Choosing the Right Gambling Partner: Experimental Evidence

Daniela Di Cagno  Emanuela Sciubba
Luiss - Guido Carli University of Rome  Birckbeck College

Marco Spallone
G. D’Annunzio University of Chieti and Pescara

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Abstract

In this paper we investigate the behavior of economic agents facing situations in which they are required to team up with other agents. In particular, we consider the case in which the future decisions of partners, albeit independently taken, affect the cumulative returns that they are committed to share: for example, the case of group-lending programs, hiring decisions, M&A decisions, and so on. We consider the case in which the future decisions of partners, albeit independently taken, affect the cumulative returns that they are committed to share: for example, the case of group-lending programs, hiring decisions, M&A decisions, and so on. We setup a simple theoretical model and we tested it through a computerized lab experiment. In our model economic agents decide individually and independently how to allocate their wealth over a portfolio of lotteries, thus making decisions under risk. We consider both the case in which agents act as individual decision makers and the case in which they act strategically being part of a two-person group. In this case they are allowed to choose their partners and are fully committed to share group cumulative payoffs with their gambling partners. Our model predicts that: 1) agents choose to team up
with similar agents (i.e., agents with the same degree of risk aversion) in homogeneous groups, and 2) agents make riskier decisions if they belong to a homogeneous group with respect to the decisions they make as single decision maker, thus exploiting the benefits of mutual insurance. Our experiment, run over a sample of 210 undergraduate Luiss-Guido Carli students, confirmed our theoretical predictions.

1. Introduction

Many microcredit programs are group-lending programs: in most cases, group lending programs imply joint liability with full commitment. In other words, even if the decisions of each group member (for example, the choice of an investment project among a set of available options) are independent, they substantially affect the payoff of other group members. Moreover, the group formation process can be either bottom-up (endogenous), when entrepreneurs form a group in order to access credit, or top down (exogenous), when entrepreneurs that ask for credit individually are randomly grouped together by microcredit institutions. Are individual decisions affected by the interaction with other group members? What kind of partners would entrepreneurs choose if they are allowed to? Is it optimal to let entrepreneurs choose their own partners?

These are the questions that this article tries to answer; obviously, microcredit group-lending programs are just an example. The same questions arise anytime an economic agent must team up with another one whose future decisions, albeit independently taken, will affect the cumulative returns that they are committed to share: for example, the same questions arise for hiring decisions, M&A decisions, and so on.

In order to answer the questions stated above, we setup a simple theoretical model and we tested it through a computerized lab experiment. In our model economic agents decide individually and independently how to allocate their wealth over a portfolio of lotteries, thus making decisions under risk. We consider both the case in which agents act as individual decision makers and the case in which they act strategically being part of a two-person group. In this case they are fully committed to share group cumulative payoffs with their gambling partners.

In the strategic case agents are allowed to choose their partners among a population of heterogeneous agents, their heterogeneity being due to different risk attitudes. Our model predicts that: 1) agents choose to team up with similar agents (i.e., agents with the same degree of risk aversion) and 2) agents make
riskier decisions if they belong to a homogeneous group (i.e., a group formed by
two agents with the same degree of risk aversion) with respect to the decisions they
make as single decision maker, thus exploiting the benefits of mutual insurance.
These results are driven by the assumption that lotteries are independent and
represent the theoretical predictions against which we evaluate our experimental
findings. We briefly discuss the case in which lotteries are correlated, postponing
a detailed analysis to a follow-up paper.

Our experiment, run over a sample of 210 undergraduate Luiss-Guido Carli
students, confirmed our theoretical predictions.

At first glance, our paper seems to find its reference in the experimental eco-
monic literature on group decisions. However, this literature investigates the
reasons why group decisions differ from individual decisions, considering the case
in which group members do not act as single independent decision makers: groups
are more rational than single individuals ([2]), groups make efficient use of informa-
tion ([1]), and groups are less risk averse than individuals ([3]). Actually, we
think that our contribution is closer to the economic literature on networks that
is concerned with issues such as homophily and similarity (...). In particular, we
think that our paper provides an economic rationale to the assumption that net-
work formation is boosted when network members display similar characteristics.

Four sections and an appendix follow this introduction. In the first one we de-
scribe the theoretical model and derive our predictions; in the second we describe
the experimental design; in the third we illustrate the experimental results; finally,
in the fourth we summarize our findings and suggest some possible extension of
our research. The Appendix contains the instructions that we provided to our
experimental subjects.

