Other People's Money: An Experimental Study of the Impact of the Competition for Funds

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Abstract

This paper investigates the impact of the competition for funds in capital markets on the risk taking behavior of fund managers. In doing this we find what we call an "Other People's Money" effect, or a tendency of people to invest the funds of others in riskier assets than they would invest their own funds. We find that this excessive risk taking is not a result of poorly designed contracts since the Other People's Money effect is present even when contracts properly align the interests of managers and investors. This does not mean that the proper design of contracts is irrelevant, however. For example, we find that contracts promoting transparency of investment choices of managers seem to go a good distance in eliminating the problem.

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1 Introduction

In this paper we experimentally investigate the impact that competing for funds has on the risk taking behavior of laboratory hedge fund managers and their tendency to invest other peoples' money in riskier assets than they would invest their own.

We find that the standard hedge fund contract leads to inefficient risk taking behavior. In the face of this inefficiency, we then construct a number of different contractual environments (which can be thought of also as policy interventions) aimed at limiting risk taking on the part of managers. More specifically, in one environment (the Transparency treatment) we impose transparency on the fund investment strategy by forcing the manager to announce (and commit to) the risk level of its intended investment before the investor invests. In a second environment (Risk Sharing), we modify the managerial incentive compensation scheme to allow complete risk sharing between the manager and the investor. Finally, in a third environment (Restricted Competition), we cap the strike price or promised return which managers can offer investors to limit how much competition could unravel. All of these treatments prove to substantially reduce risk taking in the experimental data, as predicted at equilibrium. However, they fail to fully eliminate inefficient risk taking.

In this regard, we document an *Other peoples' money* effect:[1] managers tend to invest other people's money in riskier assets than they would invest their own money. The strategy we adopt to identify this effect is straightforward. In the Risk Sharing treatment the incentives of the hedge fund managers and the investors are completely aligned. Moreover, the available investment opportunities are such that we would expect them to invest funds in the safe project. This is also true of the Own Money treatment. The only difference between the Own Money and the Risk Sharing treatments is that while in the Own Money treatment the manger is investing his own funds, in the Risk Sharing he is investing other people's money that he competed for. Therefore, if there is any difference in the behavior of managers across these two treatments, we intrepret it as a manifestation of what we call the *Other peoples' money* effect.

Our experimental data clearly documents this effect. While managers invested their own funds in the risky project only about 10.2% or 21.5% of the time (depending on the treatment), they invested other people's money in such projects 42% of the time in the Risk Sharing treatment. The *Other peoples' money* effect, therefore, represents a quantitatively significant behavioral inefficiency induced by competition for funds in our hedge fund laboratory.[2]

[1] After the title of the 1991 Norman Jewison movie, with Danny De Vito.

[2] The *Other people's money* effect is consistent with the fact that hedge fund performance appears to be positively linked only to measures of the overall pay-performance sensitivity of managerial incentive pay (the overall "delta"), which include private ownership; see Agarwal-Daniel-Naik (2008). While private ownership requirements are included in incentive contracts to align the manager's and the investors' objectives, they might also have the effect of limiting the *Other people's money* effect.

Our paper, by documenting the *Other peoples' money* effect, is related to a few recent papers that study experimentally the risk attitudes of subjects towards other people's money. Brennan-Gonzales-Guth-Levati (2008) investigates the relation between risk preferences and other-regarding concerns when one's own and another person's payoff is risky. The main finding of this paper is that behavior depends mostly on the riskiness of the subjects' own payoff and not so much by the riskiness of the others' payoff. Chakravarty-Harrison-Haruvy-Rutstrom (2010) examines risk attitudes of laboratory subjects towards their own uncertain payoffs as well as the uncertain payoffs of other subjects. The major finding is that, when subjects make a decision on behalf of an anonymous stranger, the chosen lottery (action) tends to be more risky than what the lottery they would choose for themselves, controlling for preferences and for beliefs about the preferences of others. While the experimental environments are very different, the phenomena studied in this last paper and our own are related and are both referred to as *Other peoples' money* effect. The main difference, however, is that in the Chakrvarty et al. paper the decision makers who makes decisions for others are not incentivized to do so while in our paper people make decisions for others under a variety of different incentive contracts. We feel this distinction is important since one neeeds to control the incenitves of decision makers who make decions using other peoples money in order to reach conclusions about their behavior.

1.1 What this paper does not do

Before we present our analysis it is important to state what we consider to be the main aim of our experiment. First, while we present a simple model of the competition for funds, our emphasis is not on the model's point predictions. Rather, as is true in many experiments, we are more interested in its qualitative comparative statics since it is those that have the major policy implications. Second, while we couch our discussion with reference to the hedge fund market, our interests are broader than that since our results hold for any market where firms compete for funds. Finally, with respect to hedge funds, one may argue that the terms of hedge fund contracts are not negotiated in the market but rather set historically as a "2/20 contract" (2% fixed commission and an additional 20% if the hedge fund earns more than a threshold ("high water-mark") return). Our results are still highly relevant, however, since the question remains as to whether this historically determined contract provides incentives for prudent or risky investment. In other words, this contract, while a current market norm, was presumably once set by competition and the question as to whether it was set efficiently remains of relevance.

1.2 Hedge Funds

Hedge funds are largely unregulated investment funds which, in the last twenty years have become increasing important in the capital markets. At its peak in the summer 2008, the hedge fund industry managed around $2.5 trillion, according to Aima's Roadmap to Hedge

Funds, Inechen-Silberstein (2008).[3] Hedge funds typically compete for institutional and wealthy investors, requiring a substantial minimal investment tranche to participate in the fund (thereby imposing substantial diversification costs to investors). Moreover, hedge funds are characterized by their investment strategies and by the incentive schemes their managers are compensated with.

The investment strategies and styles of hedge funds are generally opaque, and are not revealed to investors. In other words, fund managers compete for investors in this market by signalling skills through past performance and through their incentive compensation scheme. Managers' compensation includes typically a small management fee (proportional to the investment tranche, of the order of $1-2\%$) and a larger performance fee, of the order of $15-25\%$ of returns exceeding the "high-water mark" (the maximum share value in a prespecified past horizon). This incentive compensation scheme is equivalent to a call option with the "high-water mark" as strike price. Furthermore, the manager is subject only to limited liability, while it is relatively standard in the industry to require that a substantial fraction of the managers' private capital be heavily invested in their own fund.[4]

Option-like contracts, like those common in the hedge fund industry, are designed to signal managerial skills,[5] but also induce managers to take high risks.[6] A large empirical literature has documented that, in fact, *i)* hedge funds returns contain a significant excess risk-adjusted return due to managerial skills (or "alpha"),[7] *ii)* hedge fund returns are significantly riskier than other investment forms (e.g., mutual funds).[8] In particular, even though hedge fund returns display a low correlation with stock market indices, they are characterized by exceptionally large cross-sectional range and variation.[9] Furthermore, the attrition rate of hedge funds in the market is very high (over 50% in 5 years from the 90's).[10]

We proceed in this paper as follows. In Section 2 we will present a simple model of the invest-

[3] The first hedge fund was apparently founded by A.W. Jones, a sociologist and financial journalist, in 1949. In the 1990's, however, the industry was managing about $50 billions; see Malkiel-Saha (2005).

