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Social Motives and Risk-Taking in Investment Decisions[☆]

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ABSTRACT

A pervasive feature in the finance industry is relative performance, which can include extrinsic (money), intrinsic (self-image), and reputational (status) motives. In this paper, we model a portfolio decision with two assets and investigate how reputational motives (i.e., the public announcement of the winners or losers) influence risk-taking in investment decisions vis-a-vis intrinsic motives. We test our hypotheses experimentally with 864 students and 330 financial professionals. We find that reputational motives play a minor role among financial professionals, as the risk-taking of underperformers is already increased due to intrinsic motives. Student behavior, however, is mainly driven by reputational motives with risk-taking levels that come close to those of professionals when winners or losers are announced publicly. This indicates that professionals show higher levels of intrinsic (self-image) incentives to outperform others compared to non-professionals (students), but a similar behavior can be sparked among the latter by adding reputational incentives.

1. Introduction

Recent research identified tournament incentives as an important driver for excessive risk-taking in finance (Bebchuk and Spamann, 2010; Diamond and Rajan, 2009; Rajan, 2006). In particular, tournament incentives can be characterized by three major components. The first and most obvious component is the extrinsic incentive of money, which often depends on relative performance. Bonuses, for example, which are widespread in the finance industry (Goetzmann et al., 2003),

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represent extrinsic monetary incentives for outperforming others. The second and third components can be subsumed under rank incentives and address the intrinsic motives of positive self-image (Bénabou and Tirole, 2006; Köszegi, 2006) and reputational motives of improved public status among peers (Frank, 1985; Moldovanu et al., 2007). Rank incentives reflect an evolutionary established pattern to do better than peers and promise a non-monetary utility to those at the top and a disutility to those at the bottom (Barankay, 2015). In line with this, recent experimental evidence shows that rank incentives can indeed increase individuals' effort and performance (Azmat and Iriberri, 2010; Bandiera et al., 2013; Barankay, 2015; Blanes-i-Vidal and Nossol, 2011; Charness et al., 2014; Delfgaauw et al., 2013; Tran and Zeckhauser, 2012). Moreover, in asset market experiments with students, Schoenberg and Haruvy (2012) display either the portfolio value of the best or the worst performer to all traders and report effects on market prices and individual satisfaction levels.

In the finance industry, performance is very transparent, which makes it relatively easy to establish rankings and to award those that are at the top, both monetarily and with status. Annual awards to top performing fund managers, bankers, and analysts as well as the regular publication of fund rankings (e.g., Morningstar ranking) document a strong culture of social competition.[1] Given the relevance of rankings in the finance industry, as well as a growing research on preferences for social status (see, e.g., Heffetz and Frank (2011) for an excellent overview), there is surprisingly little literature on how social comparison impacts risk-taking in financial decisions. The first insights into professionals' preferences for high rank have recently been provided by Kirchler et al. (2018). In lab and online experiments, the authors report that underperforming financial professionals increase risk-taking when faced with non-incentivized, anonymous rankings. In the same setting, the authors find no rank-driven behavior among students. Importantly, as the rankings were anonymous and private, the authors focused on intrinsic (self-image) motives of social competition.

In this paper, we extend the insights of Kirchler et al. (2018) on rank incentives by separating the effects of intrinsic (self-image) motives and reputational (status) motives on risk-taking. By disentangling these two motives we follow a similar approach as Schram et al. (2019), who separate the effect of social status (resulting from the social ranking of performances) from pure rivalry for resources in a real effort task. We develop a stylized theoretical model and then test the predictions with laboratory experiments. In the model, we analyze a portfolio decision with two assets and investigate how reputational and intrinsic motives for being at the top or the bottom of a peer ranking influence risk-taking. We conjecture that risk-taking is higher when investors are informed about their rank and when top-ranked or bottom-ranked performers are publicly known. Moreover, our model suggests that when investors at the top or bottom of the ranking are publicly known, the risk-taking of highly ranked investors should be lower than that of underperformers. To test the theoretical predictions we use the experimental design of Kirchler et al. (2018) and analyze the reputational motive by announcing the winner or the loser of a group of six investors publicly at the end of the experiment. This is public knowledge from the start of the experiment. We compare this treatment with a setting where only intrinsic motives can play a role, by displaying anonymous rankings privately and without any public announcement. This comparison is complemented with baseline treatments without any rankings and, consequently, also without any public announcements. Finally, to obtain a comprehensive picture, we test our hypotheses both with 864 non-professional subjects (students) and with 330 financial professionals from investment-related areas (e.g., fund management, trading, private banking, and asset management).[2]

Our results show that, first, average risk-taking among students is higher in treatments in which the winner or the loser is announced publicly (treatments B-WINNER and B-LOSER), compared to the baseline treatment (Treatment BASELINE). Second, we show that the public announcement of the winner or loser (treatments R-WINNER and R-LOSER) increases average risk-taking among students compared to a treatment with anonymous rank information (Treatment RANKING). For professionals, however, we do not observe such effects. This indicates that reputational motives can play a role as an additional incentive, but primarily among non-professionals and less so among professionals. Finally, we observe that underperforming investors take more risk than outperformers in treatments where rankings are displayed and the winner or loser is publicly announced (treatments R-WINNER and R-LOSER). This result holds for both students and professionals. However, while underperforming students do not increase risk-taking without reputation motives, underperforming professionals increase risk-taking primarily due to intrinsic motives and are less concerned about reputation motives (Treatment RANKING). Given professionals' industry experience, reputational motives can be (partly) internalized, which may explain why professionals react relatively strongly based on intrinsic motives.

Kirchler et al. (2018) have shown that intrinsic motivation through anonymous ranking promotes rank-driven risk-taking among underperforming professionals but not among students. Our study implies that reputational motives can spark rank-driven behavior even among non-professionals, leading to substantially increased risk-taking among underperforming students. This indicates that when the full scope of motives of social comparison is addressed, i.e., intrinsic self-image concerns as well as reputational status concerns, laypeople react similarly to rankings in investment decisions as professionals do.

The remainder of the paper is organized as follows. In Section 2, we present a simple model of portfolio choice that incorporates non-monetary incentives and allows us to derive hypotheses for our experiment. In Section 3 we introduce the experimental design and implementation. In Section 4 we present the results of the experiment. In Section 5 we discuss our results and conclude the paper.

[1] See, e.g., http://www.fmya.com/; http://www.investmentawards.com; http://www.americanbanker.com/best-in-banking/; http://excellence.thomsonreuters.com/award/starmine.

[2] The experimental data of the baseline and ranking treatments are directly taken from Kirchler et al. (2018) for both students and professionals. This study adds the public announcement of winners and losers to isolate status effects.

2. Theoretical framework

In the following we present a simple, stylized model that helps us to derive predictions regarding the effects of intrinsic self-image concerns as well as reputational status concerns on risk-taking.[3] We consider a group of n investors. Every investor $i \in n$ takes a portfolio decision with two assets. Let us denote the expected and actual return of a risk-free asset as R^f and the expected return of a risky asset as R^m, with $R^m > R^f$. The expected return of the investor i's portfolio, R_i^p, is a weighted average of the expected return on the two assets, i.e., $R_i^p(b) = b_i R^m + (1 - b_i) R^f$, where b_i is the share of risky assets in the portfolio. Note that the standard deviation from the portfolio $\sigma^p = b_i \sigma^m$.

