Sorting and selection effects in tournament mechanisms: An experimental investigation†

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Abstract

In this paper we utilize optimal contracts in a Lazear-Rosen tournament to experimentally examine how the selection of an incentive mechanism by managers and, likewise, the self-selection into a mechanism by employees, affect employee output. Depending on the treatment, those assigned the role of a principal or an agent could choose between two theoretically equivalent tournaments: a reward tournament, where one agent receives the top prize, or a punishment tournament, where one agent receives the bottom prize. We find that agents prefer the punishment tournament more than the reward. By classifying the agents within three different competitiveness types, we observe that middle agents are indifferent between the two tournament mechanisms, whereas high – and mainly low – types sort into the punishment tournament. We also compare effort levels between the two treatments and find a negative (positive) selection effect on effort in the reward (punishment) mechanism. Finally, efficiency is higher when agents can select their preferred mechanism.

JEL-Classification: M52, J33, J24, D24, C90

Keywords: tournament, selection, sorting, self-selection, reward, punishment, promotion, firing, contract, experiment

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1 Introduction

A deep understanding of which incentive structures are chosen and why is vital to understand how actors behave inside a given firm which in turn details the success or demise of the firm. Firms that choose an incentive structure which is not suited to their organizational structure will suffer the consequences through high turnover or suboptimal performance; i.e., a worker who chooses to work in a firm that has an incentive structure not suited to her will likely either leave this firm or perform at a suboptimal level. Likewise, certain incentive structures may attract workers of a type not desired by the firm. Thus, at any given time, the actors in the firm - principals and agents - can (at least partially) choose between an incentive scheme where the best workers are rewarded or the worst are punished. For instance, workers can choose to work in an industry where promotion opportunities and bonuses are likely to be more readily available such as in younger industries/firms (e.g. IT driven fields) where the top prize is often quite (relatively) large encouraging competition for the top. On the other hand, they may choose to work in older industries, or those dominated by labor unions, that usually limit the upside which encourages competition away from the bottom to avoid the pitfalls of downsizing or more onerous job assignments.

Despite the relative popularity of incentive mechanisms, a dearth of basic knowledge exists on several dimensions. More specifically, it is unknown which type of worker selects each mechanism, or how the selection of different mechanisms by managers and the self-selection (or sorting) into different mechanisms by employees affect the overall profitability of a corporation. On the agents’ side, individual characteristics, such as risk and loss aversion as well as attitudes towards competition may play a role with respect to the choice of a particular pay scheme. From the firms’ perspective, the sorting of workers into different mechanisms could lead to diverse performances within and between organizations due to the composition of the labor force. This sorting effect implies that output differences may be the result of different incentive mechanisms (Lazear 2000).

It is difficult to observe productivity in a field setting, due to the lack of qualitative information available. Useful observations require measuring work ethics, effort and employees’ preferences as well as their motives and beliefs. Given the limitations of data from the field, our methodology involves the use of laboratory experiments as a first approach to understanding behavior in this setting. We look explicitly at selection and sorting into two tournament mechanisms present in most office environments. We attempt to answer the following questions: What is the most popular tournament scheme and why? Furthermore, what is the relative effect on agents’ behavior when they sort into a contest mechanism compared to when a principal selects one for them?
In our experiment, subjects participate in a chosen effort task under two incentive schemes: a winner tournament and a loser tournament. In the winner tournament, agents compete to be ranked first, which is implemented by awarding a top prize to the top agent and several (equal) lower prizes to all other agents. In the loser tournament, agents compete to avoid being last, which amounts to one low prize for the lowest ranked agent and several (equal) higher prizes for the rest. Subjects compete by submitting a number, where each number has a cost associated with it (see Bull et al. 1987). This is akin to a worker choosing their actual effort where higher effort entails higher costs. Using the prominent theory of Lazear and Rosen (1981), we calculate optimal contracts for both types of tournaments. Regardless of which incentive mechanism is selected, the model predicts that all contracts are efficient and equal in the level of contributed effort (Lazear and Rosen 1981; Nalebuff and Stiglitz 1983). We implement two different treatments in a between-subjects design: in one treatment, the agents are asked to choose which mechanism (winner or loser) they want to compete in, while in the second treatment, this choice is made by the principals. This allows us to test the effects of self-selection (or sorting) and selection on effort and efficiency.