[4] See Fung-Hsieh (1999) and Goetzmann-Ingersoll-Ross (2001) for rich institutional details on the hedge fund industry.

[5] See, however, Foster-Young (2008) for a theoretical result suggesting lack of separation along the skill dimension in these contractual environments.

[6] More precisely, a rational portfolio manager facing a dynamic option-like contract will be lead to take extreme risk while the fund is below water (its return below the "high-water" mark), while he will invest more safely when just above water. See e.g., Carpenter (2000), Goetzmann-Ingersoll-Ross (2001), and Jackwerth-Hodder (2006) for the supporting portfolio choice theory; but see also Panageas-Westerfield (2007) for different results with infinite horizon.

[7] See Edwards-Caglayan (2001).

[8] See Brown-Goetzmann-Park (2001).

[9] See Brown-Goetzmann (2001) and, especially, Malkiel-Saha (2005).

[10] Even after accounting for survivor (and other related) bias, hedge funds paid (geometric) average returns 2% in excess of mutual funds in the period $1996-2003$; see Malkiel-Saha (2005), Table $3-4$. See also Liang (2000) and Amin-Kat (2002).

ment environment we are interested in and prove some simple results about the equilibria of such markets. This will be followed in Section 3 by our experimental design. In Section 4 we present the results of our experiment. Finally in Section 5 we present our conclusions.

2 The market for *Other People's Money*

The type of markets we are interested in are the capital markets in which hedge funds compete for funds. In such markets typically,

i) the size of the investment per investor is fixed, say \$1 (million, typically);

ii) the hedge fund manager receives a share, β, of all profits made above a "high-water mark"/strike price, w;[11] if the funds are lost, the hedge fund manager is not liable, that is, he/she only shares the upside risk in the contract and not any downside.

iii) the fund manager is under no requirement to offer the investor any specific information about her fund's investment strategy.

More precisely, when β, and w are as described above and R is the return earned by the fund in any given year, the cash flow accruing, respectively, to the investor (Π^{investor}) and the hedge fund manager (Π^{manager}) can be written as follows:

$$\begin{aligned} \Pi^{\text{manager}} &= \beta \max(0, R-w) \\ \Pi^{\text{investor}} &= \min(R, w) + (1-\beta) \max(0, R-w) \end{aligned}$$

2.1 Contractual environments

Consider a world with two hedge fund managers and one investor. The investor possesses a \$$x$-chip to be invested, which the managers compete for. The manager who is successful in attracting the chip can invest it in one of two projects, called *safe* and *risky*.

The return on the safe project is a dichotomous random variable paying $R_s > 0$ with probability $0 < p_s < 1$, and 0 otherwise. The return on the risky project is also a dichotomous random variable paying $R_r > R_s > 0$ with probability $0 < p_r < p_s < 1$, and 0 otherwise. Note that the risky project, has a higher return when successful with respect to the safe asset; but the probability of success is higher for the safe asset. We assume however that the safe payoff has a higher expected return,

$$p_s R_s > p_r R_r.$$

[11] We abstract from small fixed fees, which possibly have little effect on risk taking in practice in hedge fund markets.

This assumption is called for, because we want to study the case in which investing in the risky asset is a dominated choice, absent the moral hazard implicit in the hedge fund manager's intermediation of funds.

We consider several contractual environments in which the hedge fund managers compete for the investor's funds. Each contract environment will serve as a treatment in our experiment. To avoid considering a multi-dimensional competition problem, we consider the following extreme cases.

1. *Baseline (hedge fund) contract.* In this contract β is fixed $= 1$ and the managers compete for funds by choosing the water mark, w.

2. *Risk Sharing contract.* In this contract, in contrast to the hedge fund contract above, w is fixed $= 0$ and managers compete by offering different shares β of the proceeds of their investments.

3. *Transparency contract.* This contract is identical to the hedge fund contract ($\beta = 1$ and managers compete by setting w), except that when competing for funds, the manager is required to publicly commit to the project the funds will be invested in. (This implicitly assumes the investment is verifiable).

Finally,we also study a contractual environment in which a legally binding condition restricts the hedge fund managers' offers,

4. *Restricted contract.* This contract is again identical to the hedge fund contract ($\beta = 1$ and managers compete by setting w) except for the fact that we place an upper bound, $\bar{x}$, on the $w's$ that can be offered and hence require require $w \leq \bar{x}$

In any of the contractual environments described, after observing either w or β, depending on the contractual environment, the investor decides which manager to invest his funds ($\$x$) with. The manager, before knowing if she will receive the funds decides which project, safe or risky, to invest them into. The manager who has received the funds will then go ahed and invest them as decided. After all investment decisions are made, the cash flow is realized and payoffs determined.

We specify these various contracts because we will be interested in how they affect the performance of the market for other people's money. As the propositions below indicate, these contracts can have a significant impact on the risk taking of managers and the subsequent welfare of our agents.

2.2 Equilibria

We now study equilibria in the different contractual environments.[12] We concentrate first on the basic hedge fund contract, our baseline.

Result 1: *In the Baseline contract, there exist a cutoff w^* such that, if $w \geq w^*$ each manager has an incentive to invest the funds in the risky project (strictly so, if $w > w^*$).*

In fact, w^* is such that each manager is indifferent with respect to her investment, and it satisfies

$$w^* = \frac{p_s R_s - p_r R_r}{p_s - p_r} > 0$$

Result 2: *In the Baseline contract, if one manager offers w_1 and another manager offers w_2 such that $w_1 \leq w^* \leq w_2$ and $\frac{w_2}{w_1} > \frac{p_s}{p_r}$, then the investor will give his chip to the manager who offered w_2. Likewise, in the transparency contract, if one manager offers (w_1,safe) while the other manager offers (w_2,risky) and $\frac{w_2}{w_1} > \frac{p_s}{p_r}$, then the investor will give his chip to the manager who chose the risky project.*

These results state that if one manager chooses the safe project, the other manager has an incentive to offer a high enough w *and* choose the risky project. That is, there exists a risk premium ($\frac{p_s}{p_r}$) such that a rational investor will be willing to leave the safe project for the risky one. In the transparency contract an investor is able to observe the contract in which his funds will be invested. Thus, an investor demands a compensation of at least $w_2 \geq w_1 \cdot \frac{p_s}{p_r}$ for high risk. In the baseline contract, if $w_1 \leq w^* \leq w_2$ then the investor can infer that a manager that offered w_1 will invest in the safe project and a manager that offered w_2 will invest in the risky project (see result 1). Since $\frac{p_s}{p_r} w^* < R_r$ a deviation on the part of a manager to the risky project is always feasible. This is the case under a regularity condition bounding the relative return of the safe project, a condition satisfied by the parametrization of the game we take to the lab.