2. Theoretical Predictions

In this section we model a simple theoretical framework. The theoretical predic-
tions that we derive from this model represent the benchmark against which we
will test our experimental results.

This section is divided into three subsections: in the first one we describe
the basic model; in the second one we analyze individual decisions; finally, in
the third one we introduce strategic interaction (i.e., we setup a game theoretical
model) and we derive equilibrium results under the assumption that individuals
are allowed to choose their gambling partners.
2.1. The model

Agents are endowed with one unit of capital which they must allocate to a portfolio of lotteries. There are two lotteries available: the first one is a binary risky lottery that for each unit invested returns $r > 1$ with probability $p$ and zero with probability $(1 - p)$; the second one is a degenerate lottery that returns 1 for each unit of capital invested (it is a storage technology). We assume that the risky lottery has a (strictly) higher expected return that the degenerate lottery, so to be appealing also to risk averse investors. As for agents’ preferences we assume that they are of the expected utility form, with Bernoulli utility functions over wealth $u(w, \theta)$ where $\theta$ is a risk aversion parameter. We assume that utility is monotonically increasing and strictly concave in wealth. We normalise the Bernoulli utility function so that $u(0, \theta) = 0$. Formally:

**Assumption 1.** The risky lottery has larger expected return than the degenerate lottery: $pr > 1$.

**Assumption 2.** Individual utilities over wealth $u(w, \theta)$ are such that $\frac{\partial u(w, \theta)}{\partial w} > 0$, $\frac{\partial^2 u(w, \theta)}{\partial w^2} < 0$, and $u(0, \theta) = 0$.

Agents are heterogeneous in their risk aversion parameter. In particular, if the risk aversion parameter ranges between a lower bound $\underline{\theta}$ and an upper bound $\bar{\theta}$, agents’ risk preferences are distributed on a double continuum between $\underline{\theta}$ and $\bar{\theta}$. This assumption guarantees that, for each risk aversion parameter $\hat{\theta}$, there are two (and no more than two) agents with preferences represented by $u(w, \hat{\theta})$. We index agents by $i = 1, 2, \ldots$ and hence denote agent $i$’s utility function by $u(w, \theta_i)$.

2.2. Individual decisions

Denote by $(x, y)$ a portfolio of lotteries, where $x \in [0, 1]$ and $y = (1 - x)$ are the portfolio weights in the risky and degenerate lotteries respectively. It follows that the expected utility of agent $i$ is equal to:

$$pu(xr + 1 - x, \theta_i) + (1 - p)u(1 - x, \theta_i)$$

Standard expected utility maximisation implies that the optimal portfolio weight in the risky lottery $x^*(\theta_i)$ satisfies the following first order condition:

$$p(r - 1)\frac{\partial u}{\partial w}(x^*r + 1 - x^*, \theta_i) = (1 - p)\frac{\partial u}{\partial w}(1 - x^*, \theta_i)$$  \hspace{1cm} (1)
It is easy to show that under the assumption of strict concavity of the utility function the solution to the maximisation problem \( x^*(\theta_i) \) is unique. Also, as long as \( pr > 1 \) a risk averse agent will choose \( x^*(\theta_i) > 0 \).

**Proposition 1.** Under assumptions 1 and 2, there exists a unique solution \( x^*(\theta_i) \) to the maximisation problem (1). Also, \( x^*(\theta_i) > 0 \).

**Proof.** Consider the first order condition (1):

\[
p(r - 1) \frac{\partial u}{\partial w}(x^*r + 1 - x^*, \theta_i) - (1 - p) \frac{\partial u}{\partial w}(1 - x^*, \theta_i) = 0
\]

Differentiating the left hand side with respect to \( x^* \) gives:

\[
p(r - 1)^2 \frac{\partial^2 u}{\partial w^2}(x^*r + 1 - x^*, \theta_i) + (1 - p) \frac{\partial^2 u}{\partial w^2}(1 - x^*, \theta_i) < 0
\]

Given that the left hand side of (1) is a monotonically decreasing function, the value of \( x^*(\theta_i) \) is unique. Next we prove that \( x^*(\theta_i) > 0 \). We proceed by way of contradiction. Suppose that \( x^*(\theta_i) = 0 \), then condition (1) becomes:

\[
p(r - 1) \frac{\partial u}{\partial w}(1, \theta_i) - (1 - p) \frac{\partial u}{\partial w}(1, \theta_i) = 0
\]

which cannot hold when \( pr > 1 \) (assumption 1).

