Rank matters. The Impact of Social Competition on Portfolio Choice

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Abstract

Tournament incentives schemes have been criticized for inducing excessive risk-taking among financial market participants. In this paper we investigate how relative performance-based incentive schemes and status concerns for higher rank influence portfolio choice in laboratory experiments. We find that both underperformers and over-performers adapt their portfolios to their current relative performance, preferring either positively or negatively skewed assets, respectively. Most importantly, these results hold both when relative performance is instrumental for higher payoffs in a tournament and when it is only intrinsically motivating and not payout-relevant. We find no effects when no relative performance information is given.

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1. Introduction

This paper investigates how tournament incentives and social competition affect risk attitudes and portfolio choice. In laboratory experiments subjects make repeated portfolio choices by choosing from a menu of lotteries with different levels of skewness and correlations (either idiosyncratic or correlated). In Treatment INDIVIDUAL subjects are paid linearly according to their earnings. In SOCIAL subjects are paid linearly but receive information about their relative performance. In TOURNAMENT subjects' payment is entirely based on relative performance which is a convex function of rank. We find a (i) strong relationship between rank and preferences for skewed assets in treatments TOURNAMENT and SOCIAL. While underperformers exhibit a strong preference for positively skewed assets, over-performers show a strong preference for negatively skewed assets as they offer a moderate gain with high probability. Most importantly, we find (ii) almost identical patterns in portfolio selection of subjects in treatments TOURNAMENT and SOCIAL. This result suggests that it is mainly the intrinsic desire for social status that is driving the effect of rank on risk attitudes and portfolio choice.

Rajan (2006) argues that one of the main origins of instability in highly developed financial markets are widely used convex incentives in financial institutions. It has also been argued that part of the reason for the excessive risk-taking before the financial crisis in 2007-2008 was related to these tournament-style and non-linear compensation schemes in financial institutions (see e.g. Bebchuk and Spamann, 2010; Dewatripont et al., 2010; French et al., 2010; Gennaioli et al., 2010). In a related study, Brown et al. (1996) show that fund managers indeed react to tournament-style incentives. They find that mid-year losers tend to increase fund volatility in the latter part of an annual assessment period to a greater extent than mid-year winners.[1] Similarly, Elton et al. (2003) show that mutual funds with incentive fees and poor performance increase risk more than poorly performing mutual funds without incentive fees.

However, the effects of underperformers taking more risks might not solely be due to extrinsic monetary incentives. Since Veblen (1899) coined the term “conspicuous consumption” economists have noted that part of economic behavior can be explained as an attempt to impress others. For example, Friedman and Savage (1948) suggest that people may have convex utility over certain ranges of income, when a small increase in income would imply a jump into a higher social class, explaining why people buy both insurance and lottery tickets. Robson (1992) and Becker et al. (2005) model the equilibrium distribution of consumption and risk-seeking when people have convex utility over their relative rank in society. Since investment funds and fund managers are regularly ranked by publications such as *Business Week, Forbes* and *The Financial Times,* status concerns and an intrinsic desire to outdo one's peers could be especially important for fund managers’ risk-preferences. Indeed, Roussanov (2010) models how the desire to “Get ahead of the Joneses” leads to lower aversion to idiosyncratic risks than aversion to correlated risks. Krasny (2009) examines the impact of status seeking considerations on investors’ portfolio choices. In his model, low-status investors invest in portfolios that maximize their chances of moving up the ladder. High-status investors, on the other hand, look to maintain the status quo and hedge against the choices made by the low-status investors.

[1] Mutual fund managers’ compensation typically depends on the fund’s return plus the overall size of the fund. According to Chevalier and Ellison (1997) and Sirri and Tufano (1998) the net capital fund inflows are a convex function of past performance. Since fund size is mechanically linked to inflow, the competition in the fund industry can be viewed as a tournament with convex payoff where managers compete for investor cash flow.

There has been relatively little work done on investigating tournaments, social competition, and risk-taking in the lab. The advantage of using an experimental approach when studying these issues is the possibility to control for subjects' incentives and information about their and others performance. In a seminal study James and Isaac (2000) run asset market experiments and document that tournament incentives lead to larger price bubbles. Similarly, Schoenberg and Haruvy (2012) show that experimental asset markets in which traders receive feedback about the top performer display larger asset bubbles than when information is given about the bottom performer. Nieken and Sliwka (2010) study a simple tournament game where two contestants choose between a safe and a risky strategy. They find that when outcomes are independent the leader is indeed more likely to choose the safe strategy, but when outcomes are correlated the leader might mimic the risky strategy of the laggard. There is also some experimental evidence showing that concerns over relative outcomes can affect risk-preferences.[2] In Linde and Sonnemans (2012) subjects are more likely to choose a risky option when a reference subject receives a low pay-off than when the other receives a high pay-off. Bault et al. (2008, 2011) show that people have different physiological reactions to the outcome of a lottery, depending on the outcome of other peoples' lotteries. They find a stronger reaction to social gains than to social losses.

Our setup differs in an important way compared to existing literature. We analyze whether tournament monetary incentives affect risk attitudes and portfolio choice. We further investigate to what extent social competition leads to similar behavior as tournament monetary incentives. Thus, even without explicit convex monetary incentives, social competition alone could induce underperformers to different behavior with respect to over-performers. Therefore, we are the first to disentangle

[2] See also the chapter on the social influences on risk by Trautman and Vieider (2012) in the Handbook of Risk Theory.

monetary effects of the tournaments from the effect of social competition in portfolio choice experiments. We find a (i) strong relationship between rank and preferences for skewed assets in treatments TOURNAMENT and SOCIAL. In particular, underperformers show a strong preference for positively skewed assets while over-performers invest disproportionally in negatively skewed assets (see Lin, 2011). Most importantly, we show that these outcomes are not necessarily driven by tournament incentives per se, but can be explained by a competition for social status. In particular, we show (ii) almost identical patterns in portfolio selection choices of subjects in treatments TOURNAMENT and SOCIAL. Thus, the preference for positively skewed assets of underperformers and the preference for negatively skewed assets of over-performers are virtually identical in both treatments. Thus, risk-taking in financial tournaments might not solely stem from people trying to win the tournament reward, but rather from people trying to be among the top in the tournament.