It is now straightforward to show, by a Bertrand competition argument, that

Proposition 1: *In the Baseline contract, at equilibrium, both hedge fund managers offer $w = R_r$ and invest the funds in the risky project.*[13]

Proposition 2: *In the Transparency contract, at equilibrium, both hedge fund managers offer $w = R_s$ and invest the funds in the safe project.*

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[12] See Matutes-Vives (2000) for a model of bank competition which resembles, along several dimensions, our laboratory hedge fund market.

[13] This result holds true more generally, when managers in hedge fund markets compete by choosing both the share, β, of all profits made above a "high-water mark"/strike price, w, and the "high-water mark"/strike price, w itself; see Appendix 1.

Proposition 3: *In a Restricted contract, with* $\bar{x} \leq w^*$*, at equilibrium both hedge fund managers offer* $w = \bar{x}$ *and invest the funds in the safe project.*

Proposition 4: *In a Risk Sharing contract, at equilibrium both hedge fund managers offer* $\beta = 0$ *and invest the funds in the safe project.*

Note that these contracts lead to different results in the market. For example, under the Baseline contract, competition forces w up to the level of R_r and all funds are invested in the risky project. In all the other contracts, however, at the equilibrium the funds are invested in the safe project with different equilibrium w's. For example, in the Risk sharing contracts where managers compete by offering $1 - \beta$ and where $w = 0$, the only equilibrium is one involving both investors investing in the safe project and $\beta = 0$. In this contract the incentives of the investors and managers are perfectly aligned so that the managers should invest the investor's chip as if he was investing his own money. In the Restricted contract funds should be invested in the safe project since we restrict $\bar{x} \leq w^*$.

2.3 Parametrization

In our experiments we investigate one particular parametrization of this model. In this parametrization the safe project has a cash flow of 7 tokens if successful, with probability .9, ($R_s = 7$, $p_s = .9$) while the risky project has a cash flow of 10 tokens if successful, with probability .5, $R_r = 10$, $p_r = .5$. Without loss of generality, if we restrict w to be in $[0, 10]$ it is easy to show that, in this parametrization, $w^* = 3.25$ and all our assumptions are satisfied, i.e., $6.3 = p_s R_s > p_r R_r = 5$ and $\frac{p_s}{p_r} w^* = 5.85 < R_r = 10$. Given this parametrization we have the following equilibrium predictions for our different contracts.

Table 1: Equilibrium Predictions

Contract	**Investment**	$\boldsymbol{\beta}$	**w**
Baseline	Risky	NA	10
Risk Sharing	Safe	0	NA
Transparency	Safe	NA	7
Restricted Competition	Safe	NA	3.25

3 Experimental design

Our experimental design attempts to implement the market for funds outlined above.[14] The experiment was run at the experimental lab of the *Center for Experimental Social Science* at New York University. Students were recruited from the general undergraduate population via E-mail solicitations. The experiment lasted approximately 45 minutes and average

[14] See Appendix for the instructions.

earnings were \$20. Each different contractual environment represents a treatment in the experiment.

The *Baseline treatment* is the hedge fund contract environment, which we introduce first. When subjects arrived at the lab they were divided into groups of three with two managers and one investor in each group. The experiment consisted of 20 identical decision rounds. In each round the investor was endowed with one "investment chip". Each round started by each manager simultaneously selecting a promised $w \in [0, 10]$. The managers also choose which project, safe or risky, they intend to invest in. The w's are announced to the investor in the market, but not the investment decision, which is kept private. After both managers choose their w's, the investor decides who to invest his chip with. The selected manager then has the right to make the investment that she decided on. The other manager can make no investment in this round. We ran our market with only one investor in order to maximize competition and with only two managers in an effort to minimize the number of subjects needed (and hence the amount of money required).

After the investment decisions were made the chosen project was played out and payoffs determined. A successful investment in the risky project paid $10 - w$ tokens to the manager and w to the investor. A successful investment in the safe project paid $\max\{0, 7 - w\}$ tokens to the manager and $\min\{7, w\}$ tokens to the investor (the manager is not liable for any loses imposed on the investor).

After each round, both managers observe the w chosen by the other and which manager received the chip. In case the manager received the chip, she was also informed as to which project the chip was invested in, the resulting cash flow, and whether or not she was able to pay the investor in this round. The investor was told whether or not he received his payment and his profit in this round, *but not* which project the chip was invested in. The experiment then moved into the next round where subjects were randomly matched into new groups of 3 while retaining their role in the experiment, so that if a subject was an investor (manager) in round 1 she retained that role over the entire 20 rounds. The identity of subjects were anonymous so subjects could not identify their roles. This eliminated the possibility of managers creating a reputation.

In addition to the Baseline treatment, we ran several other treatments each of which replicated one of the different contractual environments described above. The first such treatment is the *Restricted treatment*, for which we pick $\bar{x} = 3$. This treatment was run to check our hypothesis that it is competition, and the heightened promises of returns it encourages, that lead to risky behavior on the part of investors. Obviously, since $3 < 3.25 = w^*$, in this treatment we would expect all funds to be invested in the safe project. Otherwise, our hypothesis that risk taking is an artifact of market competition pushing promised returns above $w^* = 3.25$ would be easily disproved. In this treatment all procedures were identical to those of the hedge fund contract except for the restriction on w.

Our *Transparency treatment* is identical to the baseline hedge fund contract except for the fact that in the first move of the game the managers not only choose w, but also commit on a project to invest in. In other words, they choose a pair (w, Project) where Project$\in$ {safe, risky} and each pair chosen by the managers is shown to the investor. The investor then chooses a manager to give his chip to and the rest of the round is played out as in the Hedge Fund treatment.

Our fourth treatment is the *Risk Sharing treatment*. In this treatment $w = 0$ and managers offer a share $1-\beta$ to the investor indicating what fraction of the returns investors will receive if the project succeeds. If $\beta = 0$ then all the proceeds of the investments go to the investor, while if $\beta = 1$ then the manager keeps all the proceeds for himself. This treatment is conducted using private information (when making their choice investors observe only the shares both managers propose) in an effort to isolate the impact of the contract on behavioral and not confound it with transparency considerations.

In all four treatments discussed above when the experiment was over we surprised the subjects by informing them that we wanted them to engage in one more decision. In this decision we gave each of them a chip and asked them to invest it for themselves in either the risky or the safe project. The chip was worth 10 times the value of the chip used in the previous 20 rounds so this decision was a more valuable one and should indicate how subjects would invest when investing their own money rather than that of others. This investment opportunity was given to both subjects who played the role of investors and managers in the experiment. We will refer to this part of the experiment as *Own Money (big stakes) treatment.*

The *Own Money (big stakes)* treatment is similar to the "surprise quiz" round used by Merlo and Schotter (1999). In this treatment subjects play for large stakes and do so only once after their multi-round participation in the experiment. The idea is that this one large-stakes decision should be a sufficient statistics for all they have learned during their participation in the experiment.[15]

Finally, we ran an an additional Own Money treatment which we call the *Own Money (small stakes)* treatment. In this treatment, all subjects participating in the experiment performed the role of managers. In each round (20 rounds in total) the manager was endowed with his/her own chip and faced the same two investment projects: safe and risky. The task of the manager was to choose how to invest his/her own chip. After the investment decisions were made the chosen project was played out, payoffs determined and shown to the subjects. As before, a successful investment in the risky project paid 10 tokens and a successful investment in the safe project paid 7 tokens.