Next we assume that agents’ preferences are such that the relationship \( x^*(\theta_i) \) between individual portfolio choice and risk aversion parameter is one-to-one (bijective). Proposition 1 already establishes that for each value of \( \theta_i \) we obtain one and only one optimal portfolio composition \( x^* \). We further assume that for each portfolio composition \( x^* \) there is only one value of risk aversion parameter such that the portfolio is indeed optimal.

**Assumption 3.** The function \( x^*(\theta) \) admits an inverse \( x^{-1}(x(\theta)) = \theta \).

Some notable functional forms satisfy the requirement posed by assumption 3. In particular, the cases of constant absolute risk aversion and of constant relative risk aversion.

**Example 1.** Consider the case of constant absolute risk aversion:

\[
u(w, \theta) = -e^{-\theta w}
\]
First order condition for an optimum portfolio composition gives:

\[ p(r - 1)\theta e^{-\theta (xr + 1 - x)} = (1 - p)\theta e^{-\theta (1 - x)} \]

Hence optimal investment in risky lottery is equal to:

\[ x^*(\theta) = \frac{\log \frac{p(r-1)}{1-p}}{\theta r} \]

This function admits an inverse:

\[ \theta(x) = \frac{\log \frac{p(r-1)}{1-p}}{xr} \]

Example 2. Consider the case of constant relative risk aversion:

\[ u(w, \theta) = \frac{w^{1-\theta}}{1-\theta} \]

First order condition for an optimum portfolio composition gives:

\[ p(r - 1)(xr + 1 - x)^{-\theta} = (1 - p)(1 - x)^{-\theta} \]

Hence optimal investment in risky lottery has to satisfy:

\[ \frac{1 - x}{xr + 1 - x} = \left( \frac{p(r - 1)}{1 - p} \right)^{\frac{1}{\theta}} \]

Notice that the expression on the left hand side is monotone in \( x \). Hence there is only one value for \( x \) given \( \theta \) and vice versa.

The role of assumption 3 is that it will be possible to infer each agent’s preferences from their individual risky choice.

2.3. Strategic Interaction

Assume now that agents choose a gambling partner prior to making any investment decisions. If two agents \( i \) and \( j \) are gambling partners, they both decide simultaneously and independently on their preferred portfolio allocation over the two available lotteries. Any winnings are equally shared across gambling partners. We assume that the outcomes of the risky lotteries in which agents \( i \) and \( j \) invest
are independent. Under this assumption, expected utility of agent $i$ when agent $j$’s portfolio weight in the risky lottery is $x_j$ is equal to:

$$p^2 u \left( \frac{x_ir + (1 - x_i) + x_jr + (1 - x_j)}{2}, \theta_i \right) + p(1 - p) u \left( \frac{x_ir + (1 - x_i) + (1 - x_j)}{2}, \theta_i \right) +$$

$$+ p(1 - p) u \left( \frac{(1 - x_i) + x_jr + (1 - x_j)}{2}, \theta_i \right) + (1 - p)^2 u \left( \frac{(1 - x_i) + (1 - x_j)}{2}, \theta_i \right)$$

The game is in two stages. In the first stage, agent $i$ chooses a gambling partner. In the second stage, the two gambling partners decide how to allocate their endowment across the two lotteries. At the end of the second stage, any uncertainty is revealed and payoffs are distributed.

We can show that this game admits a unique Subgame Perfect Nash Equilibrium (SPNE) where in the first stage agents choose a gambling partner with equal preferences over risky outcomes and in the second stage partners invest more in the risky lottery than they would if they were investing individually.