2. Predictions

With standard preferences, say a constant relative risk aversion (CRRA) utility function, the optimal portfolio would be diversified with a bias towards assets that offer the best risk-return trade-off. When all assets have the same expected return (as will be the case in our experiment), this implies a preference for those assets with the lowest variance, although other assets will still be included in the portfolio for diversification reasons. With CRRA utility the higher moments have been shown to have a negligible effect on utility and portfolio selection (Aït-Sahalia and Brandt, 2001).

By contrast, Cumulative Prospect Theory by Tversky and Kahneman (1992) suggests that loss-averse individuals prefer negative skewness over positive skewness. A loss-averse investor, who evaluates changes in wealth relative to a reference point with a convex value function for the loss domain, prefers a one-time substantial loss to a succession of small losses. Although the overweighing of small probabilities can also make positively skewed assets seem attractive. Barberis and Huang (2008) argue that positively skewed assets can be overpriced for this reason.[3]

By building on these insights, the major question is whether convex incentives lead to rank-dependent preferences for skewness. It is important to note that we have consciously chosen the simplest models to arrive at our hypotheses. For example here we leave out private preferences over risk and skewness to focus solely on the tournament aspect. Since private preferences would not change by relative rank, including them would not change the results, but only lengthen the exposition. Of course, more complicated models might provide greater details, but have the drawback of additional assumptions.

We assume that the distribution of relative performance is stationary with a fixed mean of zero. Suppose that the final payoff over relative performance *x* is given by:

$$u(x) = \begin{cases} x & x > 0 \\ 0 & x \leq 0 \end{cases} \tag{1}$$

Now suppose a decision-maker starts with an initial relative endowment *W* and needs to choose a binary lottery ($x_L, p; x_H, 1-p$) among lotteries that have an expected value of zero and a variance equal to *V*. Given that the expected value is set at zero,

[3] Preference reversals over positively and negatively skewed lotteries have been documented in lottery experiments (see e.g. Lichtenstein and Slovic, 1971). Subjects typically prefer the negatively skewed lottery to the positively skewed lottery with the same expected value. On the other hand, when asked to put a value on the lotteries, subjects typically put a greater value on the positively skewed lottery.

the high outcome of the gamble x_H must be above zero and the low outcome x_L below.

Then the decision-maker's maximization problem is as follows:

$$\begin{gathered}\max_{\{x_L, x_H\}} pu(x_L + W) + (1-p)u(x_H + W) \\ s.t. \\ px_L + (1-p)x_H = 0 \\ p(x_L)^2 + (1-p)x_H^2 = V\end{gathered} \tag{2}$$

From the constraints it follows directly that $x_H = -\frac{p}{1-p}x_L$ and $p = \frac{V}{V+x_L^2}$.

There are three relevant cases: both $x_L+W<0$ and $x_H+W<0$, both $x_L+W>0$ and $x_H+W>0$ or $x_L+W<0$ and $x_H+W>0$. In the first case expected utility would equal zero. Given that this is inferior to any lottery that lies partly on the linear part of the convex utility function, a decision-maker can always get positive expected utility by choosing a sufficiently positively skewed distribution such that $x_H>-W$, corresponding to the third case. In the second case both outcomes would be on the linear part of the utility function and thus expected utility would simply be equal to the initial endowment W.[4]

In the third case, the first part of the utility function will be equal to zero and thus can be dropped from the maximization problem. After replacing p and x_H from the constraints, the optimization problem then becomes:

$$\max_{\{x_L\}} \left(1 - \frac{V}{V + x_L^2}\right)\left(-\frac{\frac{V}{V + x_L^2}}{1 - \frac{V}{V + x_L^2}} x_L + W\right) = -\frac{Vx_L + x_L^2 W}{V + x_L^2} \tag{3}$$

[4] Remember that the expected value of any lottery is zero, and risk-neutrality implies that utility is equal to the expected value of the gamble.

Solving for the first order condition we find the optimal $x_L^* = -(W + \sqrt{W^2 + V})$. Thus x_L^* is decreasing in *W*. Plugging this back into the objective function we find

$$EU(x_L^*, x_H^*, p^*) = 1/2\ (W + \sqrt{W^2 + V}) > W \qquad (4)$$

Thus by choosing a sufficiently negatively skewed lottery (in case the agent is leading) she can always do better than with a lottery that always ends up in the positive linear part of the utility function.

The skewness of a random variable is defined as $\gamma = \frac{E[(X-\mu)^3]}{(E[(X-\mu)^2])^{3/2}}$, which in our case boils down to: $\gamma = \frac{px_L^3 + (1-p)x_H^3}{(px_L^2 + (1-p)x_H^2)^{3/2}}$. Substituting x_L^*, x_H^* and p^* and simplifying, we find that the skewness of the optimal lottery is given by $\gamma^* = -\frac{2W}{\sqrt{V}}$. Thus when the decision-maker's initial endowment is positive and above average (*W*>0) she will prefer negatively skewed lotteries, and when her initial endowment is negative and below average (*W*<0) she would prefer positively skewed lotteries instead.

This result is the basis for our first hypothesis:

Hypothesis 1:

Subjects with above average rank prefer negatively skewed assets, while subjects with below average rank prefer positively skewed assets.

Furthermore, we address the issue whether the behavior suggested by hypothesis 1 stems from the monetary tournament incentives or whether it is driven by social competition. If we find similar behavior in a condition in which relative rank is displayed for subjects but it is not payoff relevant this implies that subjects show convex utility over rank as in Robson (1992) and Becker et al. (2005). Our second hypothesis is stated as follows:

Hypothesis 2: Social competition for rank induces similar preferences for assets with different levels of skewness as direct tournament monetary incentives.

The next question is whether decision-makers prefer idiosyncratic or correlated assets conditional on their rank. Again, to keep the analysis straightforward, here we assume a simple tournament utility function depending on own portfolio performance x_0 and average portfolio performance x_1 of the type:

$$u(x_0 - x_1) = \begin{cases} 1 & x_0 \geq x_1 \\ 0 & x_0 < x_1 \end{cases} \tag{5}$$

Suppose the performance in a tournament is determined by both a common payoff and an idiosyncratic part. A decision-maker needs to decide what fraction α_1 to invest in an asset X_1 that is idiosyncratic and what fraction $(1-\alpha_1)$ in an asset Y_1 that is perfectly correlated with the common payoff Y. In turn average performance depends on the average fraction α_2 invested in idiosyncratic assets X and the overall fraction $(1-\alpha_2)$ in the common payoff asset Y. Suppose further that the initial relative endowment is again given by W, and that both types of assets are normally distributed.