[15] In this sense it is preferable to repeating the Own Money (small stakes) treatment 20 times since in that treatment repetition may lead to boredom and false diversification.

The Own Money (small stakes) treatment is designed to replicate as close as possible the main features of the Risk Sharing treatment with one modification: managers are investing their own money ("investment chip") as opposed to the other people's money (the chip received from the investor). Indeed, similar to the other treatments, in the Own Money (small stakes) treatment the game is repeated (20 decision rounds), the stakes are of the same magnitude and, finally, subjects have no prior experience with the game being played.

Given the projects available, at equilibrium, managers invest their own funds in the safe project. This is the case also, at equilibrium, for the Risk Sharing treatment, in which managers invest funds received from the investor, because the preferences of the manager and the investor are completely aligned. Any difference we might observe in manager's behavior when they invest their own money and investors' money, will be interpreted as a manifestation of the *Other peoples' money* effect described in the Introduction.

Our complete experimental design is summarized in Table 2.

Table 2: Experimental Design

Treatment	Competition	Information	Number of subjects
Baseline	unrestricted	only w	33
Restricted Competition	$w \leq 3$	only w	30
Risk Sharing	unrestricted	only $1-\beta$	45
Transparency	unrestricted	(w,Project)	39
Own Money (small stakes)	none	NA	23
Own Money (big stakes)	none	NA	147

4 Results

Depending on the contractual environment, competition for funds might lead the market to unravel, inducing investment in a risky project when a safe project dominates in terms of expected returns. This is the case at equilibrium in the Baseline (hedge fund) contractual environment. The first fundamental question of the paper, therefore is,

1. Does the outcome in the lab experiment fit the equilibrium prediction in the Baseline treatment where all funds are invested in the risky project and $w = 10$?

On the other hand, all the other contractual environments we study experimentally predict that, at the equilibrium, managers invest in the safe project offering w's that vary with the contract used. The competitive mechanism leading to this outcome is however different in the different contractual environments. A natural question we ask, therefore, is if this prediction is borne out in the experimental data?

2. Does the market in the Restricted, Transparency, and Risk Sharing treatments lead to investment in the safe project? Does competition in these treatments manifest itself as predicted by equilibrium?

The other fundamental question we address in the paper regards the existence of an *Other people's money* effect.

3. Do managers in the Own Money treatments tend to invest their own chip in a safer manner than they invested investor's money in the Risk Sharing treatment? Is there a *Other people's money* effect?

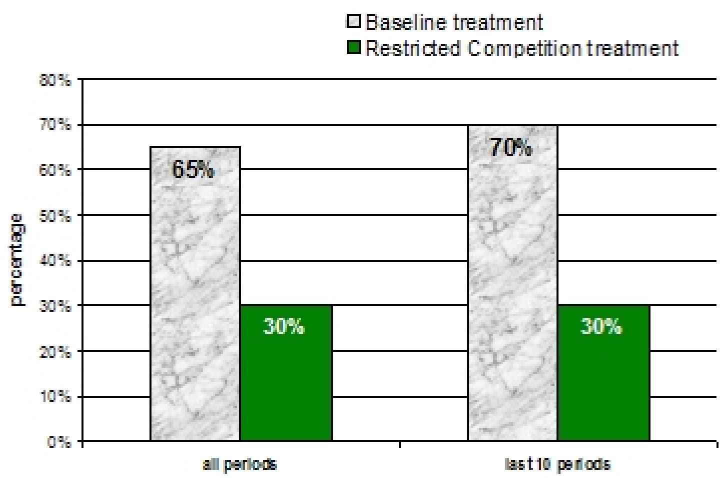
After establishing the effects of the competition on the risk taking behavior of managers, we shall turn to investors. Our main question in this respect is

4. Do investors choose the manager to invest with rationally? Do they anticipate the relationship between the return they are offered and the managers' investment strategy?

4.1 Does the market unravel in the Baseline treatment?

In the Baseline (hedge fund) contract environment, at equilibrium, managers are expected to offer the highest return $w = 10$ and invest in the risky project. The key element in this result is that competition for funds will force w above 3.25 at which point investing in the risky project becomes rational for the manager. In contrast, in the Restricted treatment, where $w \leq 3$, no funds should be invested in the risky project. Hence, our theory implies that it is competition that is responsible for risky investment since it succeeds in pushing w above the critical threshold. If funds were invested in the risky project equally in these two treatments, then the obvious conclusion would be that it is not competition that leads to risky behavior but, perhaps, some type of risk seeking that arises especially when managers are investing other peoples' money. The cleanest way to identify such market unraveling in the Baseline treatment is to compare the outcome in this treatment and in the Restricted treatment.

Figure 1: How often were chips received from investors invested in the risky project.



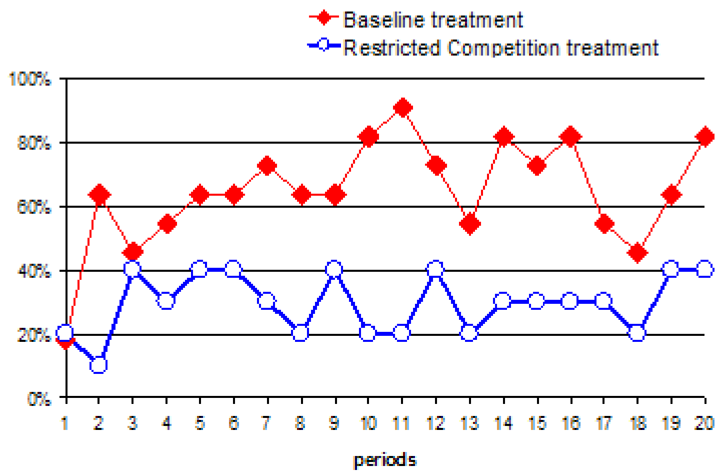
As Figure 1 indicates, in the Baseline treatment managers invested the funds they received in the risky project 65% of the time. In fact, this percentage increased to 70% over the last 10 periods of the experiment, indicating that learning increases investments in the risky project. Note that this percentage is only 30% in the Restricted Competition treatment (where we actually predict it should be 0%). Using the *Wilcoxon rank-sum test*, we reject the hypothesis that the observed sample of how risky managers are in the Baseline and the Restricted Competition treatments come from the same population in all 20 rounds ($p = 0.0060$) as well as in last 10 rounds ($p = 0.0139$).[16] Despite the lack of total conformity to the quantitative predictions of the theory, we still see that qualitatively that competition for funds does lead to significantly more risky behavior on the part of investors, as is predicted.