We first show that agents generally prefer the loser tournament more than the winner. To understand how competitive preferences shape agents’ choices, we classify them through their revealed competitive behavior into low, middle and high competitive types. Interestingly, the low and the high types sort into the loser mechanism, whereas the middle types do not show a strong preference for either one. This finding reveals the importance of better understanding sorting and selection effects in work environments. Next, we find that overall effort is lower in the winner than in the loser mechanism in terms of contributed effort when agents are able to self-select into their preferred incentive scheme. In the setting where agents are forced into a specific tournament, both pay schemes are statistically indistinguishable in terms of effort. We also find that chosen effort under the winner scheme is significantly lower when agents have chosen it than when they have been forced into it by a principal. However, the effect is exactly reversed in the loser tournament. Finally, we document that the preferred mechanism is the best in terms of overall efficiency.

The novelty of our paper is the possibility to directly compare the effects of selection and self-selection of agents in two different tournament mechanisms with optimal contracts (and with the same equilibrium predictions). Up to now we are not aware of any other paper which tries to answer these important questions in a precise way. Prior papers on selection examine sorting into a variable versus a fixed payment schemes (e.g. Dohmen and Falk 2011), comparing payment schemes with different numbers of prizes (e.g. Vandergrift
et al. 2007; Cason et al. 2010), or allow only for selecting between a specific tournament and a piece rate scheme (e.g. Bartling et al. 2009; Eriksson et al. 2009; Balafoutas et al. 2012). A further strand of literature deals with gender differences in selecting into a piece rate payment or tournament incentive mechanism, how the gender composition affects the sorting, and if women prefer cooperative over competitive environments (e.g. Gneezy et al. 2003; Kuhn and Villeval 2011; Balafoutas and Sutter 2012; Gupta et al. 2013). Our paper fills this gap in the literature and can be useful in informing firms and policy makers on the interaction between sorting and selection into different incentive schemes on the one hand, and productivity on the other. Employers looking to attract a certain type of candidate should be very interested to learn which mechanism is preferred and by whom.

2 Related Literature

There is an extensive literature on tournaments in organizations (for a review of the earlier literature see, e.g., McLaughlin 1988, Lazear 1995; for a more recent review see, e.g., DeVaro 2006; Konrad 2009; Dechenaux et al. 2012). Most of this literature focuses on tournaments that reward the best-performing employees.\(^1\) Loser incentive schemes were initially mentioned by Mirrlees (1975) and later re-examined by Nalebuff and Stiglitz (1983), who point out the equivalence of winner and loser schemes in the symmetric case.\(^2\)

Because of the difficulties in observing effort and prize valuations with field data, some of the initial empirical tests of tournament theory were conducted using laboratory experiments. One of the first is by Bull et al. (1987) who showed that, on average, rank-order tournaments generated behavior similar to piece-rate pay schemes, albeit with a higher variance in behavior. With this result established, subsequent papers delved into more nuanced topics such as affirmative action (Schotter and Weigelt 1992), tournament size and prize structure (Harbring and Irlenbusch 2003; Orrison et al. 2004), sabotage (Falk et al. 2008; Harbring and Irlenbusch 2008; Carpenter et al. 2010, Harbring and

\(^1\)Throughout this discussion, we focus on the standard static principal-agent models of tournaments in the tradition of Lazear and Rosen (1981). There is also an extensive literature on dynamic tournaments involving sequential elimination of employees (see, e.g., Rosen 1986, O’Flaherty and Siow 1995, Gradstein and Konrad 1999, Ryvkin and Ortmann 2008, Casas-Arce and Martinez-Jerez 2009). Although elimination can be thought of as a form of punishment, it is typically not discussed as such. Instead, these models focus on the incentives of the remaining (promoted) agents.