We can define a random variable

$$Z = x_0 - x_1 = W + \alpha_1 X_1 + (1 - \alpha_1) Y_1 - \alpha_2 X - (1 - \alpha_2) Y \tag{6}$$

where Z is distributed normally and only if *Z*>0 will the decision-maker beat the average performance[5]:

$$Z \sim N(W + \alpha_1\mu_{X1} + (1-\alpha_1)\mu_{Y1} - \alpha_2\mu_X - (1-\alpha_2)\mu_Y, \\ \alpha_1^2\sigma_{X1}^2 + (1-\alpha_1)^2\sigma_{Y1}^2 + \alpha_2^2\sigma_X^2 + (1-\alpha_2)^2\sigma_Y^2 - 2(1-\alpha_1)(1-\alpha_2)\sigma_{Y1}\sigma_Y) \quad (7)$$

Now for any normally distributed random variable, the probability that N(W, σ^2)>0 is given by

$$\frac{1}{2} + \frac{1}{2}\mathrm{erf}(\frac{W}{\sqrt{2}\sigma^2}) \quad (8)$$

Where erf() is the sigmoid shaped error function. This implies that for *W*>0, the agent increases the probability of *Z*>0 by decreasing σ^2, whereas for *W*<0 the agent increases the probability of *Z*>0 by increasing σ^2. This is in fact the prediction that Brown et al. (1996) tested when they found that lagging funds take more risk than leading funds.

Supposing that the expected return of both assets is zero and the variances of the correlated and idiosyncratic assets are the same (as in our experiment), the only way the decision-maker can affect the variance of *Z* is by increasing or decreasing the correlation of their own payoff with that of the market average. Thus leading players would choose a portfolio that is more correlated with common payoffs, and lagging players would choose more idiosyncratic portfolios.[6] Furthermore, diversification will ensure that all players will invest at least a portion in the common correlated asset.

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[5] Recall that the correlation ρ between *Y1* and (–*Y*) is equal to -1.

[6] A similar analysis where a tournament incentive is induced due to positive assortative matching on the marriage market can be found in Cole et al. (2001).

As a consequence, our third hypothesis is as follows:

Hypothesis 3:

Subjects with above average rank prefer assets with correlated risks, while subjects with below average rank prefer assets with idiosyncratic risks.

Analogously to hypotheses 1 and 2, we address the issue whether the behavior suggested by hypothesis 3 is driven by monetary tournament incentives or by social competition. Our fourth hypothesis is stated as follows:

Hypothesis 4: Social competition for rank induces similar preferences for assets with correlated or idiosyncratic risks as direct tournament monetary incentives.

3. The Experiment

3.1. Setup of the Experiment

We design a between-subjects portfolio choice experiment[7] where ten subjects have to form portfolios out of three different types of assets with either negative, positive or zero skewness.[8] Subjects can also choose whether to invest in either correlated or non-correlated outcomes within each type of asset, resulting in six types of assets in total. At the beginning of each treatment subjects are endowed with 15,000 Tokens and then gains and losses accumulate over twelve periods.

Table 1 provides details on the lottery types. Each type of asset has six equally probable outcomes, corresponding to the outcome of a die roll. All types of assets are characterized by the same expected payoff of zero, whereas the variance,

[7] In an earlier version of this paper we have used a within-subjects design by letting each cohort of subjects act in all three treatments sequentially. We have re-run all 18 sessions in a between-subjects design to avoid any ordering effects.

[8] For the sake of simplicity assets were labeled as lotteries in the instructions. We will use the terms "asset" and "lottery" interchangeably throughout the paper.

skewness and correlation structure varies between asset types. In each round subjects have to invest in exactly 100 shares by choosing among the six different types of assets.

Table 1. Lottery Types.

Name	Type	Payoffs (Tokens)	SD	Skew	PT, λ=2	PT, λ=2.25, α=0.88
Lottery A1	Positive skew, correlated	(-15, -15, -15, -15,-15, 75)	36.7	1.79	-75	-9.2
Lottery B1	Zero skew, correlated	(-20, -20, -20, 20, 20, 20)	27.4	0	-60	-5.8
Lottery C1	Negative skew, correlated	(15, 15, 15, 15, 15, -75)	36.7	-1.79	-75	-4.7
Lottery A2	Positive skew, idiosyncratic	(-15, -15, -15, -15,-15, 75)	36.7	1.79	-75	-9.2
Lottery B2	Zero skew, idiosyncratic	(-20, -20, -20, 20, 20, 20)	27.4	0	-60	-5.8
Lottery C2	Negative skew, idiosyncratic	(15, 15, 15, 15, 15, -75)	36.7	-1.79	-75	-4.7

SD is the standard deviation. Skew stands for skewness. The final two columns show the Prospect Theory value functions for a piecewise linear specification and a concave/convex specification respectively.[9]

Lotteries of type A1 and A2 are characterized by positive skewness with a large probability (p=5/6) of incurring a small loss of 15 tokens and a small probability (p=1/6) of a large gain of 75 tokens. The negatively skewed lotteries C1 and C2 are modeled as the opposite, i.e., yielding a small gain of 15 Tokens in 5 out of 6 cases and incurring a loss of 75 Tokens with probability of 1/6. Lotteries of type B1 and B2 have zero skewness and provide a 50/50 chance of either gaining or losing 20 tokens. Correlations between the six different assets are zero, as they are all determined by independent die throws.

[9] For the piecewise linear specification the Prospect Theory value function corresponds to $v(x) = \begin{cases} x & x > 0 \\ 2x & x < 0 \end{cases}$. For the concave/convex specification the value function as specified by Tversky and Kahneman (1992) with λ=2.25 and α=0.88 corresponds to $v(x) = \begin{cases} x^{0.88} & x > 0 \\ -2.25(-x)^{0.88} & x < 0 \end{cases}$.

Each of the three asset types has two subtypes - correlated assets of Type 1 and idiosyncratic assets of Type 2. For the correlated assets (A1, B1 and C1) the payoff is the same for all participants in the experiment in a given period, i.e., a common die determines the payout for all subjects.[10] In contrast, the outcomes of the idiosyncratic assets (A2, B2, C2) are idiosyncratic to each subject, i.e., an individual die determines the payout for each subject independently. Thus although one subject might, for instance, win 75 per share of A2, another subject may well lose 15 tokens per share with the same type of asset.