A period-by-period analysis of the investment decisions of the managers who received the fund to invest is even more striking. As we see in Figure 2, except for the very early rounds,

[16] To perform the Wilcoxon rank-sum test, we constructed one observation per manager, which indicates how often a manager invested the chip received from the investor in the risky project. The results of the test do not change if we take into account all the intended investments of a manager and not just the rounds in which he/she actually received the chip from the investor ($p = 0.0077$ for all rounds and $p = 0.182$ for the last 10 rounds).

most managers in the Baseline treatment choose the risky project.

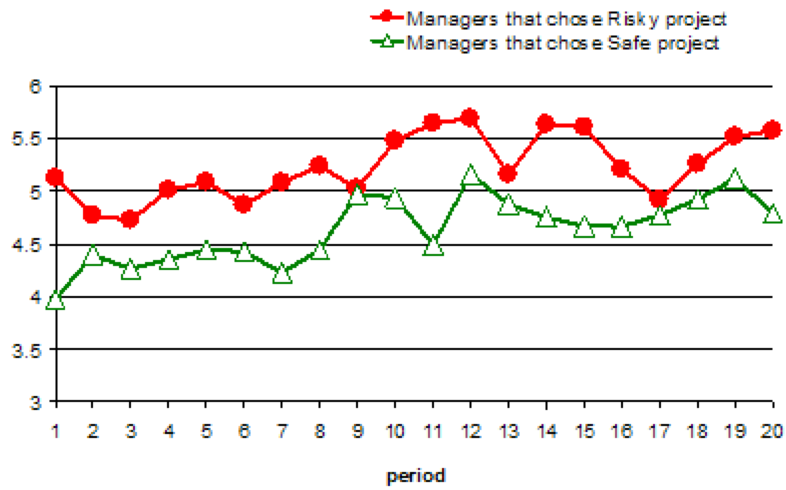
Figure 2: How often managers that received the chip from the investors invested it in the risky project, by period



A second fundamental equilibrium prediction in the Baseline treatment is that risk taking on the part of managers is associated to high-return offers (high w's) to investors. In fact, in this environment the theory predicts that w will rise to $R_r = 10$. Qualitatively, all that matters in order to observe risky behavior is that the observed w in the market rise above $w^* = 3.25$ since such high promised returns are expected to lead to risky investments. This is once again the case in the lab data.

Figure 3 presents the period-by-period offers of returns, w, for those managers intending to invest in the risky project and in the safe project.

Figure 3: Period-by-period offers of returns (w) in the Baseline treatment.



Note that managers promised consistently, on average, more than 3.25. In the first 5 periods, we observe only 6.4% (7 out of 105) of offers $w < 3.25$. In the remaining 15 rounds this number drops to less than 3%. Moreover, managers intending to invest in the risky project offer on average higher returns than those intending to invest in the safe project: managers that chose the risky project offer, on average, a return of 5.26 (5.43 in the last 10 rounds) and those that chose safe project offer, on average, 4.60 (4.84 in the last 10 rounds).

It should be clear from our discussion that while our subjects in the Baseline treatment did not push the promised return up to their limit of 10, as predicted, they did consistently push it above the threshold where risky behavior became rational. Of particular interest is the fact that for those managers intending to invest in the risky project, there seemed to be a great resistance to offering an w much above 7. Over all 20 rounds there are relatively few subjects who offered a w higher than 7. Even amongst those managers who attracted the chip we observe rarely a w above 7 (6 out of 220 cases, less than 3%). This may be true for a number of reasons. For example, in the Baseline treatment there is a residual 30% to 35% of subjects who invested in the safe project. For those subjects promising more than 7 was a losing proposition and rarely done. Hence, a manager intending to invest in the risky project may have believed that it was not necessary to offer more than 7 since there was a good chance that he would be facing a safe investor who he believed would never offer more than 7.

In summary, on a qualitative level we find that, as predicted, competition in the Baseline treatment greatly increases the fraction of funds invested in the risky project and lead consistently to promised returns above $w^* = 3.25$.

4.2 Do Transparency and Risk Sharing contracts lead to safe investments?

From the equilibrium predictions of our theory we would expect that Transparency or Risk Sharing contracts would eliminate risky investment. This would be the case for different reasons, however. In the case of Risk Sharing, since $w = 0$, the incentives of the manager and the investor are aligned. Since the safe project has a higher expected return, it is in the interest of the manager to invest in it so all funds should be invested in the safe project. In the Transparency case it is competition that insures safe investment since the only equilibrium is one where both firms promise to invest safe and offer $w = 7$ and, at that return, there exists no promised return that can induce the investor to want his chip invested in the risky project. As a result, we would expect less risky investment in the Risk Sharing and Transparency treatments than in the Baseline treatment.

Figure 4: How often the chip received from investors was invested in the risky project.

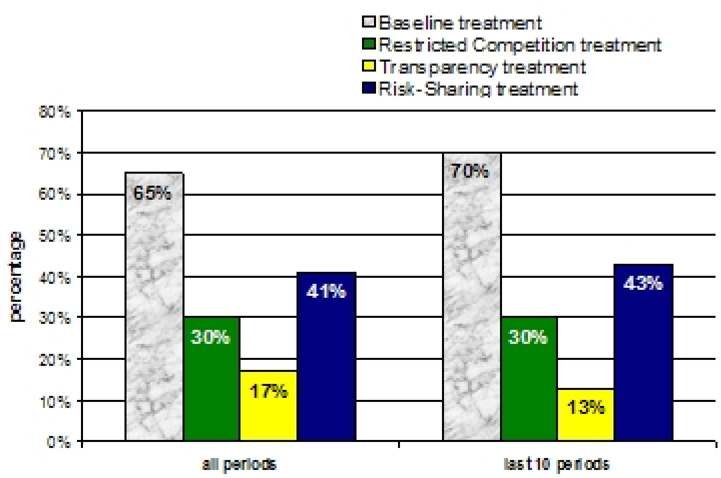


Figure 4 indicates that these expectations are substantiated by our data. As we can see, while subjects invested in the risky project 65% of the time over the 20 periods of the Baseline treatment, the did so only 41% and 17% of the time in the Risk Sharing and Transparency treatments respectively. The dramatic impact of transparency on the hedge fund contract is noteworthy since it indicates that investors in the experiment prefer to have their funds invested in the safe project and that the excessive risk taking in the Baseline treatment might be ascribed to investors inability to control how their funds are being invested.