Suppose that an investor i's utility from her portfolio's return $U_i(\cdot)$ is a function of her valuation for money ν_i^y (derived from the portfolio return R_i^p), and her valuation ν_i^r for achieving a certain rank $r_i(\mathbf{R}^p)$ given the vector of portfolio returns $\mathbf{R}^p$ of all n investors, which stems from the self-image and possibly her social image (status). Our specification of the image valuation is inspired by Bénabou and Tirole (2006): each investor i's preference type $\nu_i \equiv (\nu_i^r, \nu_i^y)$ is private information, only known to the investor when she invests and not observable by others. The investor i's image valuation depends on observers' posterior belief regarding the investor i's type ν_i, given her rank. In a setting with n investors, an investor i's portfolio return R_i^p is ranked at a given rank r with probability $p_{i,r}(\cdot, \mathbf{b}) \geq 0$, with $\sum_r p_{i,r}(\cdot, \mathbf{b}) = 1$, where $\mathbf{b} = (b_1, ..., b_n)$ refers to the choices of all n investors and $\cdot$ here indicates other exogenous factors (such as e.g. differences in investors' initial portfolio returns) that may be of influence.[4] If the rank is observed, others get a strong signal regarding an investor i's type ν_i. The factor $x_k > 0$ with $k = r, s$ measures the visibility or salience of the rank, and its value thus depends on whether the rank will be observed by the investor herself (x_r) and others respectively (x_s), where $x_k \in \{0, 1\}$, depending on the treatment. We assume that all investors $i \in n$ simultaneously choose the share of risky assets b_i to maximize their expected utility, which is given as:

$$U_i(R_i^p(b_i), b_i, p_{i,r}(\cdot, \mathbf{b})) = \nu_i^y(R_i^p(b_i), b_i) + x_r \sum_{r=1}^{n} p_{i,r}(\cdot, \mathbf{b}) \nu_{i,r}^r + x_s p_{i,l}(\cdot, \mathbf{b}) \nu_{i,l}^r \forall i \in n. \quad (1)$$

with $l = \{1, n\}$ if the highest, or respectively lowest ranked investor is publicly announced. To keep our stylized model as tractable and intuitive as possible we make a number of simplifying assumptions. We assume (i) that function $\nu_i^y(\cdot)$ is twice differentiable, increasing, and strictly concave in R_i^p, while the investor i's attitude toward risk is captured by the properties of $\nu_i^y(\cdot)$ with respect to changes in b_i. (ii) We consider the portfolio decision in each period t independently.[5] (iii) We assume that valuation $\nu_{i,r}^r$ for achieving a certain rank is increasing in the rank but at a decreasing rate, i.e. $\nu_{i,j}^r - \nu_{i,k}^r \leq \nu_{i,n-k+1}^r - \nu_{i,n-j+1}^r$ for $r = j, k$ with $j < k \leq \frac{n+1}{2}$, and $\nu_{i,1}^r > 0$ while $\nu_{i,n}^r < 0$. To avoid introducing further parameters, we (iv) assume that the effects of self-image and social image on utility are governed by the same function.

Each investor i's optimization problem can thus be written as:

$$max_{b_i}\Big(U_i\big(R_i^p(b_i), b_i, p_{i,r}(\cdot, \mathbf{b})\big)\Big). \quad (2)$$

Taking the derivative and rearranging the first order condition such that the marginal utility from the investor i's valuation for money ν_i^y derived from the portfolio return R_i^p is on the right-hand side and her marginal image utility for achieving a certain rank $r_i(\mathbf{R}^p)$ are on the left-hand side, the equilibrium portfolio, b_i^*, satisfies the following first-order condition:

$$x_r \sum_{r=1}^{n} \frac{\partial p_{i,r}(\cdot, \mathbf{b})}{\partial b_i} \nu_{i,r}^r + x_s \frac{\partial p_{i,l}(\cdot, \mathbf{b})}{\partial b_i} \nu_{i,l}^r = -\left(\frac{\partial \nu_i^y(R_i^p, b_i)}{\partial R_i^p} \frac{\partial R_i^p(b_i)}{\partial b_i} + \frac{\partial \nu_i^y(R_i^p, b_i)}{\partial b_i}\right), \quad (3)$$

with $l = \{1, n\}$.[6] In the following we will analyse the investor's optimal decision for the different treatments, in which either the rank is not visible (no image valuation), is visible only to the investor (self-image), the highest (lowest) ranked investor is publicly announced (social image/status), and the combination of the last two.

If investor i's rank is not visible to herself or to others, i.e., $x_r = x_s = 0$, investor i's decision is non strategic and the above first-order condition resembles the textbook case where only the investor's attitude toward risk will determine whether she will buy stocks on the margin or not. For a risk-neutral or risk-seeking investor, characterized by $\partial \nu_i^y(R_i^p, b_i)/\partial b_i \geq 0$, the right-hand side of (3) will be zero or negative, given the concavity of $\nu_i^y(\cdot)$ in R_i^p. Thus, investor i's utility increases with a larger R_i^p, which leads to a corner solution and therefore the optimal $\tilde{b}^* = b_{\max}$, where $\tilde{b}^*$ refers to investor i's optimal choice if $x_r = x_s = 0$. In the following, we focus on the more relevant case where the investor is risk averse, i.e., $\partial \nu_i^y(R_i^p, b_i)/\partial b_i < 0$, such that the right-hand side of (3) can be positive, and an inner solution to condition (3) exists.

Now suppose that the (risk averse) investor's rank is visible to herself, i.e., $x_r > 0$ while $x_s = 0$. In this case the sign of her marginal image benefits affect optimal risk taking. Since $\sum_r \frac{\partial p_{i,r}(\cdot, \mathbf{b})}{\partial b_i}|_{b_i = b^*} = 0$ and $\frac{\partial p_{i,r}(\cdot, \mathbf{b})}{\partial b_i} = -\frac{\partial p_{i,n-r+1}(\cdot, \mathbf{b})}{\partial b_i}$, the left-hand

[3] As our aim is to predict treatment effects rather than estimates for the strength or size of underlying parameters, we do not present a more complex structural model that includes non-observable parameters.

[4] For simplicity, we assume that the pdf of the distribution of noise is continuous and symmetric around zero, which implies that the probability of ties is zero.

[5] For notational convenience, we thus do not index all variables with t.

[6] In order to focus on the basic mechanisms, we assume for simplicity that the conditions for the existence of a pure-strategy equilibrium with non-negative equilibrium risk levels are assured.

side of (3) is positive given assumption (iii).[7] Investor i's marginal benefits from risk taking are thus higher than in the absence of any intrinsic image valuation, which induces the investor to take more risk in equilibrium, i.e., $b_i^* > \tilde{b}^*$.

Next, suppose that the highest (lowest) ranked investor is publicly announced such that investor i's rank is visible to others (and herself) if and only if she is the highest (lowest) ranking investor, i.e., $x_s > 0$ while $x_r = 0$. Now status concerns will affect investors' optimal portfolio decisions in equilibrium. As indicated by Bénabou and Tirole (2006), it follows from (3) that observing an investor to be either a winner or a loser reveals the sum of her three motivations (at the margin): intrinsic, extrinsic, and reputational. Analogously to the previous case, due to the properties of the derivatives of $p_{i,r}(\cdot, \mathbf{b})$ and assumption (iii) we can conclude that if an investor's rank is revealed to others, marginal benefits from risk taking are higher than in absence of any reputational / social status valuation and thus optimal risk-taking increases, i.e., $b_i^{**} > \tilde{b}^*$.

Finally, suppose investor i's rank is visible to the investor herself and additionally the investor with the lowest (highest) rank is publicly announced. The above mentioned positive marginal benefits for achieving a certain rank r_i are now multiplied by $x_r > 0$ and $x_s > 0$, respectively, and thus $b_i^{***} > b_i^{**} > \tilde{b}^*$.[8]

We can summarize these insights as follows:

Proposition 1. *Suppose the investor is risk averse, i.e., $\partial v_i^y(R_i^p, b_i)/\partial b < 0$, and intrinsically values a higher rank and status. (i) If investor i's rank is visible to the investor herself, i.e., $x_r > 0$, investor i's optimal portfolio is characterized by a larger share of the risky asset than when the rank is not visible, i.e., $b_i^* > \tilde{b}^*$. (ii) If the investor with the lowest (highest) rank is publicly announced, i.e., $x_s > 0$, investor i's optimal portfolio is characterized by a larger share of the risky asset than in the absence of the public announcement, i.e., $b_i^{**} > \tilde{b}^*$. (iii) If investor i's rank is visible to the investor herself and the investor with the lowest (highest) rank is publicly announced, i.e., $x_r > 0$ and $x_s > 0$, investor i's optimal portfolio is characterized by a larger share of the risky asset than when the rank is not publicly announced and/or not visible, i.e., $b_i^{***} > b_i^{**} > \tilde{b}^*$.*

