in the pink color, you belong in the **Pink** sub-group.

For **Group A**, we are setting up **6** lotteries. One is called the **White Lottery**. The other five are named by their respective colors: **Blue**, **Grey**, **Orange**, **Pink**, and **Yellow**.

The price of a lottery ticket is the same, **\20**, for all lotteries.

Each of **Group A** participants is eligible to purchase tickets for the **White Lottery** and the color lottery that matches the color of his/her Settlement Sheet. In your case, it is the **Pink Lottery**. In other words, you can (but do not have to) buy lottery tickets for the **White Lottery** and the **Pink Lottery**. You are not eligible to purchase tickets for any other color lotteries.

For each lottery, **White** or **Color**, **only one** winning ticket will be drawn. The prize will be **90%** of the sales proceeds for that lottery. That is, for every \20 paid for a ticket, **\18** (i.e., 90%) will be pooled into **one single prize**. For example, if the total number of tickets sold for a particular lottery is **N**, the prize for the single winning ticket for that lottery will be **18N yen**.

White Lottery: Every one of you in Group A can purchase tickets for this lottery.

Pink Lottery: Only those in Group A with pink Settlement Sheet can purchase tickets for this lottery.

If you have purchased X **White Lottery** tickets and Y **Pink Lottery** tickets (X and Y are numbers ranging from 0 to 23 with $X+Y \leq 23$), we will do the following at the end of the experiment. We will randomly assign X **White Lottery** tickets and Y **Pink Lottery** tickets to you, record on your Settlement Sheet the numbers of these tickets, put the tickets of the same color into the same box. Then, the single winning ticket for each color (i.e., **Blue, Grey, Orange, Pink, Yellow** and **White**) will be drawn. You are welcome to stay and witness the entire process.

The **prize monies** will be available **in cash** immediately after the draws. However, for the purpose of our study, it is necessary not to publicly reveal the identity of the winner. Therefore, the winners will be notified by email and their student numbers will be posted on ENB as soon as possible. The winner should claim the prize money from the Department of Economics no later than 5:00 p.m. Any prize that is not claimed after this time will be forfeited.

Important Notes:

a. You do not have to buy any tickets for either of the two lotteries that you are allowed to participate in.

b. The **total number** of tickets that you purchase **must not exceed 23**.

Now, please fill out the bottom part of the Settlement Sheet.