Our Result 2 implies that if one manager proposes to invest in the safe project while the other proposes to invest in the risky project, as long as the promised return on the risky project is more than $\frac{p_s}{p_r}$ times the promised return on the safe project (1.8 in our parameterization), the investor should prefer to invest his money in the risky project. Perhaps one of the reasons why we see so much investment in the safe project in the Transparency treatment is that while there is a significant premium for risky investment in this treatment (see Table 3 below), it is not sufficiently large to induce investors to want to go risky. For example, note that in the Transparency treatment the mean w offered for investment in the safe project over all periods (last 10 periods) was 4.43 (4.73) while the same w offered for investment in the risky project was 5.54 (5.95). As we see, while this premium is statistically significant[17], it is not, on average, as high as needed to be sufficient to make risky investment preferred by investors.

Table 3: Average offers of managers, by treatment

	average w in all rounds	average w in last 10 rounds
Baseline treatment		
investors that chose risky project	5.26	5.43
investors that chose safe project	4.60	4.84
Transparency Treatment		
investors that chose risky project	5.54	5.95
investors that chose safe project	4.43	4.73
	average β in all rounds	average β in last 10 rounds
Risk Sharing Treatment		
investors that chose risky project	64.3%	71.6%
investors that chose safe project	63.7%	71.7%

Finally, note that in the Risk Sharing treatment, managers that intended to invest in the risky and in the safe projects offered very similar shares of the proceeds to the investor: about 64% in all 20 rounds and about 72% in the last 10 rounds (see Table 3)[18]. Thus, the investors could not infer from the promises made by managers whether their funds will be allocated to the safe or to the risky project.

4.3 Is there an *Other people's money* effect?

The *Other peoples' money* effect postulates that managers, for some reason, tend to be more willing to take higher risks when investing other peoples' than their own money. To be precise, we define the Other people's money effect as the difference in the risk taking behavior of managers in the Risk Sharing and Own Money treatments. In both treatments, in fact, managers' incentives are completely aligned with those of investors and theoretically,

[17] According to the Wilcoxon ranksum test, we reject the null hypothesis that the w's offered for investment in the safe and risky projects come from the same population for all 20 rounds ($p < 0.01$) as well as for the last 10 rounds ($p < 0.01$).

[18] Wilcoxon ranksum test cannot reject the hypothesis that shares offered by the managers who intended to invest in the risky project come from the same population as the ones offered by those who intended to invest in the safe project ($p = 0.4948$ in all 20 rounds and $p = 0.9448$ in the last 10 rounds).

at equilibrium, we expect to see all funds invested in the safe project.

Table 4: How often funds were invested in the risky project, in the Risk Sharing and the Own Money treatments

	Risk Sharing	**Own Money (small stakes)**	**Own Money (big stakes)**
round 1 to 5	36.7%	23.5%	
round 6 to 10	42.0%	21.7%	
round 11 to 15	46.7%	19.1%	
round 16 to 19	40.8%	16.3%	
round 20	43.3%	43.5%	
Overall	41.7%	21.5%	managers 10.2% investors 10.2%

Table 4 presents the percentage of times subjects made risky investment in the Risk sharing and the Own money treatments. In the Own Money (big stakes) treatment only 10.2% of subjects (both managers and investors) invested their own funds in the risky project,[19] while they did so 41.7% of the time in the Risk Sharing treatment. In other words, if subjects have learned anything over the course of the 20 rounds experiment it is that they want their chip to be invested in the safe project when it is worth a lot of money.

Similar conclusions can be drawn from comparing the Risk Sharing and the Own Money (small stakes) treatments. Except for the very last round, subjects are much more likely to make risky investments when they allocate other people's money (41.7%) than their own (21.5%). Moreover, the fraction of risky investments monotonically decreases with experience in the Own Money treatment, while it is not the case in the Risk Sharing treatment. The last round of the Own Money (small stakes) treatment shows the end-game effect: in the last round 43.5% of the managers chose the risky project, which is two times more than the percentage of risky investments in the first 19 rounds where average is about 20%.[20]

Figures 5 and 6 below depicts the histograms and the cumulative distributions of the riskiness of the managers' investments in the Own Money (small stakes) and in the Risk Sharing treatments.[21]

[19]Recall that the Own Money (big stakes) treatment was performed at the end of each session after another treatment. There is, however, no significant difference in the behavior of either managers or investors according to the the different treatments they previously played (by the test of proportions). Therefore, we pool together all the data from Own Money (big stakes) treatment and report them together.

[20]End-game effects are often observed in the experiments on finitely repeated games. See, for instance, Reuben and Suetens (2009) and the references mentioned there for end-game effects in the repeated prisoners' dillemma game.

[21]For each manager, one observation is the fraction of the times he/she invested funds in the risky project over the course of 20 rounds.

Figure 5: How often managers chose risky project in Risk Sharing and Own Money (small stakes) treatments

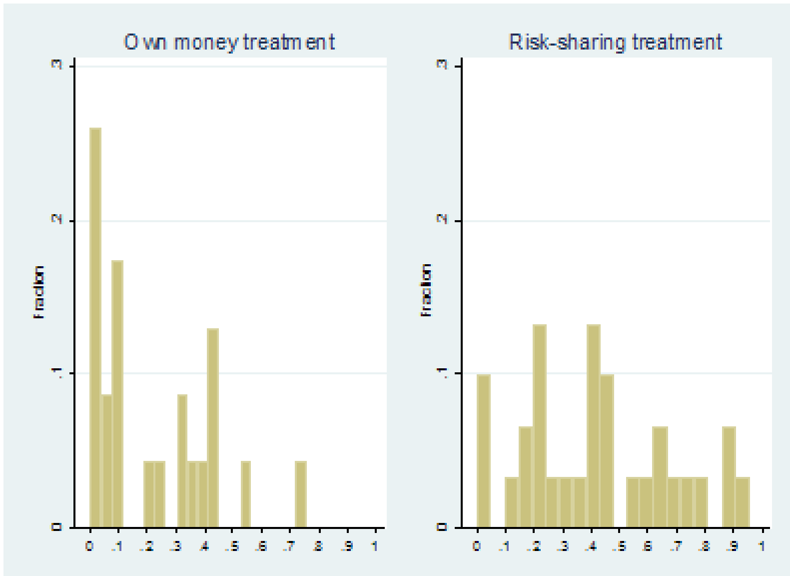
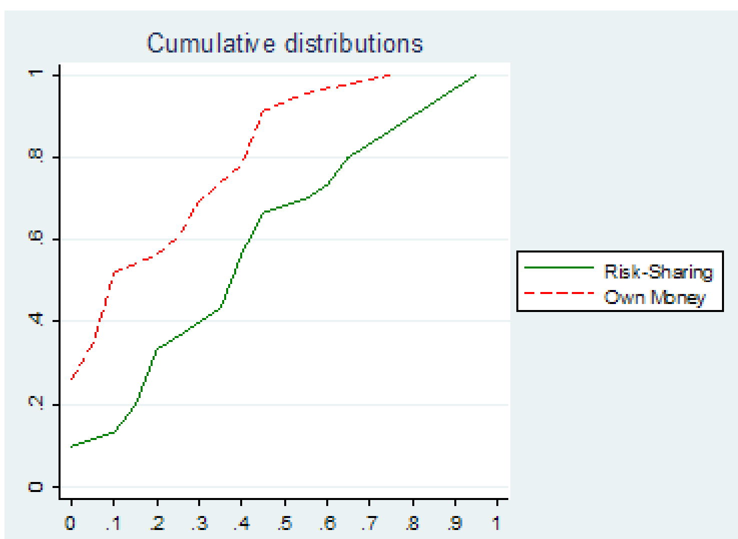