Note that investors' extrinsic and reputational motives work in the same direction and increase their marginal utility of taking risk. Whether the announcement of the winner or the announcement of the loser leads investors to hold a larger share of risky assets depends on the relative strength of the extrinsic and reputational motives and can only be determined with stronger assumptions.[9]

So far we have, for simplicity, considered a symmetric setting. Deriving insights regarding the choice of risk depending on an investor's rank in a previous round is less straightforward and closely relates to the literature on rank-order tournaments with heterogeneous agents.[10] Note that in our setting an investor's portfolio return in the previous round is added to the current period return, which implies that heterogeneity among investors falls into the category of additive heterogeneity analyzed by Akerlof and Holden (2012).[11] An investor with a high last-period portfolio return needs to receive a considerably worse draw from the noise distribution in order to be ranked below an investor with low last-period return. Therefore, for the same level of risk-taking, investors with a high last-period portfolio return have a lower probability of placing in the bottom of the ranking. From this we can conclude that investors with different last-period portfolio returns will choose different levels of risk. Unfortunately, not much can be said about the properties of $\sum_r \frac{\partial p_{i,r}(\cdot, \mathbf{b})}{\partial b_i}$ for general distributions of noise parameters. Akerlof and Holden (2012) show for additive heterogeneity (under the somewhat restrictive assumption of an even number of two types of heterogeneous agents with quadratic cost functions) that for "loser-prize tournaments" (i.e. tournaments like ours that punish more than reward) the disadvantaged agents increase effort compared to the homogeneous case, while effort among agents with a head start decreases.[12] Since our setting with risk averse investors is closely related to the one studied by Akerlof and Holden (2012), we conjecture that their result applies to our setting if we assume that image dis-utility from being (publicly announced as) the lowest ranked investor is, in absolute terms, sufficiently larger than image utility from being (publicly announced as) the highest ranked investor.

In line with these arguments, we thus, additionally, formulate the following conjecture:[13][14]

Conjecture 1. *Suppose the investor is risk averse, i.e., $\partial v_i^y(R_i^p, b_i)/\partial b_i < 0$ and intrinsically values a higher rank and status. If the rank is visible to the investor herself, i.e., $x_r > 0$, low ranked investors (underperformers) are holding a larger share of risky assets*

[7] See Akerlof and Holden (2012).

[8] Note that we cannot order b_i^{**} and b_i^* without any further assumptions.

[9] Moreover, note that although we do not indicate it explicitly in our notation, when the winner is announced, risk-taking is influenced by the probability to reach the highest rank, while when the loser is announced, risk-taking is influenced by the probability to reach any rank that is not the lowest. At the same time, the observers' posterior expectations of investor i's type v_i, given the announcement that the investor is not the loser, is lower than when the investor is announced to be the winner. In general, no clear predictions can be derived from these considerations without stronger assumptions.

[10] See Akerlof and Holden (2012); Balafoutas et al. (2017); Gürtler and Kräkel (2010); Kräkel (2008); Nieken and Sliwka (2010) for tournaments with heterogeneous agents.

[11] See the authors' supplementary online material and the extended working paper version of the paper.

[12] Note that both our treatments can be characterized as "loser-prize tournaments" if we assume that investors believe their rank to be lowest (highest) when not being publicly announced as being the investor with the highest (lowest) rank.

[13] Note that in our model all contestants are assumed to have equal types regarding their risk preferences, i.e., all investors are identically risk averse. For Conjecture 1 we, however, assume that they are heterogeneous with regard to initial portfolio returns. This is distinct to the case of investors differing with respect to their risk attitudes and thus self-selecting into the ranks.

[14] That underperformers take more risk than overperformers when the rank is visible to investors themselves, has been shown in experiments by Kirchler et al. (2018).

Table 1
Treatments

		Public announcement of rank after experiment		
		No	Yes (RANK 1)	Yes (RANK 6)
Private ranking after each period	No	BASELINE	B-WINNER	B-LOSER
	Yes	RANKING	R-WINNER	R-LOSER

This table outlines the between-subjects 2x3 treatment design. "Private ranking after each period" indicates whether an anonymous league table, detailing all group members' current wealth levels, associated rank (RANK $\in \{1, 2, \ldots, 6\}$), and subjects' own position in the ranking was displayed after each period. This ranking was not publicly disclosed and not incentivized. "Public announcement of rank after experiment" indicates whether the top performer (Rank 1), the lowest performer (Rank 6), or nobody at all was publicly announced after the last period. Given that the professional sample was smaller than the student sample, we did not run treatments B-WINNER and B-LOSER with professionals.

than highly ranked investors. This is also the case if additionally the rank is visible to others if and only if she is the (highest) lowest ranking investor, i.e., $x_s > 0$.

3. Experimental design and hypotheses

3.1. Design and treatments

The subjects played an investment game, which is identical to the design of Kirchler et al. (2018). Over eight periods, the participants repeatedly made portfolio choices between a risk-free alternative and a risky asset. The investment game was inspired by, and resembles games of, Lohrenz et al. (2007), Ehm et al. (2014), Bradbury et al. (2015), and Huber et al. (2016). In each period, the risk-free asset yielded a return of $R^f = 0.015$ (1.5%) and the risky asset paid an expected return of $R^m = 0.036$ (3.6%) with a standard deviation of 15.9%. The participants received information about the mean and standard deviation of the return distribution but no information about the origin of the underlying data (except that they were part of historical financial market data).[15] In each period, the participants decided which fraction b, *RISK*, of their current portfolio wealth, W^p, to invest in the risky asset. Portfolio wealth is carried over from one period to the next. The participants were allowed to invest up to 200% of their portfolio wealth, meaning that the amount exceeding W^p was borrowed at the risk-free rate R^f.[16]

We randomly assigned the participants to groups of six, which remained the same for the duration of the investment game. Each group played one of the six treatments in a between-subjects design. Table 1 outlines the six treatments, based on a 2x3 design with the treatment variables "Private ranking after each period" and "Public announcement of rank after experiment." The former treatment variable indicates whether an anonymous league table, detailing all group members' current wealth levels, associated rank (RANK $\in \{1, 2, \ldots, 6\}$), and subjects' own position in the ranking, was displayed after each period. This ranking was anonymous and not incentivized. The latter treatment variable indicates whether the top performer (Rank 1), the lowest performer (Rank 6), or nobody at all was publicly announced after the last period.[17] At the end of the experiment (before participants received their payment), the highest ranked participant in each group was announced to all participants in the room as WINNER (LOSER) of this investment challenge. This procedure was common knowledge to all participants of the respective sessions from the beginning of the experiment (see the the instruction in the online appendix for the exact wording). Given that the professional sample was smaller than the student sample, we restricted data collection for the professionals to the four most important treatments to guarantee sufficient statistical power

[15] We computed these numbers from time series data of the 6-months EURIBOR for the risk-free rate (before 1999: FIBOR, Frankfurt Interbank Offered Rate) and from the DAX 30 for the risky asset. We calculated returns and standard deviations for a 20-year period from January 1, 1994 to December 31, 2013. The numbers reflect semi-annual returns and standard deviations. In each period, one return was randomly drawn from a distribution with the above mentioned two moments of the distribution. Thus, the first and second moments of the distribution were computed from empirical data, but the random draws in the experiment were taken from a Gaussian distribution with same parameters. Of course, financial time series exhibit excess kurtosis and skewness, but we wanted to keep the distribution as easily understandable as possible. Treatment RANKING served as a baseline for the return draws and returns drawn in this treatment were also implemented in the other treatments for the sake of comparability. See Fig. A1 in the appendix for a histogram of the returns drawn in the experiment across all groups of six subjects.

[16] Before the investment game started, the participants had to sample 30 returns from the theoretical distribution with the above-mentioned first two moments of the distribution. This procedure was intended to increase familiarity with the properties of the risky asset. As Kaufmann et al. (2013) and Bradbury et al. (2015) report, experience sampling increases decision commitment and confidence, while it can also decrease known biases such as overestimation of loss probabilities.