**Lemma 1.** Optimal gambling partner choice is such that $\theta_j = \theta_i$.

**Proof.** We solve for Subgame Perfect Nash Equilibria (SPNE). Hence we proceed backwards. In the second stage agent $i$ chooses her optimal investment in the risky lottery $x_i(x_j)$, given her own risk aversion parameter $\theta_i$ and given the choice of her partner $x_j(\theta_j)$. For notational convenience denote by $x_i$ and $x_j$ agents $i$ and $j$’s choices respectively. For any given choice of agent $j$, $x_j$, the optimal investment in the risky lottery by agent $i$ solves:

$$p^2 \frac{\partial u}{\partial w} \left( \frac{x_ir + (1 - x_i) + x_jr + (1 - x_j)}{2}, \theta_i \right) \frac{r - 1}{2} +$$

$$+ p(1 - p) \frac{\partial u}{\partial w} \left( \frac{x_ir + (1 - x_i) + (1 - x_j)}{2}, \theta_i \right) \frac{r - 1}{2} +$$

$$= p(1 - p) \frac{\partial u}{\partial w} \left( \frac{(1 - x_i) + x_jr + (1 - x_j)}{2}, \theta_i \right) \frac{1}{2} +$$

$$+ (1 - p)^2 \frac{\partial u}{\partial w} \left( \frac{(1 - x_i) + (1 - x_j)}{2}, \theta_i \right) \frac{1}{2}$$
Similarly, agent $j$ takes agent $i$'s investment choice as given and solves:

$$
p^2 \frac{\partial u}{\partial w} \left( \frac{x_i r + (1 - x_i) + x_j r + (1 - x_j)}{2}, \theta_j \right) \frac{r - 1}{2} +
$$

$$
+p(1 - p) \frac{\partial u}{\partial w} \left( \frac{x_i r + (1 - x_i) + (1 - x_j)}{2}, \theta_j \right) \frac{r - 1}{2} +
$$

$$
= p(1 - p) \frac{\partial u}{\partial w} \left( \frac{(1 - x_i) + x_j r + (1 - x_j)}{2}, \theta_j \right) \frac{1}{2} +
$$

$$
+(1 - p)^2 \frac{\partial u}{\partial w} \left( \frac{(1 - x_i) + (1 - x_j)}{2}, \theta_j \right) \frac{1}{2}
$$

Notice now that, for $\theta_i = \theta_j$, the first order conditions of agents $i$ and $j$ coincide and correspond to a global optimum for player $i$ (and $j$). In fact, gambling partner $j$ with the same preferences as agent $i$ chooses for himself the same portfolio of lotteries that agent $i$ would have chosen for her partner, had he been free to optimise both with respect to her own portfolio and with respect to her partner’s. Given that second period expected payoffs correspond to a global maximum for agent $i$ whenever $\theta_i = \theta_j$, first stage choice falls on a partner with equal risk aversion parameter.

What is crucial for the result in lemma 1 is our assumption of independence across lotteries played by the two gambling partners. By choosing gambling partners that have the same risk preferences as themselves, agents manage to duplicate their preferred lottery combination. Given that lotteries are independent, it is optimal to do so. Although we do not carry out here a full analysis for the case of correlation across lotteries played by the two gambling partners, it would seem that results are qualitatively different for the case of correlation. In particular, it would seem that while in the case of independence (analysed here) partners’ investment shares in the risky lottery are strategic complements; in presence of positive correlation, partners’ investment shares are strategic substitutes: when one agent invests more in the risky lottery, the other agent invests less.

**Example 3.** Assume that there is perfect positive correlation across the two risky lotteries played by the gambling partners. First order condition for agent $i$ gives:

$$
p \frac{\partial u}{\partial w} \left( \frac{(x_i + x_j)r + 2 - (x_i + x_j)}{2}, \theta_i \right) (r - 1) = (1 - p) \frac{\partial u}{\partial w} \left( \frac{2 - (x_i + x_j)}{2}, \theta_i \right)
$$

Given that what matters for agent $i$ is the sum of the investments in the risky lottery, the two investment shares are strategic substitutes.
Next we show that the optimal choice in the second stage of the game involves a larger share of investment in the risky lottery compared to \( x^*(\theta_i) \), i.e. the investment share in the risky lottery in the case of individual choice.

**Lemma 2.** In the second stage gambling partners invest in the risky lottery a share of endowment \( x^{**}(\theta_i) > x^*(\theta_i) \).