Using the parameterization of Table 1 and numerically optimizing a standard CRRA utility function with a risk aversion coefficient equal to 0.5 for a single period, a subject would diversify the portfolio but bias it towards the low-variance lottery B. The optimal asset allocation would be 10 A lotteries, 30 B lotteries and 10 C lotteries of each type (both correlated and type 1 and idiosyncratic type 2). In contrast, when optimizing a Prospect Theory value function using the parameters given in Table 1, the optimal portfolio would be biased towards the negatively skewed lottery C and would consist of 17 A lotteries, 7 B lotteries and 26 C lotteries of each type.

Empirical evidence suggests that the returns on small firm stocks typically are positively skewed, medium sized firms have stock returns with zero skew, and large firm stocks have negatively skewed returns (Engle and Mistry, 2008). Furthermore, some stocks are more or less uncorrelated with the general market return, i.e. they have beta close to zero, while others are correlated with the market, i.e. they have beta close to one (Berk and DeMarzo, 2011, p. 318). Finally, stock market index returns display negative skewness (Albuquerque, 2012). Thus, in real markets it is possible to find for instance assets with idiosyncratic and positively skewed returns

[10] If for example the common die for lottery A1 is six in a particular round, then all subjects that invested in lottery A1 gain 75 tokens per invested share.

(stocks in a small pharmaceutical firm) and assets with correlated and negatively skewed returns (stocks in a large conglomerate or an index fund).[11]

3.2. Treatments

We run the following three treatments. Notably, each subject participated only in one session, populated by ten subjects.

INDIVIDUAL: Subjects are paid an amount of SEK (Swedish Kronor) equal to their final cumulative holdings of tokens after period 12, divided by 100.[12] Subjects only observe their own performance during the treatment and not that of other subjects.

SOCIAL: Again, subjects are paid according to the number of tokens they hold after period 12, divided by 100. However during and after each round subjects are shown the token holdings of all other subjects in the experiment and thus their current rank within the experiment.

TOURNAMENT: As outlined in Table 2 final earnings in Treatment TOURNAMENT no longer depend linearly on the amount of tokens held in period 12, but rather on subjects' relative performance as a function of their rank among the ten subjects.

[11] Of course, the assets in our experiments are extreme in the sense that they have exactly the same skewness but with opposite signs and correlated and idiosyncratic assets have exactly the same volatility. However, most experimental asset market studies use extreme and very simplified assets. See Sunder (1995) and Palan (2013) for reviews.

[12] The exchange rate of Euro to SEK was approximately 1:9 at the time of the experiment.

Table 2. Payouts in Treatment TOURNAMENT.

Rank	Final Payoff (SEK)
1	500 SEK
2	400 SEK
3	300 SEK
4	200 SEK
5	100 SEK
6	0 SEK
7	0 SEK
8	0 SEK
9	0 SEK
10	0 SEK

Underperformers of rank six to ten receive zero SEK, whereas over-performers end up with 100 to 500 SEK. During and after each period subjects were able to observe the token holdings of the other subjects in the experiment as in Treatment SOCIAL.

3.3. Elicitation of Risk and Loss Aversion

We administer two additional tasks to elicit risk and loss aversion as well as a short questionnaire with demographic background data at the end of each session.

To elicit risk aversion we use a simple mechanism based on Gneezy and Potters (1997) as deployed by Charness and Gneezy (2010). For this task subjects are endowed with an additional SEK 20, out of which they can invest a proportion X in a 50/50 coin flip lottery. In case the subject wins the lottery she earns 20+1.5X, which is added to the earnings of the experiment. If the subject loses, she earns SEK20-X. The more risk averse, the less a subject would invest in the lottery, and thus the lower X.

Table 3. Lotteries for the loss aversion task.

Lottery	Accept	Reject
1. Heads you lose SEK20, Tails you win SEK50	o	o
2. Heads you lose SEK30, Tails you win SEK50	o	o
3. Heads you lose SEK40, Tails you win SEK50	o	o
4. Heads you lose SEK50, Tails you win SEK50	o	o
5. Heads you lose SEK60, Tails you win SEK50	o	o

To elicit loss aversion a mechanism developed by Gächter et al (2007) is used. Before the loss aversion experiment starts the payment and the outcome of the risk aversion elicitation task is determined as well. This is done such that subjects know their earnings in the experiment so far and thus experience these earnings as their current endowment. Then subjects are asked to either accept or reject a series of coin flip lotteries as outlined in Table 3. Afterwards one of the lotteries is randomly selected to determine earnings for the loss-aversion task. In case the randomly chosen lottery is rejected, the subject would earn zero SEK, regardless of the outcome of the coin flip. In case the lottery is accepted the subject would either earn SEK 50 or lose an amount X. The amount X is varied between lotteries. Assuming a simple piecewise linear loss aversion specification, the row in which a subject would switch from accepting the lottery to rejecting it would imply a loss aversion parameter λ, as outlined in Table 4.[13]

[13] In practice not all subject were consistent in their choices. Thus two measures were computed: the lambda implied by the first lottery that was rejected, and the lambda implied by the last lottery that was accepted. For subjects that only switched once these two measures would coincide. For subject that would switch more than once, the average of the two measures was taken.

Table 4. Implied lambda's for the loss aversion task displayed in Table 3.

Decision	Implied Lambda
1. Reject all lotteries.	>2.5*
2. Reject lotteries 2-5.	2.5
3. Reject lotteries 3-5.	1.66
4. Reject lotteries 4-5.	1.25
5. Only reject lottery 5.	1
6. Accept all lotteries.	<0.83**

** For subjects rejecting all lotteries we select a lambda equal to 3.*
*** For subjects accepting all lotteries we select a lambda equal to 0.83.*

3.4. Experimental Implementation

The experiment was programmed with z-Tree (Fischbacher, 2007) and participants were recruited with ORSEE (Greiner, 2004). Three non-incentivized trial rounds were run at the beginning of the experiment to acquaint subjects with the experimental interface.

The experimental sessions were run in September and October of 2012 at the University of Gothenburg with bachelor- and master-students from various disciplines. We conducted 18 sessions with 10 subjects each in a between-subjects design. Average earnings of subjects were 250 SEK.