[17] The main reasons why we decided to only announce the top or the lowest performer are the following. First, we wanted to isolate the reputation (announcement) effect as much as possible. With only announcing the winner or the loser, we can control for confounding effects that might arise when announcing the entire ranking publicly. Second, in the related literature on rank-order tournament it is common to design tournaments with one winner prize and $N - 1$ loser prizes (see e.g. Dutcher et al., 2015, among others).

for those treatments. In particular, we did not run treatments with professionals where only the rank after the treatment was publicly announced ("B-WINNER and B-LOSER").

In Treatment BASELINE, the participants faced linear incentives and allocated their portfolio in eight periods without peer feedback. Students received an initial endowment of 30 euro (90 euro for professionals) and accumulated gains and losses depending on their investments over time. In line with Cohn et al. (2014, 2017) and Kirchler et al. (2018), each participant received the payout of the investment game with a probability of 20% to facilitate high stakes. There is a growing body of literature indicating that these commonly used payment schemes with random components do not bias risk-taking behavior in experiments (Cubitt et al., 1998; Hey and Lee, 2005; March et al., 2015; Starmer and Sugden, 1991). Moreover, Charness et al., 2016 pointed out that the pay-one (or pay-a-subset) method is either equal or even superior to the pay-all method in the majority of cases.

The treatments B-LOSER and B-WINNER are identical to BASELINE with the only difference that, respectively, the worst performer (loser) or the top performer (winner) in the ranking of each group was publicly announced after the last period of the investment game and therefore all subjects saw the winners (or the losers, depending on the treatment) in the session they took part. This procedure was common knowledge from the beginning of the experiment.

In Treatment RANKING, the participants received the same linear incentives as in BASELINE, but after each period we showed them an anonymous league table, detailing all group members' current wealth levels, associated rank (RANK $\in \{1, 2, \ldots, 6\}$), and their own position in the ranking. This ranking was not incentivized, and there was no public disclosure of the ranking in the end. Hence, we apply a very mild form of social comparison in this treatment. All data of treatments BASELINE and RANKING are taken from the experiments in Kirchler et al. (2018).[18]

Treatments R-LOSER and R-WINNER are identical to Treatment RANKING, except for the announcement of the loser or the winner, respectively, according to the ranking in each group. The treatments with the public announcement of the loser, or respectively the winner, are designed to investigate the effect of reputational motives beyond intrinsic rank incentives.

After the investment game, in a second part of the experiment, we administered two additional experimental tasks, one of which was paid out randomly, and some survey questions. Please see the online appendix for the instructions of all experimental tasks. Part 2 of the instructions were handed out after all participants had completed Part 1. In the first task we measured risk-attitudes in a standard choice list setting (Abdellaoui et al., 2011; Bruhin et al., 2010).[19] We also measured risk attitudes/tolerance (on a Likert scale from 1 to 7) with a survey question from the German Socio-Economic Panel (SOEP; Dohmen et al., 2011). The participants answered the question: "How do you see yourself: Are you willing to take risks or try to avoid risks?" The answers were provided on a Likert scale from 1 (not at all willing to take risks) to 7 (very willing to take risks). In the second task, we measured loss tolerance using the procedure of Gächter et al. (2010).[20] The participants earned 18 euro as a show-up fee for participating in the experiment, which covered the potential maximum loss in the loss tolerance task. In the survey, we measured the participants' attitudes toward social comparison with three questions on social status, financial success, and relative performance, taken from Cohn et al. (2014). Furthermore, we measured CRT scores (Cognitive Reflection Test, Frederick, 2005) with slightly modified questions (see appendix).[21] Questions on demographics concluded the experiment.appen.

3.2. Hypotheses

We can now use the treatments defined above to operationalize the insights from the model. Proposition 1 allows us to formulate hypotheses regarding portfolio choice in different treatments in which investors are informed about their rank and/or the winner or loser is publicly announced:

Hypothesis 1. Risk-taking is higher in treatments where investors are informed about their rank (RANKING), compared to the baseline treatment (BASELINE).

Hypothesis 2. If investors are not informed about their rank, risk-taking is higher in treatments where the winner or the loser is announced (B-LOSER and B-WINNER), compared to the baseline treatment (BASELINE).

Hypothesis 3. In treatments where investors are informed about their rank and where the winner or the loser is announced (R-LOSER and R-WINNER), risk-taking is higher compared to the treatment without announcement (RANKING).

[18] In Kirchler et al. (2018) the treatments BASELINE and RANKING are referred to as TBASE and TRANK, respectively.

[19] The participants could choose between a risky option, paying either 0 or 8 euro with equal probability, or a safe payment, which ranged between 1 and 7 euro in steps of 1 euro.

[20] In the task measuring loss tolerance, the participants had to decide whether to play a particular lottery or not. If they decided to play the lottery, they either received, with equal probability, 15 euro or incured a loss of X. The loss X varied from 1 to 6 euro in steps of 1 euro. If the participants decided not to play a particular lottery, they received a payout of zero.

[21] In Table A4 in the appendix we analyze the impact of these control variables on the average level of risk taking of the individuals in the experiment. We find that loss tolerance has the highest explanatory power in explaining risk taking in the experiment (i.e., with a highly significant positive coefficient in both subject pools). We also elicited the 10-item Big-5 personality traits according to Rammstedt and John (2007) and socially undesirable personality traits, such as narcissism, psychopathy, and machiavellianism (i.e., Dark Triad), using the 12-item test of Jonason and Webster (2010). We did not include the Big-5 and Dark Triad personality traits to Table A4, because of missing data points. The questions asked in the survey were programmed in a separate z-Tree file, which will be provided upon request.

Moreover, based on Conjecture 1, we can formulate hypotheses with respect to the portfolio choice of highly ranked investors in comparison to underperformers.

Hypothesis 4. In treatments where investors are informed about their rank (RANKING), the risk-taking of highly ranked investors is lower compared to risk-taking of underperformers.

Hypothesis 5. In treatments where investors are informed about their rank and where the winner or the loser is announced (R-LOSER and R-WINNER), the risk-taking of highly ranked investors is lower compared to risk-taking of underperformers.

3.3. Implementation

To test our hypotheses we recruited 864 student subjects for Experiment STUD, i.e., 144 subjects for each treatment. We administered the experiment to bachelor and master students from various disciplines at the University of Innsbruck (Austria) at the Innsbruck EconLab. We recruited 75.7% male students to stay as close as possible to the gender ratio of the professionals in Experiment PROF (see below). The average age was 23.2 years, and 47.7% were students with a major in economics or management. The students received an average payout of 17 euro for both parts of Experiment STUD with a maximum payout of 161 euro and an average duration of 45 minutes per session. We paid out subjects privately, in cash, after the experiment. We programmed and conducted all experiments (STUD and PROF) using the same source code, programmed in z-Tree (Fischbacher, 2007). Student subjects were recruited via hroot (Bock et al., 2014).

For Experiment PROF we recruited 330 professionals from major financial institutions in several OECD countries. All professionals that participated in our experiments were regularly confronted with competitive rankings, bonus incentives, and investment decisions—i.e., professionals from private banking, trading, investment banking, portfolio management, fund management, and wealth management.[22] In Experiment PROF, 87.3% of the participants were male, their average age was 36.8 years, and they had been working in the finance industry for 12.6 years on average.

In all experiments with professionals, we booked a conference room on location or in close proximity (for several organizations to participate simultaneously), set up our mobile laboratory, and invited professionals to show up. Our mobile laboratory is virtually identical to the Innsbruck EconLab at the University of Innsbruck, where we ran the experiment with students (see pictures in the appendix). The mobile lab consists of laptops and partition walls on all sides for each participant, allowing for conditions similar to those in regular experimental laboratories. We mainly recruited members of professional associations/societies, ensuring that most sessions were populated with professionals from different institutions. In this way, we achieved high comparability with the student sample, as most professionals did not know, or barely knew, each other. In total, 78, 102, 66, and 84 professionals participated in treatments BASELINE, RANKING, R-LOSER, and R-WINNER, respectively. Because of a limited number of professionals we refrained from running treatments R-LOSER and R-WINNER in Experiment PROF and rather focused on a sufficiently large sample in the four other treatments.[23]

All specifications were identical to the experiment with students except for the stake size. Similar to other studies (Alevy et al., 2007; Cohn et al., 2014; Kirchler et al., 2018; List and Haigh, 2005), we scaled up the students' payoffs with a multiplier of three for professionals in all parts of the experiment. The professionals received an average payout of 48 euro for both parts of Experiment PROF, with a maximum payout of 286 euro and an average duration of 45 minutes per session. For participants who received money in the investment game, the average payout was 112 euro for a task of 20 minutes, ensuring salient incentives for professionals.[24] The professionals received the payout in sealed envelopes and in cash directly after the experiment.