**Proof.** We compare the conditions at the margin in the case of choice with a partner and individual choice. Recall that the optimal risky investment in the case of the individual choice solves:

\[
p(r - 1) \frac{\partial u}{\partial w}(x^*r + 1 - x^*, \theta_i) = (1 - p) \frac{\partial u}{\partial w}(1 - x^*, \theta_i)
\]

The first order condition when choosing with a gambling partner is:

\[
p(r - 1) \frac{\partial u}{\partial w}\left(\frac{x_i r + (1 - x_i) + x_j r + (1 - x_j)}{2}, \theta_i\right) r - \frac{1}{2} +
+p(1 - p) \frac{\partial u}{\partial w}\left(\frac{x_i r + (1 - x_i) + (1 - x_j)}{2}, \theta_i\right) r - \frac{1}{2}
= p(1 - p) \frac{\partial u}{\partial w}\left(\frac{(1 - x_i) + x_j r + (1 - x_j)}{2}, \theta_i\right) \frac{1}{2} +
+(1 - p)^2 \frac{\partial u}{\partial w}\left(\frac{(1 - x_i) + (1 - x_j)}{2}, \theta_i\right) \frac{1}{2}
\]

which can be rewritten as:

\[
p(r - 1) \left[ \frac{\partial u}{\partial w}\left(\frac{x_i r + (1 - x_i) + x_j r + (1 - x_j)}{2}, \theta_i\right) +
+(1 - p) \frac{\partial u}{\partial w}\left(\frac{x_i r + (1 - x_i) + (1 - x_j)}{2}, \theta_i\right) \right] =
\]

\[
(1 - p) \left[ p \frac{\partial u}{\partial w}\left(\frac{(1 - x_i) + x_j r + (1 - x_j)}{2}, \theta_i\right) +
+(1 - p) \frac{\partial u}{\partial w}\left(\frac{(1 - x_i) + (1 - x_j)}{2}, \theta_i\right) \right]
\]

In equilibrium \( x_i = x_j = x^{**} \). Hence:

\[
p(r - 1) \left[ \frac{\partial u}{\partial w}\left(x^{**}r + 1 - x^{**}, \theta_i\right) +
+(1 - p) \frac{\partial u}{\partial w}\left(\frac{x^{**}r}{2} + 1 - x^{**}, \theta_i\right) \right] =
\]

\[
(1 - p) \left[ p \frac{\partial u}{\partial w}\left(\frac{x^{**}r}{2} + 1 - x^{**}, \theta_i\right) +
+(1 - p) \frac{\partial u}{\partial w}(1 - x^{**}, \theta_i) \right]
\]
We represent conditions (2) and (3) graphically. Consider the individual first order condition (2) first. The left hand side is decreasing in $x$. In fact:

$$\frac{\partial^2 u}{\partial w \partial x} (x^* r + 1 - x^*, \theta_i) = \frac{\partial^2 u}{\partial w^2} (x^* r + 1 - x^*, \theta_i) (r - 1) < 0$$

Also, it ranges between $p(r - 1) \frac{\partial u}{\partial w} (r, \theta_i)$ (for $x = 1$) and $p(r - 1) \frac{\partial u}{\partial w} (1, \theta_i)$ (for $x = 0$). The right hand side in (2) is increasing in $x$:

$$\frac{\partial^2 u}{\partial w \partial x} (1 - x^*, \theta_i) = \frac{\partial^2 u}{\partial w^2} (1 - x^*, \theta_i) (-1) > 0$$

and it ranges between $(1 - p) \frac{\partial u}{\partial w} (1, \theta_i)$ (for $x = 0$) and $(1 - p) \frac{\partial u}{\partial w} (0, \theta_i)$ (for $x = 1$).

Conditions at the margin for the individual choice are represented in figure 1.

Figure 1: Individual choice.

Consider now first order condition (3). Notice that

$$p \frac{\partial u}{\partial w} (x^{**} r + 1 - x^{**}, \theta_i) + (1 - p) \frac{\partial u}{\partial w} \left( \frac{x^{**} r}{2} + 1 - x^{**}, \theta_i \right)$$

$$> \frac{\partial u}{\partial w} (x^* r + 1 - x^*, \theta_i) \text{ for } x > 0$$

$$= \frac{\partial u}{\partial w} (x^* r + 1 - x^*, \theta_i) = \frac{\partial u}{\partial w} (1, \theta_i) \text{ for } x = 0$$

$$\frac{p \partial u}{\partial w} \left( \frac{x^{**} r}{2} + 1 - x^{**}, \theta_i \right) + (1 - p) \frac{\partial u}{\partial w} (1 - x^{**}, \theta_i)$$