Figure 6: Cumulative distributions of how often managers chose risky project in Risk Sharing and Own Money (small stakes) treatments



Figures 5 and 6 clearly show that managers were much more risky with the investors' money than with their own. Indeed, 52.2% of the managers in the Own Money (small stakes) treatment invested their own funds in the safe project 90% of the time or more. That is, more than half of managers chose the risky project *at most* twice out of 20 rounds played in the Own Money treatment. The same behavior is rare in the Risk Sharing treatment, in which only 13.3% of the managers behave that way. According to *Kolmogorov-Smirnov test*, we reject the hypothesis that the distributions of the riskiness of the managers' investments are the same in these two treatments (corrected $p = 0.022$).

This evidence for the *Other people's money* effect possibly suggests that something in the nature of competing for funds leads managers to want to be take more risks, risks that they obviously would not want to take if they were investing their own money. It is natural to search for rationalizations of this effect in the realm of behavioral economics. For instance, managers might place other people's money in a different mental account than their own (see Thaler (1985), (1999)). In this case, the Other people's money effect we document would be related to the *House money effect* discussed by Thaler-Johnson (1990) and Keasey-Moon (1996).

4.4 How do investors behave?

In this section we discuss the behavior of investors. Our objective here is to understand if the behavior of investors in our experimental data is also qualitatively consistent with equilibrium. This is particularly apparent in the Transparency treatment, where the rational action of investors is not confounded by their beliefs about which project the manager will invest in. In this treatment, over all 20 rounds there were 172 cases where both managers chose the same project. In 164 of these cases (95%), investors, as expected, gave their chip to the manager offering the highest w. In 88 cases, one manager chose the risky project while the other chose the safe one. In 7 of these cases the risky manager promised 1.8 more than the safe one and in 5 of these 7 (71.4%), the investors gave their chip to the risky manager. On the other hand, in 13 cases the safe manager promised more than the risky one and in all 13 cases (100%) the investors gave the chip to the safe manager. Finally, in 68 cases the manager offering a risky investment promised more than the one offering a safe investment but less than 1.8 times more. Here the chip should go to the safe manager and it did so 58 out of 68 cases (85.3%). All of these statistics are supportive of the hypothesis that investors behaved as we expected them to in the experiment. In all of these cases above (except for the 5 out of 7 cases), using a binomial test, we can reject the hypothesis that the chip was allocated randomly with a prob = 50%.[22]

[22] Over the last 10 periods the results are even stronger, albeit with fewer observations. More precisely, in 91 cases both managers chose the same project. In 89 out of 91 cases (98%), investors gave their chip to that manager making the highest promised w. In 39 cases, one manager chose the risky project and another chose the safe one. In 2 of these cases the risky manager promised 1.8 more than the safe one and in both 2 cases (100%), the investor gave the chip to the risky manager. In 6 cases the safe manager promised more than the risky manager and in all 6 cases (100%) the investors gave the chip to the safe manager. Finally, in 31 cases, the risky manager promised more than the safe manager but less than 1.8 times more, and the

5 Conclusions

This paper has investigated the impact of competition on the risk taking behavior of laboratory hedge fund managers who operate under the standard hedge fund option-like compensation contracts. We find that the competition for funds does indeed lead to an equilibrium where funds are invested in an inefficient risky manner. This problem can be mitigated by either changing the contract type, restricting the watermark used in the hedge fund contract or by forcing managers to reveal the projects in which funds will be invested. While these interventions are successful to a limited degree, they fail to completely eliminate the risky behavior of managers due to their documented inclination to invest the money of others in riskier assets than their own.

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chip went to the safe manager in 27 out of 31 cases (87.1%). Again, all of these facts are supportive of the hypothesis that investors behaved in a rational manner in our experiment.

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6 Appendix 1: A Note on Hedge Fund Contracts

As we described in Section 2, a typical hedge fund contract specifies a pair (w, β) which represents a watermark w and a share β of profits above watermark that managers keeps for himself. We will show below that,

if $\beta \geq \bar{\beta} > 0$[23] *there exists an equilibrium in which all the funds are invested in the risky project.*

We will show that we can sustain an equilibrium in which both managers propose contract with $w = R_r$, $\beta \in [\bar{\beta}, 1]$ and invest in the risky project.

First, similarly to the Result 1, if $w > w^*$ then a manager will prefer to invest in the risky project because

$$\begin{aligned} \Pi^{\text{manager}}_{w,\beta,\text{safe}} &< \Pi^{\text{manager}}_{w,\beta,\text{risky}} \Leftrightarrow p_s\beta(R_s - w) < p_r\beta(R_r - w) \\ &\Leftrightarrow w > w^* = \frac{p_sR_s - p_rR_r}{p_s - p_r} \end{aligned}$$

Thus, when an investor gives his funds to a manager that promised $w = R_r$, his funds will be invested in the risky project.

To sustain the equilibrium proposed above, the only deviation that we need to rule out is the one in which one of the managers proposes $w = w^*$ and $\beta' \in [\bar{\beta}, 1]$. If this proposal attracts the investor, then it is clearly beneficial for the manager because it gives him/her positive expected profits, as opposed to the zero profits which is what he/she earns following strategy $w = R_r$ and $\beta \in [\bar{\beta}, 1]$. However, this deviation will attract the investor only if $\Pi^{\text{investor}}_{w=R_r,\beta} < \Pi^{\text{investor}}_{w=w^*,\beta'}$. Thus, to rule out this deviation we need to make sure that $\Pi^{\text{investor}}_{w=R_r,\beta} \geq \Pi^{\text{investor}}_{w=w^*,\beta'}$. But:

$$p_r \cdot R_r \geq p_s \cdot [w^* + (1 - \beta')(R_s - w^*)] \Leftrightarrow \beta' \geq \beta^* = \frac{p_sR_s - p_rR_r}{p_s(R_s - w^*)}$$

Thus if $\beta^* < \bar{\beta}$ then for any $\beta' \in [\bar{\beta}, 1]$, there exists an equilibrium in which all the funds received from an investor are allocated to the risky project.

We interpret therefore the assumption that $\beta = 1$, which we adopted in the paper, as a simplification of the analysis.