4. Results

To test Hypotheses H1 to H5, we run random effects panel regressions with AR(1) disturbance.[25] In all specifications, the percentage that subjects invested in the risky asset (RISK) is the dependent variable. As control variables, we include R^p_{t-1}, which measures the log-return of subject i's portfolio since the start of the experiment, and R^m_{t-1}, which records the preceding period's asset return. With treatment dummies we test for differences between treatments, as defined in the hypotheses. With RANK_{t-1}, which denotes subject i's rank at the end of the preceding period, we analyze the effect of

[22] We signed non-disclosure agreements (NDA) regarding the identity of the participating financial institutions.

[23] More specifically, we decided to conduct the most "extreme" treatments with financial professionals.

[24] In the questionnaire, the professionals reported an average annual gross salary of 76,548 euro. Accordingly, the average (maximum) hourly payoff from the experiment amounted to roughly 2.9 times (18 times) the average professional's hourly wage after taxes. For this calculation, we assumed a working time of 45 hours/week for 47 weeks/year and 40% taxes to calculate an hourly net wage (22 euro). In our experiment, the participants' average (maximum) hourly payment was 64 (381) euro (48*60/45 and 286*60/45), resulting in 295% (1,756%) of their salary. Haigh and List (2005) report that their average traders' payment for a 25-minute task was 40 U.S. dollars, which translates to an hourly payment of 96 U.S. dollars. Given an exchange rate of about 1.32 at the time of the study, the payment in Haigh and List (2005) is equivalent to an average hourly wage of 73 euro. Note that monetary incentives in experiments with a representative sample of the general population are less accurate because of the high heterogeneity in the participants' salaries. In our case, the hourly payout of nearly three times the average applies to a sample with a more homogeneous salary distribution.

[25] See Table A1 in the appendix for a randomization check. It turns out that the only variables that are significantly different across treatments are age and loss tolerance. As a robustness check, we add these two control variables in the regression models, leading to qualitatively identical results. See Table A2 and Table A3 in the appendix for details.

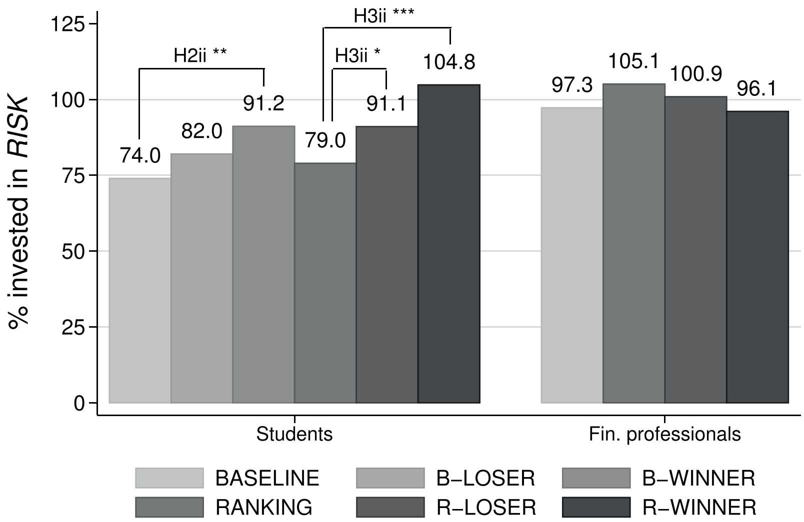

Fig. 1. Average fraction invested in the risky asset (*RISK*) across treatments for the student subject pool (left bars) and financial professionals (right bars). The significant results – based on regression data – are marked with asterisks.

relative performance on risk-taking. The results are reported in Table 2 (STUD) and Table 3 (PROF). Furthermore, we run the same regression with all treatments to draw a complete picture over all treatments (with BASELINE as reference treatment; see columns ALL).[26]

Result 1 (H1): *Average risk-taking does not differ between treatments where investors are informed about their rank (RANKING) and the baseline treatment (BASELINE). This holds for both experiments, STUD and PROF.*

The coefficients of the intercept and of the treatment dummy RANKING in the first column of Tables 2 and 3 show the levels of risk-taking in the two relevant treatments. Risk-taking in Experiment STUD increases from 73.5% (coefficient of α) in Treatment BASELINE to 79.4% in Treatment RANKING (sum of coefficients of α and of dummy RANKING). However, this increase is not statistically significant (at $p = 0.336$), as shown by the standard errors for the dummy RANKING. In Experiment PROF, the level of risk-taking is generally higher than in Experiment STUD: the corresponding levels of risk-taking by professionals are 97.0% and 104.4% in Treatments BASELINE and RANKING, respectively. Again, this increase is not statistically significant. This result is in line with Kirchler et al. (2018). We include it for the sake of completeness and as a comparison for our analyses of status concerns in the following hypotheses.

Result 2 (H2): *In Experiment STUD, average risk-taking is higher in treatments in which the winner or the loser is announced (B-WINNER and B-LOSER), compared to the baseline treatment (BASELINE).*

Recall that we did not run Treatments B-WINNER and B-LOSER in Experiment PROF. We therefore test Hypothesis 2 with Experiment STUD only. As reported in Columns 2 and 3 of Table 2, average risk-taking in treatments accounting for reputational motives is significantly higher compared to the baseline treatment in Experiment STUD. When pooling Treatments B-WINNER and B-LOSER with the dummy WIN&LOS, the effect of reputational motives on risk-taking is significant at a 5% level. This effect is mainly driven by announcing top performers in Treatment B-WINNER, with a highly significant increase of risk-taking by 18 percentage points (and an average level of risk-taking of 92.1%). When the bottom-ranked subjects are announced in Treatment B-LOSER, average risk-taking is 82.9% and not statistically different from the baseline treatment.

Result 3 (H3): *In Experiment STUD, average risk-taking is higher when investors are informed about their rank and when the winner or the loser is announced (R-WINNER and R-LOSER), compared to no announcement (RANKING). This effect does not hold in Experiment PROF.*

As shown in Columns 4 and 5 of Table 2, even when controlling for intrinsic rank incentives, reputational motives in Treatments R-WINNER and R-LOSER significantly increase average risk-taking compared to Treatment RANKING in Experiment STUD. This effect is, again, mainly driven by the announcement of top performers in Treatment R-WINNER, similar to the above results in support of Hypothesis 2. The aggregate effect of both treatments (dummy WIN&LOS), reported in Column 4, is significant at a 0.1% level. For professionals, we find no differences in average risk-taking between Treatments R-WINNER, R-LOSER, and RANKING (see Columns 2 and 3 of Table 3). This striking difference in behavior compared to the student sample may be due to the relatively high risk-taking of underperforming professionals in RANKING. We will return to this finding when testing Hypothesis H4.

[26] As a robustness check, we run Table 3 including the years in the finance industry as a proxy of work experience. We do not detect differences to the main results, outlining that younger professionals do not exhibit different behavior to professionals with longer tenure in the industry. Results can be provided upon request.