4. Results

4.1. Descriptive Overview

In Table 5 we report average portfolio choices for the three treatments. It is evident that there is a clear preference for the negatively skewed asset C in all treatments.[14]

[14] The differences between the average share of A, B and C lotteries are highly significant ($p<10^{-5}$) for all three treatments.

This preference is not predicted by either variance minimization or linear loss aversion, as both theories predict a preference for the asset with the lowest variance, Asset B (See Table 1). However, a specification that incorporates concavity in gains and convexity in losses in line with Prospect Theory (Kahneman and Tversky, 1979) correctly predicts the preference for negatively skewed asset.

Table 5. Average portfolio shares.

Treatment	Share A (Pos Skew)	Share B (Zero Skew)	Share C (Neg Skew)	Share Type 1 (Correlated)
TOURNAMENT	20.7 (27.8)	32.0 (27.5)	47.3 (32.8)	49.9 (21.6)
SOCIAL	20.9 (26.1)	35.2 (26.9)	43.9 (30.1)	50.7 (20.1)
INDIVIDUAL	18.8 (23.4)	33.7 (27.0)	47.5 (31.4)	49.9 (22.0)

Share A is portfolio share of the positively skewed assets A1 and A2. Share B is the portfolio share of assets with zero skewness B1 and B2. Share C is the portfolio share of the negatively skewed assets C1 and C2. Share Type 1 is the portfolio share of the correlated assets A1, B1 and C1. Standard deviations are given in parentheses.

In Table 6 we report the average measures of risk aversion and loss aversion which are very similar across treatments, although investment *X* in the risky gamble is slightly lower in the TOURNAMENT treatment than in the INDIVIDUAL treatment, implying a slightly higher CRRA coefficient of risk-aversion[15] σ (Wilcoxon rank sum test, p=0.10). There are no significant differences in the implied coefficient of loss aversion λ from the loss aversion task.

Table 6. Risk Aversion and Loss Aversion

Treatment	Amount *X* invested in the risky prospect	Implied CRRA σ	Implied PT λ
TOURNAMENT	14.2 (6.5)	0.50 (1.23)	1.94 (0.70)
SOCIAL	15.1 (6.1)	0.45 (1.22)	1.87 (0.66)
INDIVIDUAL	15.9 (6.6)	0.39 (1.12)	1.91 (0.71)

Standard deviations are given in parentheses.

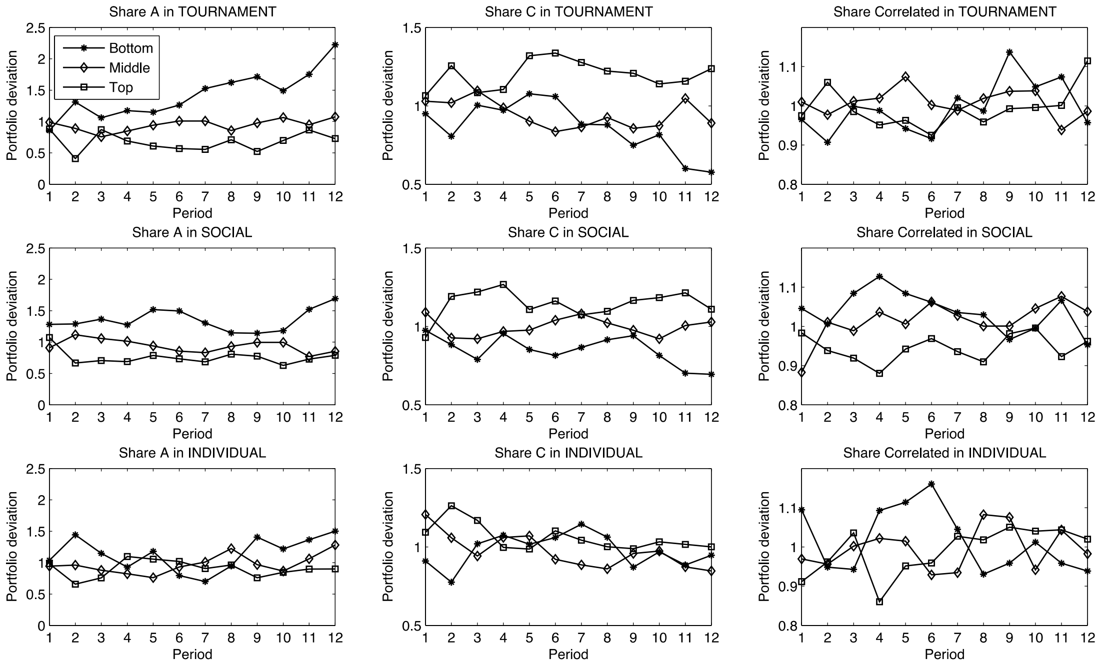
Figure 1 provides a first answer to the question whether convex tournament incentives and social competition induce changes in portfolio choice. We display the

[15] This is derived from fitting investment *X* as an optimal risky investment given a CRRA utility function with parameter σ.

relative deviations from average portfolio shares (as given in Table 5) for each of the twelve periods of the session for three groups of subjects: the top three subjects, the bottom three, and the middle four. In treatments TOURNAMENT and SOCIAL one can see the portfolio shares between the top three and the bottom three diverging over time and becoming more pronounced towards the end. Especially those ranked in the bottom three start shifting money out of the negatively skewed asset C into the positively skewed asset A. However, there appears to be hardly any difference in the choices between correlated and idiosyncratic assets in any of the treatments.[16]

[16] Only three subjects ended the final period with a negative amount of tokens, of which two participated in the TOURNAMENT treatment, and one participated in the SOCIAL treatment. These subjects only received their show-up fee. Two more subjects (one in TOURNAMENT, one in INDIVIDUAL) held a negative amount of tokens at some point during the experiment, but recovered to holding a positive amount by the final period. All subjects participated in the experiment until the final round.

Figure 1. Deviation from average asset share by rank.



The horizontal axis shows periods 1-12, the vertical axis present the deviation from average portfolio share for the bottom, middle, and top ranked subjects. Thus the vertical axis is centered on one for all asset types, even though the average asset shares are different (see Table 6). Share A stands for positively skewed assets, share C for the negatively skewed ones. The ranks are grouped by Top (Rank 1-3, squares), Middle (Rank 4-7, diamonds), Bottom (Rank 8-10, circles).