$$< \frac{\partial u}{\partial w} (1 - x^*, \theta_i) \text{ for } x > 0$$

$$= \frac{\partial u}{\partial w} (1 - x^*, \theta_i) = \frac{\partial u}{\partial w} (1, \theta_i) \text{ for } x = 0$$
Hence compared to the conditions at the margin we had for the individual choice here we have that the left hand side can be represented graphically by a curve that has the same vertical intercept and lies entirely above \( p(r - 1) \cdot \frac{\partial u}{\partial w}(x^*r + 1 - x^*, \theta_1) \); while the right hand side can be represented by a curve that has the same vertical intercept and lies entirely below \((1 - p) \frac{\partial u}{\partial w}(1 - x^*, \theta_1)\). It follows that \( x^{**} > x^* \).

Figure 2: Risk sharing with a gambling partner.

The two agents risk-share, hence more risks are taken (see figure 2).

Lemma 1 and 2 constitute our theoretical prediction.

**Proposition 2.** In the game with gambling partner choice, there is a unique SPNE: in the first stage agents choose gambling partners with equal risk aversion parameter; in the second stage their risk-share by taking on more risks than they would individually: \( x^{**}(\theta) > x^*(\theta) \).

**Proof.** By lemma 1 and 2.

The intuition behind Proposition 2 is that choosing a gambling partner with the same risk aversion as themselves, agents can exploit the benefits of mutual insurance. More precisely, they have access to a new lottery with the same return and lower variance, hence choosing to allocate a larger fraction of their wealth on the risky lottery.
3. Experimental Design

Our computerized experiment consists of 2 treatments, T1 and T2, in which experimental subjects are required to make decisions under risk. Each treatment is divided into 3 rounds, R1, R2, and R3: the first round is about individual decisions and it is the same in both treatments; in the following two rounds experimental subjects keep on making individual decisions, but they are grouped in pairs and they equally share the aggregate payoff of the pair, with no regard to individual contribution. The difference between T1 and T2 is in the group formation mechanism: in T1 experimental subjects are randomly matched, while in T2 they are allowed to choose their partner. In both treatments, in R2 experimental subjects have no information about the individual decisions undertaken by others in the first round, while in R3 they can observe the decisions undertaken in R1 by their potential partners.

Throughout the experiment subjects were required to decide upon the optimal allocation of 5 experimental credits (EC) over two lotteries: the first lottery (Lottery 1) paid 1 or 3 EC with equal probabilities; the second lottery paid 1 or 5 EC with probabilities equal to 0.8 and 0.2 respectively. So, lotteries were designed such that Lottery 1 displayed both a lower expected return and a lower variance than Lottery 2. In the remaining sections we will refer to Lottery 2 as "the risky lottery".

It is worth providing more details about the group formation mechanism that we employed in T2. After the first round, each subject can propose to one of the other (9) subjects to form a pair\(^1\). If the proposal is accepted, the pair is formed and it cannot be broken apart until the next round starts. In R2 subjects make their proposals without knowing the individual decisions undertaken in R1 by their potential partners; in R3 they are allowed to see what their potential partners did in R1 before making their proposals.

We recruited 210 Luiss - Guido Carli University undergraduate students from the faculties of Law, Economics, and Political Sciences through ORSEE recruitment system. We ran 21 ten-person sessions: 140 subjects performed T1, 70 performed T2. At the end of each session experimental subjects were paid cash immediately. The average payoff was 8 Euros, the maximum payoff was 12.5 Euros.

The instructions distributed to experimental subjects are in the Appendix of

\(^1\)Experimental subjects are displayed on the screen in an anonymous way. In particular, they are labeled as ...
4. Experimental Results

In this section we will describe the results of the computerized experiment run at Luiss - Guido Carli University of Rome over a sample of 210 undergraduate students. In particular, we will focus on the comparison between the experimental results and the predictions of our theoretical model.

This section is divided into three subsections: in the first subsection, we will comment on the individual decisions made by our experimental subjects; in the second one, we will describe how experimental subjects chose their gambling partners; in the last one, we will compare individual decisions with group decisions.