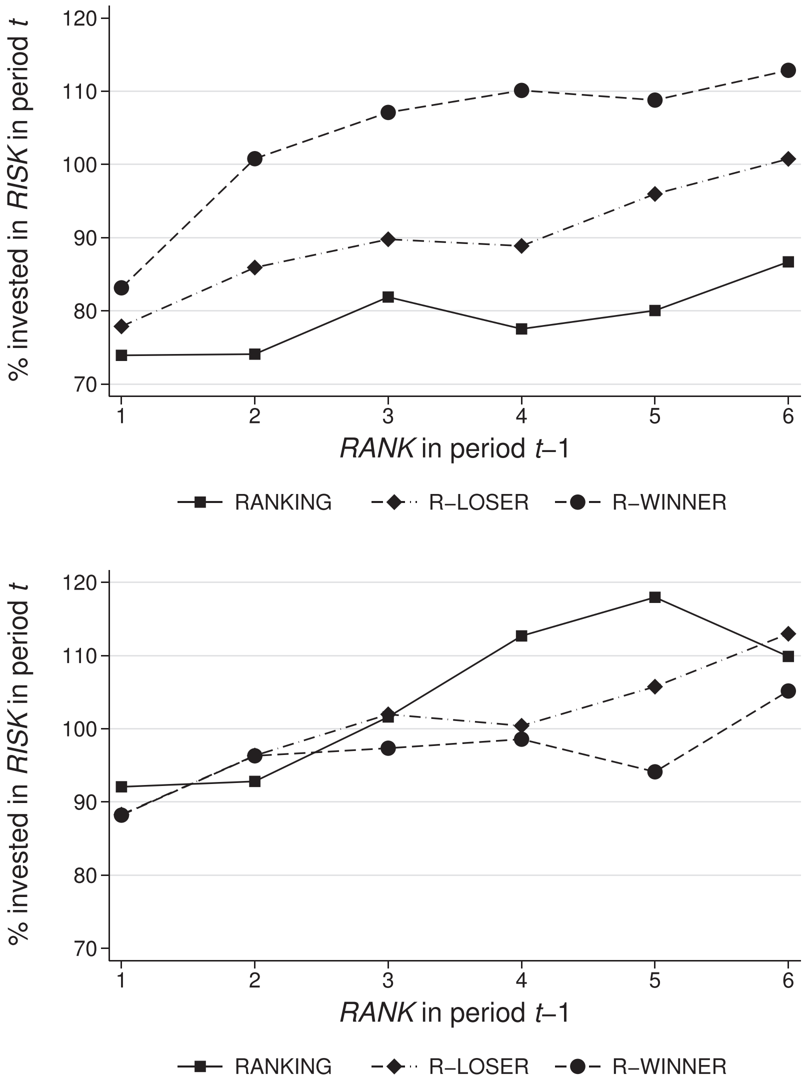

Fig. 2. Average percentage invested in the risky asset (*RISK*) in period t conditional on subject's rank in the previous period $t-1$ (RANK_{t-1}) across treatments RANKING, R-LOSER, and R-WINNER (top panel: STUD; bottom panel: PROF)

For illustrative purpose, we present the results of average risk-taking graphically in Fig. 1 for hypotheses H1 to H3. Note that the values are taken from the regression in column "ALL" of the respective subject pool.

In addition, we add a regression with all treatments for each subject pool in Table 2 (STUD) and Table 3 (PROF) with BASELINE as reference treatment (see columns ALL). While we do not report any differences across treatments in pairwise Wald coefficient tests ($p > 0.05$) in the professional sample, we find differences in the absolute level invested in the risk asset in the treatment comparisons B-WINNER VS R-WINNER ($p = 0.023$), RANKING VS R-WINNER ($p = 0.009$), and RANKING VS R-LOSER ($p = 0.043$) in the student subject pool.

Result 4 (H4): *In Experiment* PROF, *in treatments where investors are informed about their rank (*RANKING*), the risk-taking of highly ranked investors is lower compared to that of underperformers. This effect does not apply to Experiment* STUD.

Column 4 of Table 3 reports that the coefficient for the variable RANK_{t-1} is positive and significant. This indicates that underperforming professionals increase risk-taking markedly compared to outperformers. With a coefficient of 5.1, the effect is significant on a 1% level, translating into a difference in risk-taking of more than 30 percentage points between rank 6 and rank 1. In contrast, students do not react to anonymous rankings, leaving the coefficient of variable RANK_{t-1} insignificant (see Column 6 of Table 2). This difference in rank effects between the two subject pools has been shown in Kirchler et al. (2018) but is important to recall, as it may help to understand Result 3 above. Specifically, the fact that intrinsic rank effects strongly increase the risk-taking of underperforming professionals but not of students (Result 4) seems to leave room for underperforming students to react to reputational motives (R-WINNER and R-LOSER). In contrast, profes-

Table 2
Econometric Estimation of Experiment STUD

	Hypotheses							
Dep. var: RISK	H1	H2i	H2ii	H3i	H3ii	H4	H5	ALL
R^p_{t-1}	-0.386***	-0.360***	-0.361***	-0.206***	-0.206***	-0.295***	-0.103*	-0.273***
	(0.047)	(0.036)	(0.036)	(0.035)	(0.035)	(0.076)	(0.043)	(0.025)
R^m_{t-1}	-0.041	-0.225***	-0.225***	-0.114*	-0.114*	-0.090	-0.175*	-0.171***
	(0.060)	(0.048)	(0.048)	(0.055)	(0.055)	(0.094)	(0.068)	(0.036)
RANKING	5.854							5.007
	(6.089)							(5.987)
WIN&LOS		13.391*		19.001***				
		(5.252)		(5.143)				
B-LOSER			8.809					8.061
			(6.046)					(5.986)
B-WINNER			17.979**					17.186**
			(6.048)					(5.987)
R-LOSER					12.079*			17.094**
					(5.902)			(5.986)
R-WINNER					25.924***		14.018*	30.835***
					(5.903)		(5.730)	(5.985)
RANK_{t-1}						1.630	4.354***	
						(1.343)	(0.935)	
α	73.528***	74.093***	74.093***	78.232***	78.228***	73.192***	74.492***	73.972***
	(4.301)	(4.284)	(4.273)	(4.208)	(4.183)	(6.569)	(5.264)	(4.232)
N	2016	3024	3024	3024	3024	1008	2016	6048
R^2	0.072	0.073	0.077	0.042	0.049	0.049	0.035	0.063
Chi^2	83.290	190.457	192.886	72.674	78.479	32.607	61.019	246.395
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Treatments	BASELINE	BASELINE	BASELINE	RANKING	RANKING	RANKING	R-LOSER	ALL
	RANKING	B-LOSER	B-LOSER	R-LOSER	R-LOSER		R-WINNER	
		B-WINNER	B-WINNER	R-WINNER	R-WINNER			
Reference	BASELINE	BASELINE	BASELINE	RANKING	RANKING	none	R-LOSER	BASELINE

Random effects panel regressions with AR(1) disturbance, testing treatment differences of students' percentage invested in the risky asset (*RISK*). R^p_{t-1} is the log-return of subject *i*'s portfolio since the start of the experiment, and R^m_{t-1} is the preceding period's asset return. RANK_{t-1} indicates subject *i*'s rank at the end of the preceding period. In Columns H1 to H2(ii), Treatment BASELINE, in which the students invested without information on their rank, serves as the reference group. Treatment RANKING was identical except for the display of an anonymous and non-incentivized ranking after each period and serves as a reference group for H3(i) and H3(ii). Treatments B-LOSER (B-WINNER) and R-LOSER (R-WINNER) were identical to BASELINE and RANKING except that the lowest (top) performer in a group of six was publicly announced after the final period. The dummy variable WIN&LOS indicates whether observations are from treatments B-LOSER or B-WINNER (if the reference treatment is BASELINE) or from R-LOSER or R-WINNER (if the reference treatment is RANKING). Column H4 displays Treatment RANKING, H5 treatments R-LOSER and R-WINNER, and ALL covers all student treatments (with BASELINE as the reference treatment). Standard errors are provided in parentheses. ***, **, and * represent significance at the 0.1%, 1%, and 5% levels, respectively.

sionals (Result 3) have reached similarly high levels of risk-taking, even without the announcement of winners or losers (in RANKING).

Result 5 (H5): *In treatments where investors are informed about their rank and the winner or the loser is announced publicly (R-WINNER and R-LOSER), the risk-taking of highly ranked investors is lower compared to that of underperformers.*

As outlined in Column 7 of Table 2, the coefficient of the variable RANK_{t-1} (rank effect) becomes significant for the student sample as soon as reputational motives are added to the ranking in Treatments R-WINNER and R-LOSER. In the professional sample, in contrast, the rank effect remains significant when the rankings are combined with reputational motives (see Column 5 of Table 3).