\(^2\)Although the equivalence of optimal tournament contracts with an arbitrary configuration of prizes in the symmetric case was mentioned already by Lazear and Rosen (1981), Nalebuff and Stiglitz (1983) discuss the equilibrium existence and note that in the case of loser the agents’ payoff functions remain concave as the number of agents \(n\) increases, whereas the pure strategy equilibrium disappears as \(n\) increases in the case of winner. Thus, loser prize structures tend to eliminate nonconvexities in the principal-agent problem.
Irlenbusch 2011), selection (Camerer and Lovallo 1999; Eriksson et al. 2009; Cason et al. 2010), dynamic tournaments (Sheremeta 2010), and gender effects (Gneezy et al. 2003), just to name a few.

Most of the experimental literature of selection into tournaments focuses on the decision whether to participate or not (Camerer and Lovallo 1999; Anderson and Stafford 2003; Fischbacher and Thöni 2008; Morgan et al. 2012a, 2012b), or compares piece-rate and tournament incentive schemes (e.g. Bartling et al. 2009; Eriksson et al. 2009; Balafoutas et al. 2012; Gupta et al. 2013). Kuhn and Villeval (2011) look at preferred work environments where subjects can choose either an individual or a team-based compensation scheme. Most of the previous literature reports a gender gap in competition rates. Since we focus on selection in different tournament mechanisms, we will not review this strand of literature here. The papers closest to ours are the following: Dohmen and Falk (2011) allow for sorting into a performance dependent variable payment scheme (piece-rate, tournament, or revenue-sharing) when a fixed payment is also available, and find higher effort in the variable payment schemes compared to the fixed payment. They link the sorting decision to individual characteristics such as the willingness to take risks, relative self-assessment, and gender. Another approach is to vary the number of prizes. Vandegrift et al. (2007) allow for self-selection into a piece-rate, single-prize, or multiple-prize incentive scheme and find higher effort but lower entry rates in single-prize contests compared to multi-prize contests by keeping the overall payment across the contests constant. In their experiment the single-prize tournament attracts the most capable players. Cason et al. (2010) find, by comparing a winner-takes-all to a proportional prize tournament, that the latter one elicits higher entry rates and thus more total achievement. Finally, two recent studies are especially important with regards to our paper. Eriksson et al. (2009) show that if subjects have the opportunity to self-select into a rank-order tournament, average effort is higher and the variance of effort is lower compared to a situation in which the same incentive scheme is imposed. However, they only allow subjects to choose between a tournament and a piece-rate incentive scheme and do not implement a selection between different tournament mechanisms. So far, there is only one paper concentrating on principals and agents in a tournament incentive framework (Sheremeta and Wu 2012). The authors allow the principal to choose a pair of prizes, which leads to optimal contracts for the agents. Their experimental design allows them to study incentive response as well as the impact of incentive design.\(^3\)

\(^3\)It must be noted that Harbring and Irlenbusch (2005, 2008, 2011), Harbring, et al. (2007), and Falk et al. (2008) study the role of the principal as a contest designer and provided lots of findings especially in tournaments with possibility for negative effort (sabotage). The main focus of these papers is to study the behavior of sabotage from the agents after exogenously imposed prize spreads from the principal,
To the best of our knowledge, there is no study which allows for self-selection in different tournament schemes with equivalent optimal contracts and takes both perspectives into account – the one of the principal and the one of the agents. Dechenaux et al. (2012; p. 42) state in their review: “In summary, all of these findings highlight the importance of endogenous sorting when players are allowed to choose other opportunities and the tendency for rank-order tournaments to systematically attract people with specific individual characteristics, including people that are less risk or inequality averse.” Our paper attempts the first clean comparison of the choices of agents and principals between different tournament mechanisms under the same equilibrium predictions.