4.1. Individual Decisions

A summary of the individual decisions under risk of our experimental subjects (i.e., the individual decisions over the allocation of the initial amount of EC between the two lotteries described in the previous section) is contained in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Treatment 1</th>
<th>Treatment 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Observations</td>
<td>70</td>
<td>140</td>
</tr>
<tr>
<td>Mean</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Variance</td>
<td>0.98</td>
<td>1.41</td>
</tr>
</tbody>
</table>

It is worth noticing that there is no difference between the individual decisions made under the two treatments. This result is relevant because subjects under Treatment 2 knew from the beginning of the treatment that their individual decisions could affect the search of gambling partners in the last round of the treatment. A T-test run over the two distributions of individual decisions confirmed that the decisions made by our experimental subjects are not statistically different under the two treatments.

Under Expected Utility Theory (EUT) both risk neutral and risk loving subjects should not allocate EC on Lottery 1 because Lottery 2 displays a higher expected return. As it is summarized in Table 1 the mean is different from zero under both treatments. Moreover, only 5 subjects out of 210 decided to allocate zero EC on Lottery 1, so the risk aversion assumption made in the previous sections is strongly supported by experimental evidence.
4.2. Gambling Partner Selection

The main result in terms of gambling partner selection is that our experimental subjects, when provided with information about other subjects’ individual decisions, chose to join partners who displayed a similar degree of risk aversion, as predicted by our theoretical model.

In order to evaluate the differences between subjects belonging to the same two-person group, we defined a measure of the intra-group distance. Let us call \( x_i \) the amount of EC allocated by subject \( i \) on Lottery 1 in the individual decision round of both treatments. Then, the intra-group distance \( (D) \) is the following:

\[
D = (x_i^* - x_{-i}^*)^2
\]

First, we will compare the average intra-group distance in Round 3 across Treatment 1 and Treatment 2. Let us recall that in the third round of both treatments each subject was allowed to view the individual decisions of the other 9 subjects who were simultaneously performing their experimental tasks. However, while in Treatment 1 groups were randomly formed, in Treatment 2 each subject could in principle choose his/her gambling partner.

Table 2 shows that the intra-group distance is different across the two treatments.

### Table 2: Group Formation - Intra-Group Distance

<table>
<thead>
<tr>
<th></th>
<th>Round 3 - Treatment 1</th>
<th>Round 3 - Treatment 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Observations</td>
<td>70</td>
<td>140</td>
</tr>
<tr>
<td>Mean</td>
<td>2.70</td>
<td>1.51</td>
</tr>
<tr>
<td>Variance</td>
<td>4.88</td>
<td>10.9</td>
</tr>
</tbody>
</table>

A T-test run over the two distributions of intra-group distances confirmed that the two sample means are statistically different (at a 1% significance level).

Since we considered this result crucial, we performed a two step-robustness analysis based on the decisions made under Treatment 2: first, we compared the group composition in Round 2 with the group composition in Round 3; then, we looked at the sequential order in which groups were formed in Round 3.

The first comparison is aimed at understanding whether information mattered in the gambling partner search process; in fact, in both Round 2 and Round 3 subjects could in principle choose their favourite gambling partners; however, while in Round 3 they knew the individual decisions of their potential partners, in Round 2 they did not know them. Our experimental result is striking: 50
groups out of 70 formed in Round 2 were changed in Round 3 (i.e., information about individual decisions induced more than 70% of previously formed groups to change their composition).

As for the sequential order in which groups were formed, this analysis is relevant because in Round 3 subjects could propose themselves as gambling partners only to subjects not already teamed with others. So, experimental subjects who did not propose themselves quick enough were forced to join left over subjects against their will. What we observe from our experimental data is that the average intra-group distance for the first three groups formed in each experimental session is 0.5, well below the sample mean in Table 2; hence, the difference between the intra-group distance across the two treatments is underestimated if timing is not considered. This result confirms the willingness of experimental subjects to choose partners who displayed a similar degree of risk aversion in the individual decision round.

4.3. Individual Vs Paired Decisions

The main objective of this paper is to compare individual decisions with group decisions. We wish to remind that our theoretical model predicts that in equilibrium group decisions are riskier than individual ones.

Our experimental results seem to confirm our theoretical predictions: in fact, in both treatments, subjects made riskier choices in Round 3 than in Round 1, as Table 3 below clarifies.