Again, for illustrative purposes, we present Fig. 2, showing the major findings of hypotheses H4 and H5. Here, we report students' (top panel) and professionals' (bottom panel) risk-taking conditional on their rank in the previous period (RANK_{t-1}).[27]

These results indicate that students intrinsically care less about anonymous social comparisons in investment decisions but show similar risk-taking behavior as financial professionals as soon as reputational motives are introduced. Professionals, in contrast, exhibit strong rank-driven behavior, even when only anonymous rankings are displayed, revealing higher levels of intrinsic (self-image) motives to outperform peers in investment decisions (Kirchler et al., 2018).

[27] In particular, in Fig. 2, we report the sum of the intercept and the coefficient of each rank dummy, reflecting the rank-specific average of *RISK*, which, in turn, controls for portfolio wealth and asset returns.

Table 3
Econometric Estimation of Experiment PROF

	Hypotheses					
Dep. var: *RISK*	H1	H3i	H3ii	H4	H5	ALL
R^p_{t-1}	-0.435***	-0.493***	-0.494***	-0.384***	-0.439***	-0.454***
	(0.057)	(0.056)	(0.056)	(0.092)	(0.077)	(0.044)
R^m_{t-1}	-0.060	-0.133	-0.132	-0.067	-0.245*	-0.132
	(0.094)	(0.078)	(0.078)	(0.129)	(0.098)	(0.068)
RANKING	7.442					7.840
	(7.520)					(7.626)
WIN&LOS		-7.016				
		(6.555)				
R-LOSER			-4.209			3.647
			(8.066)			(8.479)
R-WINNER			-9.223		-4.787	-1.186
			(7.524)		(8.318)	(7.968)
RANK_{t-1}				5.055**	4.152**	
				(1.566)	(1.271)	
α	97.002***	105.619***	105.625***	86.272***	86.611***	97.253***
	(5.659)	(5.097)	(5.095)	(7.635)	(7.850)	(5.740)
N	1260	1764	1764	714	1050	2310
R^2	0.096	0.060	0.061	0.114	0.046	0.069
Chi^2	72.702	107.609	107.924	46.438	88.045	143.469
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Treatments	BASELINE RANKING	RANKING R-LOSER R-WINNER	RANKING R-LOSER R-WINNER	RANKING	R-LOSER R-WINNER	ALL
Reference	BASELINE	RANKING	RANKING	none	R-LOSER	BASELINE

Random effects panel regressions with AR(1) disturbance, testing treatment differences of professionals' percentage invested in the risky asset (*RISK*). R^p_{t-1} is the log-return of subject *i*'s portfolio since the start of the experiment, and R^m_{t-1} is the preceding period's asset return. RANK_{t-1} indicates subject *i*'s rank at the end of the preceding period. In Column H1, Treatment BASELINE, in which the professionals decided without information on their rank, serves as the reference group. Treatment RANKING was identical except for the display of an anonymous and non-incentivized ranking after each period and serves as a reference group for H3(i) and H3(ii). Treatments B-LOSER (B-WINNER) and R-LOSER (R-WINNER) were identical to BASELINE and RANKING except that the lowest (top) performer in a group of six was publicly announced after the final period. The dummy variable WIN&LOS indicates whether observations are from treatments R-LOSER or R-WINNER (if the reference treatment is RANKING). Column H4 displays Treatment RANKING, H5 Treatments R-LOSER and R-WINNER, and ALL covers all professional treatments (with BASELINE as the reference treatment). Standard errors are provided in parentheses. ***, **, and * represent significance at the 0.1%, 1%, and 5% levels, respectively.

5. Conclusion

In this paper, we presented theoretical mechanisms and experimental evidence regarding how rank incentives impact risk-taking in investment decisions among 864 non-professionals (students) and 330 financial professionals from investment-related areas, such as fund management, trading, private banking, and asset management. In particular, we separate intrinsic (self-image) and reputational (status) motives and investigate their contribution to risk-taking in investment decisions.

We found that average risk-taking among students is higher in treatments in which the winner or the loser is announced publicly, compared to the baseline treatment. The public announcement of winners or losers also increases average risk-taking among students compared to a treatment with anonymous rank information. For professionals, however, we do not observe such effects, which indicates that reputation motives primarily play a role among non-professionals. We also find that underperforming investors take more risk than outperformers in treatments where both intrinsic and reputational motives are possible drivers, i.e., where rankings are displayed and the winner or loser is publicly announced. This result holds for both students and professionals. However, while underperforming students do not increase risk-taking without reputational motives, underperforming professionals increase risk-taking primarily in treatments where intrinsic motives play a role. Hence, reputational motives, as an additional incentive, seem to be of less importance for financial professionals, as the rank-driven behavior of underperformers is already strong when anonymous rankings are in place. This could cautiously be interpreted as professionals showing higher levels of intrinsic (self-image) motives to outperform others compared to non-professionals (students) in investment decisions.

Our results differ compared to the findings of Gilpatric (2009) in a tournament setting. The main reason is that the authors, in contrast to our approach, focus on symmetric equilibria and assume risk neutral, identical contestants. Their main conclusion is that risk taking can be mitigated or eliminated by structuring the contest with more than two payoff levels, specifically by introducing a fine for the contestant ranking last. Another reason why our results differ from previous findings in contest settings, specifically rank-order tournaments, is that agents in tournaments usually earn either one high prize or one of n-1 low prizes (see Dechenaux et al., 2015, for a comprehensive survey). In our experiment, however, *each* subject receives a payment that solely depends on his/her final portfolio value. This payment is determined by individual risk-taking and is completely independent of others' choices. In monetary terms this implies a different strategic situation than in tournament settings. In tournaments, subjects, who are behind, or belief that the likelihood of winning is low, might give up and maximize their own profit in minimizing the effort costs. The result is a U-shaped effort distribution: some people try to win and invest a lot of effort and others will invest very little or almost no effort (Dutcher et al., 2015).

Our results also have welfare implications. If professionals care about their ranking vis-a-vis their peers, we show that they will increase risk-taking. As professionals mostly do not invest their own money, this behavior may exceed the risk bearing capacity of their clients, which can lead to a situation where professionals take excessive risks with their customers' money because of their private social motives. If that is the case, regulators should consider putting restrictions on providing rank information in financial markets. Note that regulators should focus on private rank information as we find that reputation does not seem to add much risk-taking.

Of course, this paper can only attempt to shed some light on the complex relationships between extrinsic, intrinsic, and reputational motives on risk-taking and the possible import of professional norms and values into competitive investment decisions. Further research is needed to disentangle these mechanisms and their effects on risk-taking and decision-making in general.

Appendix A

A1. Additional figures and tables

Table A1
Randomization check This table shows Kruskal–Wallis test statistics across treatments within subject pool samples of demographics and other elicited variables – questions about overconfidence, financial risk-taking, loss tolerance, risk tolerance, CRT score, summary of the three dark triad items (and combined), and the summary of the five Big-5 items.

Variable	Students	Fin. Professionals
age	$p < 0.005$	$p < 0.005$
gender	$p > 0.100$	$p > 0.100$
overconfidence	$p > 0.100$	$p > 0.100$
risk question	$p > 0.050$	$p > 0.100$
LA	$p < 0.005$	$p < 0.050$
RA	$p > 0.100$	$p > 0.100$
CRT	$p > 0.100$	$p > 0.100$
Dark Triad	$p > 0.100$	$p > 0.050$
Big 5	$p > 0.100$	$p > 0.100$

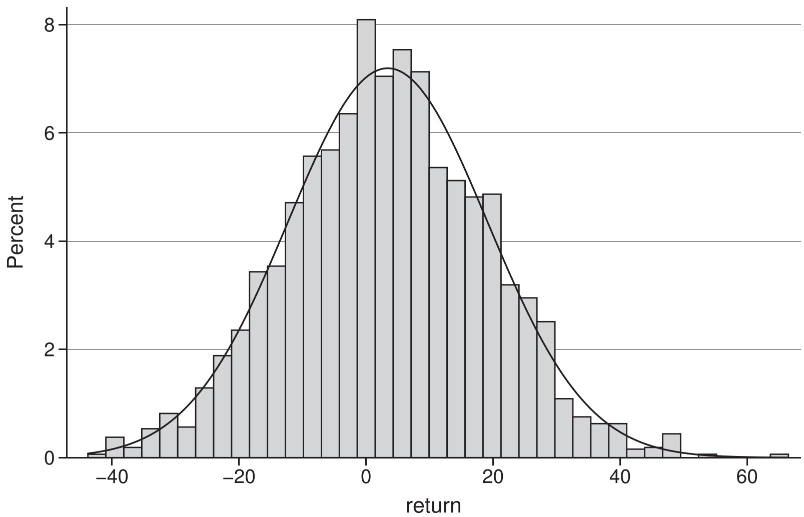

Fig. A1. Histogram of the asset returns, R_t^m, drawn in the experiment across all groups of six subjects.