4.2. Tests of Hypotheses 1 and 2

In Table 7 we regress subject *i*'s portfolio choice in period *t* - the portfolio weight of shares A and C as well as share type 1 - on rank, risk aversion, loss aversion, and a gender indicator variable. In addition, we interact rank with a dummy variable for the final three periods (periods 10, 11 and 12) to test for end-of-experiment effects. All measures are normalized so that coefficients can be interpreted as the effect on asset allocation associated with e.g. an increase from the lowest level of risk aversion to the highest. Risk aversion is normalized as (20-X)/20 and thus equals 1 for subjects that invest zero in the risk aversion task, and 0 for subjects that invest the entire amount (20 SEK). Loss aversion is normalized with (lambda-0.83)/2.13

and thus likewise is a measure ranging between 0 and 1. Rank is normalized as well such that the highest ranked subject has a Rank of 0 and the lowest ranked subject a rank of 1. Thus the coefficient on Rank should be interpreted as the estimated change in asset allocation associated with moving from the top rank to the lowest rank. All standard errors are clustered on subject.

In panel A we report the results for the positively skewed assets of type A. The dependent variable is the combined share of lottery A1 and A2 (out of a total of 100 lotteries chosen each round). The results for treatments TOURNAMENT and SOCIAL are consistent with the visual inspection of Figure 1. Rank has a significantly positive effect on the share of positively skewed assets. In TOURNAMENT the lagging subject is expected to have a 23 percentage points higher share in the positively skewed asset than the leading subject. In the SOCIAL treatment the direction of the effect is similar but smaller at 18 percent. However, in Treatment SOCIAL the rank effect is stronger in the final periods. The coefficient of the Rank*Last Periods interaction term is 13.9 and significant. Finally, in the INDIVIDUAL treatment, no rank effect is evident.

In panel B we report the results for the negatively skewed assets of type C. The results roughly mirror the results in panel A. Rank has a significant negative effect on the share of negatively skewed assets. In Treatment TOURNAMENT the lagging subject is expected to have 16.5 percentage points lower share in the negatively skewed asset than the leading subject. Treatment SOCIAL shows a similar effect with a difference between the leader and the lagging subject of 26.6 percentage points. Furthermore, in Treatment TOURNAMENT there is an additional effect during the last periods. The Rank*Last Period interaction is negative and significant. Again, there is no rank effect in Treatment INDIVIDUAL. In line with Prospect Theory, Loss

Aversion is generally associated with less (more) holdings of the positively (negatively) skewed asset in Table 7.

In Table 8 we test for treatment differences of the effect of rank on the choice of positively and negatively skewed assets, respectively. The TOURNAMENT treatment serves as baseline. We find no significant difference in the effect of rank between the TOURNAMENT and SOCIAL treatments. The variables SOCIAL and Rank*SOCIAL are both insignificant. Thus, competitive social preferences alone appear to generate similar changes in portfolio selection as explicit convex tournament pecuniary incentives. On the other hand, we find significant differences between treatments TOURNAMENT and INDIVIDUAL. We observe for the positively skewed assets of type A in model 1 that variable INDIVIDUAL is significantly positive while Rank*INDIVIDUAL shows a negative and significant coefficient.

Hence, hypothesis 1 cannot be rejected as we report strong effects in subjects' portfolio selection conditional on their rank. Importantly, we detect no significant differences between treatments TOURNAMENT and SOCIAL indicating that the effect of rank on portfolio choice is mainly driven by an intrinsic concern for status, and not primarily by additional instrumental (monetary) concerns. Therefore, hypothesis 2 cannot be rejected as well.

Table 7. The influence of rank on portfolio choice, by Treatment

Panel A: Dependent variable: Share A (Positively skewed)

Treatment	TOURNAMENT		SOCIAL		INDIVIDUAL	
	(1)	(2)	(3)	(4)	(5)	6)
Rank	25.2***	23.1***	17.5**	18.1***	-4.4	-6.0
	(7.6)	(6.7)	(7.0)	(6.8)	(11.0)	(10.3)
Last Periods	2.8	3.2	-9.2	-8.7***	3.6	3.8
	(4.3)	(4.1)	(3.6)	(3.3)	(5.2)	(4.9)
Rank * Last	5.9	5.2	14.8*	13.9**	-5.5	-6.0
Periods	(8.5)	(8.4)	(7.7)	(7.0)	(8.2)	(7.8)
Male		5.2		0.0		3.6
		(4.1)		(5.4)		(5.7)
Risk Aversion		1.7		-5.6		-5.4
		(5.4)		(9.1)		(8.0)
Loss Aversion		-20.7***		-0.5		-17.6*
		(5.6)		(9.0)		(9.5)
Intercept	5.4	12.9**	7.8**	9.0	22.9***	31.7***
	(3.3)	(5.4)	(3.2)	(7.3)	(7.0)	(8.74)
Adj. R^2	0.10	0.18	0.07	0.07	0.00	0.07
Obs.	720	720	720	720	720	720

Panel B: Dependent variable: Share C (Negatively skewed)

Treatment	TOURNAMENT		SOCIAL		INDIVIDUAL	
	(1)	(2)	(3)	(4)	(5)	6)
Rank	-22.6**	-16.5*	-30.3***	-26.6***	-3.5	-4.9
	(10.3)	(9.6)	(7.7)	(6.8)	(10.6)	(10.4)
Last Periods	3.0	3.4	10.6	10.6	-5.3	-5.5
	(5.3)	(4.6)	(7.7)	(7.5)	(6.2)	(6.2)
Rank * Last	-14.1	-14.8*	-15.1	-15.2	6.9	7.4
Periods	(9.4)	(8.3)	(11.0)	(10.5)	(9.9)	(10.1)
Male		-1.5		-6.7		1.2
		(5.8)		(5.8)		(7.7)
Risk Aversion		18.4**		-6.2		13.0
		(8.8)		(8.7)		(10.1)
Loss Aversion		17.2*		17.9**		1.8
		(10.4)		(8.2)		(10.7)
Intercept	61.0***	44.4***	63.2***	57.2***	47.6***	44.2***
	(6.3)	(9.7)	(4.6)	(6.8)	(7.0)	(9.8)
Adj. R^2	0.06	0.14	0.09	0.14	0.00	0.12
Obs.	720	720	720	720	720	720

Rank, Risk Aversion and Loss Aversion are normalized. Standard errors are clustered on a subject level.
**** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level.*