Table 3: Individual Vs Paired Decisions - EC on Lottery 1

<table>
<thead>
<tr>
<th></th>
<th>T1 - Round 1</th>
<th>T1 - Round 3</th>
<th>T2 - Round 1</th>
<th>T2 - Round 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Obs.</td>
<td>70</td>
<td>70</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>Mean</td>
<td>2.60</td>
<td>2.10</td>
<td>2.61</td>
<td>2.36</td>
</tr>
<tr>
<td>Variance</td>
<td>0.98</td>
<td>1.69</td>
<td>1.41</td>
<td>1.54</td>
</tr>
</tbody>
</table>

In our experimental environment a lower amount of EC on Lottery 1 implies riskier decisions. So, as it is evident from Table 3, group decisions were riskier than individual decisions. The mean differences summarized by Table 3 have been tested through a set of t-tests. In both treatments the mean differences between individual and group decisions are statistically significative.

However, the theoretical predictions of our model do not refer to groups, rather they refer to "homogeneous" groups: in fact, our model predicts that subjects belonging to homogenous pairs make riskier choices. In order to check for this result,
we divided our sample into two subsamples: the first subsample (Subsample $H$) contains homogeneous pairs, the second one (Subsample $D$) contains dishomogeneous pairs. In particular, in Subsample $H$ we consider all pairs whose intra-group distance is either 0 or 1; in Subsample $D$ we consider all remaining pairs. The following table summarizes our experimental evidence.

<table>
<thead>
<tr>
<th>Table 4: EC on Lottery 1 - Subsample H Vs Subsample D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsample</td>
</tr>
<tr>
<td>N. Obs.</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Variance</td>
</tr>
</tbody>
</table>

Table 4 confirms that generally speaking group decisions were riskier than individual decisions. However, Table 4 that considers the two subsamples separately conveys a larger amount of information:

1. Our t-tests state that only for homogeneous subsamples individual and group decisions are statistically different (at a 2% significance level);

2. Moreover, as it is clear from Table 4, in Treatment 2 experimental subjects belonging to dishomogeneous pairs made riskier decisions than subjects belonging to homogeneous pairs.

The first finding fully confirms the result of our theoretical model. First, experimental subjects chose to join other subjects displaying a similar degree of risk aversion; then, being part of an homogeneous pair, they made riskier choices, thus fully exploiting the benefits of an implicit mutual insurance.

The second finding is more difficult to explain in terms of our theoretical model. A possible explanation is that more risk loving subjects did not care about finding an homogeneous gambling partner, so they did not hurry to find one (hence ending up in a dishomogeneous group), and finally confirmed their individual choice.

Another plausible interpretation is that a fraction of our experimental sample did not recognize the benefits of mutual insurance and made identical individual and group decisions. This interpretation is supported by the fact that the fraction of individuals who did not behave accordingly with our theoretical predictions is much smaller under Treatment 2: in fact, in Treatment 2 experimental subjects were forced to consider the strategic implications of partner selection, thus were
forced to reason about mutual insurance benefits. Probably, the randomizations of Treatment 1 induced experimental subjects to underestimate the potential benefits of mutual insurance. However, this interpretation fails to explain why subjects unaware of mutual insurance benefits happen to be less risk averse than others.

5. Concluding Remarks

We investigated the behavior of economic agents facing situations in which they are required to team up with other agents. In particular, we considered the case in which the future decisions of partners, albeit independently taken, affect the cumulative returns that they are committed to share: for example, the case of group-lending programs, hiring decisions, M&A decisions, and so on. We did it from both a theoretical and an experimental point of view.

In our theoretical model we proved that:

1) Whenever agents are allowed to choose a gambling partner, they decide to team up with other agents that display the same degree of risk aversion as themselves;

2) Whenever agents belong to a homogeneous group (i.e., to a group formed by two agents with the same degree of risk aversion), they make riskier decisions with respect to the decisions that they make as single decision maker, thus exploiting mutual insurance benefits.

From an experimental point of view, the main finding is that the experimental results confirm our theoretical predictions. In fact, experimental subjects chose to join other subjects displaying a similar degree of risk aversion; moreover, being part of an homogeneous pair, they made riskier choices, thus fully exploiting the benefits of an implicit mutual insurance.

Our research can be extended in many directions. For example, the theoretical model could take into consideration correlated lotteries and the experimental setup could be changed accordingly. Moreover, our experimental results could be analyzed using more sophisticated econometric techniques. Finally, the potential of our results in terms of real world applications could be further exploited.
References


[4] ...