Table A2

Econometric Estimation of Experiment STUD Random effects panel regressions with AR(1) disturbance, testing treatment differences of students' percentage invested in the risky asset (*RISK*). R^p_{t-1} is the log-return of subject *i*'s portfolio since the start of the experiment, and R^m_{t-1} is the preceding period's asset return. RANK_{t-1} indicates subject *i*'s rank at the end of the preceding period. In Columns H1 to H2(ii), Treatment BASELINE, in which the students invested without information on their rank, serves as the reference group. Treatment RANKING was identical except for the display of an anonymous and non-incentivized ranking after each period and serves as a reference group for H3(i) and H3(ii). Treatments B-LOSER (B-WINNER) and R-LOSER (R-WINNER) were identical to BASELINE and RANKING except that the lowest (top) performer in a group of six was publicly announced after the final period. The dummy variable WIN&LOS indicates whether observations are from treatments B-LOSER or B-WINNER (if the reference treatment is BASELINE) or from R-LOSER or R-WINNER (if the reference treatment is RANKING). Column H4 displays Treatment RANKING and H5 treatments R-LOSER and R-WINNER. "Controls" include the variables age and loss tolerance. Standard errors are provided in parentheses. ***, **, and * represent significance at the 0.1%, 1%, and 5% levels, respectively.

	Hypotheses							
Dep. var: *RISK*	H1	H2i	H2ii	H3i	H3ii	H4	H5	ALL
R^p_{t-1}	-0.385***	-0.365***	-0.366***	-0.213***	-0.213***	-0.293***	-0.115**	-0.280***
	(0.046)	(0.035)	(0.035)	(0.035)	(0.035)	(0.075)	(0.043)	(0.025)
R^m_{t-1}	-0.043	-0.223***	-0.223***	-0.114*	-0.114*	-0.092	-0.175**	-0.170***
	(0.060)	(0.048)	(0.048)	(0.055)	(0.055)	(0.094)	(0.068)	(0.036)
RANKING	8.755							8.500
	(5.769)							(5.705)
WIN&LOS		12.853**		16.108**				
		(4.984)		(5.098)				
B-LOSER			8.745					7.866
			(5.702)					(5.709)
B-WINNER			17.050**					16.196**
			(5.732)					(5.721)
R-LOSER					8.674			16.604**
					(5.831)			(5.713)
R-WINNER					23.315***		15.030**	31.282***
					(5.788)		(5.530)	(5.700)
RANK_{t-1}						1.518	4.228***	
						(1.339)	(0.931)	
α	-17.402	-6.435	-6.914	23.190	23.658	-3.083	40.016	5.675
	(19.936)	(20.055)	(20.011)	(17.293)	(17.168)	(26.545)	(22.141)	(13.297)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
N	2016	3024	3024	3024	3024	1008	2016	6048
R^2	0.142	0.151	0.154	0.080	0.087	0.092	0.074	0.120
Chi^2	125.716	259.245	261.850	104.892	112.327	44.524	83.446	347.178
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table A3

Econometric Estimation of Experiment PROF Random effects panel regressions with AR(1) disturbance, testing treatment differences of professionals' percentage invested in the risky asset (*RISK*). R^p_{t-1} is the log-return of subject *i*'s portfolio since the start of the experiment, and R^m_{t-1} is the preceding period's asset return. RANK_{t-1} indicates subject *i*'s rank at the end of the preceding period. In Column H1, Treatment BASELINE, in which the professionals decided without information on their rank, serves as the reference group. Treatment RANKING was identical except for the display of an anonymous and non-incentivized ranking after each period and serves as a reference group for H3(i) and H3(ii). Treatments B-LOSER (B-WINNER) and R-LOSER (R-WINNER) were identical to BASELINE and RANKING except that the lowest (top) performer in a group of six was publicly announced after the final period. The dummy variable WIN&LOS indicates whether observations are from treatments R-LOSER or R-WINNER (if the reference treatment is RANKING). Column H4 displays Treatment RANKING and H5 Treatments R-LOSER and R-WINNER. "Controls" include the variables age and loss tolerance. Standard errors are provided in parentheses. ***, **, and * represent significance at the 0.1%, 1%, and 5% levels, respectively.

	Hypotheses					
Dep. var: *RISK*	H1	H3i	H3ii	H4	H5	ALL
R^p_{t-1}	-0.435***	-0.500***	-0.501***	-0.404***	-0.445***	-0.456***
	(0.057)	(0.055)	(0.055)	(0.092)	(0.076)	(0.044)
R^m_{t-1}	-0.060	-0.130	-0.129	-0.064	-0.243*	-0.132
	(0.095)	(0.078)	(0.078)	(0.130)	(0.098)	(0.068)
RANKING	9.960					11.970
	(7.460)					(7.401)
WIN&LOS		-10.219				
		(6.396)				
R-LOSER			-5.366			6.783
			(7.736)			(8.273)
R-WINNER			-14.316		-9.062	-1.562
			(7.372)		(7.908)	(7.851)
RANK_{t-1}				5.114**	4.055**	
				(1.558)	(1.261)	
α	63.816***	79.559***	78.061***	37.635	63.704***	68.958***
	(17.581)	(14.360)	(14.394)	(24.290)	(19.111)	(13.016)
Controls	YES	YES	YES	YES	YES	YES
N	1260	1764	1764	714	1050	2310
R^2	0.118	0.111	0.114	0.156	0.118	0.110
Chi^2	82.422	134.094	135.445	56.992	110.064	171.516
p-value	0.000	0.000	0.000	0.000	0.000	0.000

Table A4
Individual Investment in the Risky Asset Ordinary least squares regression of average percentage invested in the risky asset, $\widetilde{RISK}$, with *AGE*, *FEMALE*, and *CRT* representing the age, gender, and the outcome of the CRT questions. *LOSS_TOLERANCE* is a measure of loss attitudes (from 0 to 1; higher values indicate lower loss aversion) and *RISK_TOLERANCE* is a measure of risk attitudes. Standard errors are provided in parentheses. ***, **, and * represent significance at the 0.1, 1, and 5 percent levels, respectively.

Dep. var: $\widetilde{RISK}$	STUD	PROF
AGE	1.922***	-0.096
	(0.520)	(0.316)
FEMALE	-1.811	-11.333
	(3.393)	(6.239)
LOSS_TOLERANCE	61.492***	59.855***
	(11.853)	(15.704)
RISK_TOLERANCE	30.274*	5.211
	(12.791)	(18.442)
CRT	-0.672	2.509
	(1.449)	(2.807)
RANKING	5.658	8.464
	(6.873)	(9.609)
B-WINNER	13.489	
	(6.984)	
B-LOSER	5.918	
	(6.973)	
R-WINNER	28.025***	-4.099
	(6.764)	(9.432)
R-LOSER	14.510*	1.431
	(6.656)	(10.593)
α	-5.689	61.452***
	(13.528)	(16.328)
N	864	330
Clusters	144	55
R-squared	0.142	0.080
F	11.335	3.746
Prob > *F*	0.000	0.001

A2. Pictures of the experimental laboratories

Fig. A2. Top: Example of a mobile laboratory in the conference room of a financial institution. Bottom: Innsbruck EconLab.

A3. Modified CRT questions

- An IT company offers you storage space. Every day your volume of data doubles. If it would need 20 days to max out the provided space, how long would it take to max out half of the space?
- A football shoe and a ball cost 110 euro together. The shoe costs 70 euro more than the ball. How much costs the ball?
- 5 machines need 5 minutes to produce 5 keyboards. How long would 80 machines need for 80 keyboards?

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.jedc.2021.104116

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