Table 7 (continued). The influence of rank on portfolio choice, by Treatment

Panel C: Dependent variable: Share 1 (Correlated)

Treatment	TOURNAMENT		SOCIAL		INDIVIDUAL	
	(1)	(2)	(3)	(4)	(5)	6)
Rank	1.7	2.6	0.9	1.2	12.4	10.6
	(3.2)	(4.6)	(4.7)	(5.2)	(7.3)	(7.1)
Last Periods	2.8	2.3	3.3	3.4	6.8	6.5
	(3.6)	(3.5)	(3.4)	(3.3)	(5.1)	(4.8)
Rank * Last	-6.8	-5.9	-2.3	-2.5	-14.2	-13.6
Periods	(6.8)	(6.4)	(7.3)	(7.3)	(9.1)	(8.5)
Male		1.5		-1.3		4.2
		(2.6)		(4.3)		(4.6)
Risk Aversion		-0.8		-1.3		16.2**
		(4.6)		(5.3)		(7.2)
Loss Aversion		9.0		-0.8		-0.4
		(5.5)		(9.7)		(7.4)
Intercept	48.9***	42.3***	49.4***	50.5***	43.3***	38.9***
	(3.2)	(3.0)	(2.8)	(6.9)	(5.2)	(5.8)
Adj. R^2	0.00	0.02	0.00	0.00	0.02	0.06
Obs.	720	720	720	720	720	720

Rank, Risk Aversion and Loss Aversion are normalized. Standard errors are clustered on a subject level.
**** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level.*

Table 8. Treatment differences in effect of rank on portfolio

Dependent Variable	Share A Pos Skew (1)	Share C Neg Skew (2)	Share 1 Correlated (3)
Rank	24.0***	-21.5**	2.0
	(6.8)	(9.6)	(4.6)
Rank * SOCIAL	-5.8	-10.4	-1.8
	(9.8)	(12.0)	(6.9)
Rank *	-30.9**	19.5	8.2
INDIVIDUAL	(12.5)	(14.1)	(8.5)
Male	2.5	-2.1	1.5
	(2.8)	(3.7)	(2.0)
Risk Aversion	-2.4	9.4	4.7
	(4.3)	(5.5)	(3.5)
Loss Aversion	-13.3***	12.2**	3.3
	(4.5)	(5.7)	(4.1)
SOCIAL	-0.2	5.4	2.9
	(4.5)	(7.4)	(4.5)
INDIVIDUAL	16.8**	-12.1	-2.8
	(7.4)	(9.2)	(6.2)
Intercept	13.2***	51.8***	43.8***
	(4.5)	(6.6)	(3.7)
Adj. R^2	0.09	0.08	0.01
Obs.	2160	2160	2160

Rank, Risk Aversion and Loss Aversion are normalized. Standard errors clustered on a subject level.
**** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level.*

4.3. Tests of Hypotheses 3 and 4

In Table 7 panel C we report the results for the correlated assets of type 1. We find no significant Rank or last periods effects in terms of the correlated asset. Similarly, in the last column of Table 8, we find neither a general significant rank effect, nor significant differences between treatments. Thus, while laggards (leaders) strategically use positively (negatively) skewed assets to improve (protect) their rank, there are no indications that idiosyncratic and correlated assets are strategically used for similar purposes. Consequently, hypothesis 3 can be rejected. As we do not find any support for hypothesis 3 it is not possible to make inference about hypothesis 4.

5. Discussion and Conclusion

In this paper we used laboratory experiments to investigate the influence of tournament-style incentives and social competition on risk-taking and portfolio choice. We found a (i) strong relationship between rank and preferences for skewed assets in treatments TOURNAMENT and SOCIAL. In particular, underperformers showed a strong preference for positively skewed assets while over-performers invested disproportionally in the negatively skewed assets. We further observed no difference in the preference for idiosyncratic or correlated assets between over- and underperformers in each treatment. Most importantly, we found (ii) almost identical patterns in portfolio selection choices of subjects in treatments TOURNAMENT and SOCIAL. Thus, the preference for positively skewed assets of underperformers and the preference for negatively skewed assets of over-performers are virtually identical in both treatments. This finding suggests that it is mainly the intrinsic desire for social status that is driving the effect of rank on risk behavior and portfolio choice.

Our results are in line with studies by Brown et al. (1996) and Brown et al. (2001) showing that underperforming fund managers adopt more risky strategies to climb the ladder. In particular, we corroborate the findings of Lin (2011) that underperforming fund managers show a stronger tendency towards positively skewed assets, while over-performers frequently invest in negatively skewed assets. However, empirical studies on fund manager performance cannot disentangle whether the effects are driven by convex monetary incentives or by social competition and the related pursuit to reach a high rank among peers. We add to this literature and show that these patterns are mainly driven by the social-effect rather than the income-effect.

Our results have two important real-world implications. The first one is related to the policy discussion about regulation of investment managers' incentive schemes (see e.g. Turner, 2009,) and Walker, 2009). Our results suggest that limits on investment managers' contracts may have limited effect on their appetite for risk as long as they will be able to infer their relative performance. Due to intrinsic concern for rank, underperformers may take excess risks in order to increase the probability of improved social status. Similarly, over-performers may take tail risks in order to increase the probability to "stay ahead of the Joneses". Based on this argument it also becomes questionable from a company perspective to provide investment managers with costly bonus compensation contracts, since similar behavior might be observed purely due to investment managers' comparison with their peers. However, the question whether this kind of behavior is desirable from a company or society perspective is not the focus of this paper.

The second implication is related to how investment managers may construct their portfolios given their current relative rank and how this may affect the risk exposure of managed investment portfolios. By choosing positively or negatively skewed assets, investment managers can achieve the risk-profile that will increase the probability to improve their relative rank or to keep their top-rank. This observation has bearing on the discussion about how investment portfolios' risk-exposure shall be measured (see e.g. Rosenberg and Schuerman, 2004 and Hull, 2012, pp. 341-343). Our results suggest that estimated skewness should be part of the reported risk-exposure.