7 Appendix 2: Instructions for the Baseline Treatment

This is an experiment in decision-making. If you follow the instructions and make good decisions, you can earn a substantial amount of money, which will be paid to you at the end of the session. The currency in this experiment is called tokens. All payoffs are denominated

[23] In fact, in the hedge fund markets, managers typically keep 15−25% of returns exceeding the watermarks. Thus, we will focus on the situation in which this share β is bounded away from zero.

in this currency. The experiment consists of **20 identical decision rounds.** At the end of the experiment, we will sum up the tokens you earned in all 20 rounds and this amount will be converted into US dollars using a conversion rate of 10 tokens = $1. In addition, you will receive a participation fee.

Before the beginning of the experiment you will be randomly assigned roles: $\frac{2}{3}$ of the participants will be assigned a role of **investors** and $\frac{1}{3}$ of participants will be assigned a role of **lenders**. The role of an investor will be to invest an "investment chip" if one given to him by the lender, while the role of the lender will be to decide whom to given his investment chip to. Roles stay fixed until the end of the experiment. That is, if at the beginning of the experiment you were assigned the role of an investor (lender) you will keep this role for all 20 rounds.

In each round, participants will be randomly matched into the groups of 3 people. Each group consists of two investors and one lender. Once the round is over, you will be re-matched with other participants for the next round. However, there will always be two investors and one lender in every group. The investors will receive a participation fee of $10 and lenders will receive a participation fee of $5.

Decision of the investors in each period.

Each period starts with the lender being given one chip which he/she will lend to one of the investors in their group. This chip has no value other than providing the right to get a return if it is invested, i.e. it cannot be converted to tokens. Investors are the ones who decide how a chip received from the lender is invested and how many tokens the lender will receive if the investment is successful.

There are two investment projects: Project 1 and Project 2, which differ in the returns and the probability of defaulting:

- **Project 1** pays back 10 tokens with probability 50% and 0 tokens with probability 50%.
- **Project 2** pays back 7 tokens with probability 90% and 0 tokens with probability 10%.

In other words, **Project 1** has a return of 10 tokens and 50% probability of defaulting. **Project 2** has return of 7 tokens and 10% probability of defaulting.

Each period starts with the investors making two decisions. First, each Investor chooses how many tokens he is willing to pay to the lender that lends him his/her chip in case the investment is successful. Second, each investor chooses a Project in which the chip received from the lender will be invested. The number of tokens that the investor can pay the lender for a chip can be any number between 0 and 10 tokens with one digit after decimal, i.e. numbers like 3.2, 4.6, 5.9, 8.6 etc... This number represents how many tokens an investor will pay the lender that lends him his/her chip in case the project in which this chip was invested was successful. If the project in which the chip was invested defaulted, then both the investor and the lender get zero tokens. Each investor makes his/her choice without knowing what the other investor from his group chose.

Decision of lenders in each period.

After both investors make their choices, the lender observes how many tokens each investor promises to pay to the lender that gives him his chip. The lender's task is to choose which investor he/she is willing to lend his chip to. Notice that lenders do not observe which project the investor chose to invest in (project 1 or 2); they observe only the promises of the investors in their own group. The screen for the lenders will look like this

Investor A promised to pay back x tokens
Investor B promised to pay back y tokens

It is important to note that in each round, the lender is matched with different investors. Therefore, it is impossible to track the same investor between periods. For instance, an investor who appears as Investor A in one round is not the same person as investor who appears as Investor A in the next round.

How the profits of the investors and the lender are determined.

In any period, an investor that did not receive a chip from the lender will receive zero tokens in that period.

If the investor who did receive a chip and promised to pay back x tokens, then

- if the project in which the chip was invested defaulted, both the investor and the lender get 0 tokens in that period
- if the chip was invested in Project 1 and did not default, then the investor gets $10 - x$ tokens in that period and the lender gets x tokens as promised.
- if the chip was invested in Project 2, did not default and $x \leq 7$, then the investor gets $7 - x$ tokens in that period and the lender gets x tokens as promised.
- if the chip was invested in Project 2, did not default and $x > 7$, then the investor gets 0 tokens in that period and the lender gets 7, which is less than what investor promised to him.

Quiz.

Question 1

Say an investor that received a chip from the lender promised to pay back 7.3 tokens, invested this chip in Project 1 and Project 1 did not default. What is the profit of the lender in this period? What is the profit of the investor that received the chip in this period? What is the profit of the other investor from the same group? What is the profit is each subject in a group if Project 1 defaulted?

Question 2

Say investor that received the chip from the lender promised to pay him back 4.9 tokens, invested this chip in Project 2, which did not default. What is the profit of the lender in this period? What is the profit of the investor that received the chip? What is the profit of the other investor from the same group?

Investor's feedback.

At the end of each period investors observe the following information: how many tokens he/she promised to pay back to a lender that lends him/her chip; how many tokens the other investor promised to pay back to lender; whether or not the investor received the chip from the lender; in case the investor received the chip from the lender, which project was the chip invested in and whether the project was successful or not; whether the investor was able to repay the lender what he promised and profits of the investor in tokens. You will not be told what project the other investor decided to invest in.

Lender's feedback.

At the end of each period the lender observes the following information: how many tokens each investor promised to repay to a lender that gives him his chip; which investor he/she chose to lend the chip to and whether this investor was able to repay the promised return or not. The lenders are also informed about how many tokens they received in this period.

To summarize:

- At the beginning of the experiment, subjects are assigned roles of investors and lenders, which they keep for the whole duration of the experiment.
- In each period subjects are divided into the groups of 3 people: two investors and one lender.
- Each period starts with the decision of investors as to how many tokens they promise

to repay to a lender that gives him/her an investment chip and which project, 1 or 2, the chip received from the lender will be invested in.

- The lenders observe the promised returns and choose one investor in their group to lend chip to
- The chip received by an investor is then invested in the project of his/her choice as determined at the beginning of the period
- Payoffs are realized and all lenders and investors observe how many tokens they receive in this period
- At the end of the experiment all tokens earned in these 20 periods will be summed up and their sum converted to US dollars at a rate of 10 tokens = $1. In addition, you will receive a participation fee.

Last part of the experiment.

In this part of the experiment we will ask you all to act as an investor for one period and make one investment decision with an investment chip which we will give you. Please choose whether you want to invest in Project 1 or Project 2:

- Project 1 pays back 10 tokens with probability 50% and 0 tokens with probability 50%
- Project 2 pays back 7 tokens with probability 90% and 0 tokens with probability 10%

After you made your decision, we will roll a 10-sided dice to determine whether the project you invested in defaulted or paid back. If you invested in Project 1 and dice lands on 0, 1, 2, 3 or 4 then Project 1 defaults and you get 0 tokens. If it lands on any number strictly above 4 (that is, 5, 6, 7, 8 or 9) then you get 10 tokens. If you invested in Project 2 and dice lands on 0 then Project 2 defaults and you get 0 tokens. If it lands on any other number (1, 2, 3, 4, 5, 6, 7, 8 or 9) then you will get 7 tokens.

Amount of tokens you earn in this part will be converted into US dollars, using the conversion rate 1 token = $1, and added to your total payment.

Please circle the Project in which you want to invest your investment chip:

Project 1 Project 2