Finally, we want to stress that the tournament monetary payoffs in our experiments might not resemble the relative pay for real investment managers perfectly. However, they create incentives for very serious participation among participants in the experiment (Camerer and Hogarth, 1999). At the same time, if we would use more realistic and therefore more extreme payouts (e.g., threefold or more), it would be important to strengthen the social effect as well. Now, the social incentive – like the tournament monetary effect – is modeled rather weak. The ranking is anonymous, meaning that no one else in the room will know a subject's performance and ranking. Imposing a stronger social incentive would for instance mean that the winners (Top 5) are announced in public which will most likely make the social incentive stronger as well. However, we leave these considerations for future research.

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Appendix A: Experimental Instructions

We welcome you to this experimental session and kindly ask you to refrain from talking to each other for the duration of the experiment, and switch off your cell phones. If you face any difficulties, contact one of the supervisors.

First of all you should now carefully read these instructions.

The show-up fee for this experiment is SEK50.

PART 1
The units of account for the experiment are Tokens. At the beginning of the experiment you will start with 15.000 Tokens. Every round you can either gain or loose Tokens. You gain and loose Tokens by investing in lotteries. You have to choose exactly 100 lotteries every period. The experiment lasts 12 periods.

There are three types of lotteries: type A, B and C. The outcome of a lottery is decided by throwing a (virtual) die. Thus each lottery has six possible outcomes, and each outcome is equally likely. Below are the amounts of tokens earned or lost for each possible outcome of the die throw: either landing 1, 2, 3, 4, 5 or 6.

LOTTERY A

Die throw	**1**	**2**	**3**	**4**	**5**	**6**
Earnings	-15	-15	-15	-15	-15	+75

LOTTERY B

Die throw	**1**	**2**	**3**	**4**	**5**	**6**
Earnings	-20	-20	-20	+20	+20	+20

LOTTERY C

Die throw	**1**	**2**	**3**	**4**	**5**	**6**
Earnings	-75	+15	+15	+15	+15	+15

Furthermore, for every lottery there are two sub-types:

Type I: Common die.
For lotteries A1, B1 and C1, **one common die** is thrown deciding the outcome for **ALL** participants in a certain lottery. Thus for example if the common die for lottery A1 lands at 6, everybody that has chosen a positive number of lottery A1 earns 75 Tokens per lottery.

Type II: Private die.
For lotteries A2, B2 and C2, a **different private die is thrown for each participant in each lottery**. For example your individual die might land at 6 for Lottery A2, it might be 1 for another participant and 4 for a third one.

Every round you must decide how many of each type of lottery to acquire. The total amount of lotteries must always sum up to 100.

After all participants have made their decision, the computer throws the dice. (one common one for each of the A1, B1 and C1 lotteries, and one for each participant for the A2, B2 and C2 lotteries).

For each lottery you will be informed of the outcome of the die throw, the resulting payoff of the lottery, and your total earnings for that lottery. The combined earnings for all six lotteries will determine your earnings that round.

Every round you are informed about your own earnings that round and your total earnings in the experiment so far.

[*** TOURNAMENT AND SOCIAL TREATMENTS ONLY ***]
You are also informed about the average earnings in the experiment, your rank in the earnings distribution, and the earnings of the other participants in the experiment.

[*** SOCIAL AND INDIVIDUAL TREATMENT ONLY ***]
Your earnings in this part of the experiment will depend on the amount of tokens you hold after period 12.

[*** TOURNAMENT TREATMENT ONLY ***]
Not your absolute number of Tokens, but your rank in period 12 will determine your payoff of the experiment. The higher your rank, the higher your earnings (see Table 1). Thus your earnings will consist of the show-up fee (SEK50) + (Final payoff depending on rank).

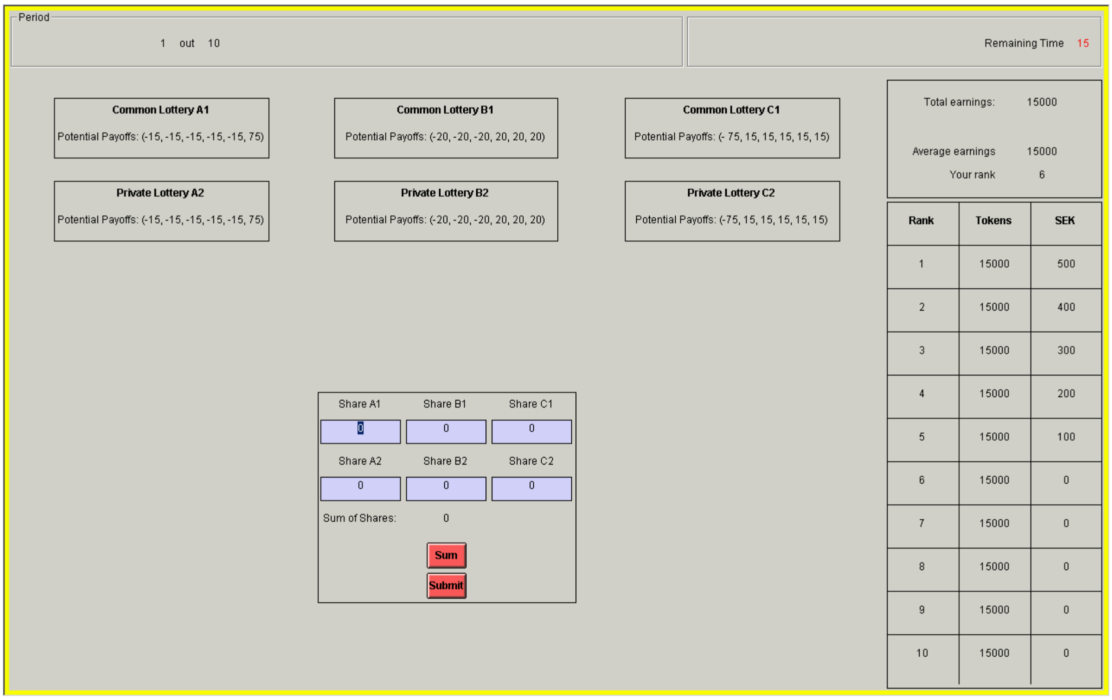
Table 1. Rank and earnings

Rank	**Final Payoff (SEK)**
1	500 SEK
2	400 SEK
3	300 SEK
4	200 SEK
5	100 SEK
6	0 SEK
7	0 SEK
8	0 SEK
9	0 SEK
10	0 SEK

In order to get used to the experimental procedure, we will start with three practice rounds that will have no effect on your final earnings.

Appendix B Screenshots

B.1 Decision Screen.



B.2 Result Screen.