3 Formal Framework

Our model builds on the seminal theory of Lazear and Rosen (1981). Agents perform their jobs by choosing effort, which is not observable by the principal (and cannot be contracted upon). The principal only observes ordinally ranked output which is the result of chosen effort and a random shock. The principal designs an optimal contract based on an ordinal comparison of agents’ (observable) output levels. There must be $n \geq 2$ identical risk-neutral agents participating in a tournament, indexed by $i = 1, \ldots, n$, where agent $i$’s output is $y_i = e_i + u_i$, where $y_i$ is observable output, $e_i \geq 0$ is agents’ exerted effort and $u_i$ is a zero-mean idiosyncratic random shock. In the case of homogeneous risk-neutral workers, the two tournament contracts represent the two polar cases of a class of tournament mechanisms that are efficiency and profit-equivalent under a symmetric equilibrium, i.e., the predicted work effort and firm profits are the same under both incentive schemes.

A winner tournament is defined as a tournament which rewards one high prize, $V_1$, to the agent with the highest $y_i$ and $(n - 1)$ lower prizes, $V_2$, to the rest. A loser tournament is defined as a tournament where one low prize, $W_2$, is given to the agent with the lowest $y_i$ and $(n - 1)$ higher prizes, $W_1$, for the rest. The expected profit to agent $i$ in the winner tournament ($WIN$) and the loser tournament ($LOS$) is equal or:

$$\pi_{i,WIN}(e) = V_2 + (V_1 - V_2)p^{(i)}(e) - cg(e_i)$$

and not the effects from sorting in one out of two (or more) incentive schemes with identical equilibrium predictions and constant wage sum.

4It is assumed that shocks $u_1, \ldots, u_n$ are i.i.d. across agents and drawn from the distribution with support $[u_l, u_h]$, pdf $f(u)$ and cdf $F(u)$.
5See Dutcher et al. (2013) for the complete theoretical framework, all the calculations and proofs of the two tournament mechanism we use.
\[ \pi_{i,LOS}(e) = W_1 - (W_1 - W_2)q^{(i)}(e) - cg(e_i) \]

where \( e = (e_1, \ldots, e_n) \) is the vector of all agents’ effort levels, \( cg(e_i) \) denotes the cost of effort \( e_i \) and \( p^{(i)} \) and \( q^{(i)} \) are the probabilities of being ranked first or last in the respective winner or loser tournament. The homogeneous cost parameter, \( c > 0 \), and the function \( g(\cdot) \) are strictly increasing and strictly convex. The expected payoff to a risk-neutral principal is defined as the difference between aggregate effort and the sum of all prize payments:\(^6\)

\[ \Pi_{WIN} = \sum_i e_i - V_1 - (n - 1)V_2 \]

\[ \Pi_{LOS} = \sum_i e_i - (n - 1)W_1 - W_2 \]

In the symmetric case where all agents contribute the same equilibrium effort, \( \bar{e} \) maximize their expected payoffs. Combined with the zero-profit condition of the principal, the optimal contracts expressed in terms of \( \bar{e} \) for \( WIN \) and \( LOS \) are:

\[ \bar{V}_1 = \bar{e} + \frac{n - 1}{n\bar{\alpha}_n}, \quad \bar{V}_2 = \bar{e} - \frac{1}{n\bar{\alpha}_n}. \]

\[ \bar{W}_1 = \bar{e} + \frac{1}{n\bar{\alpha}_n}, \quad \bar{W}_2 = \bar{e} - \frac{n - 1}{n\bar{\alpha}_n}. \]

Both optimal contracts are socially efficient.

4 Experimental Design and Hypotheses

4.1 Basics

The experiments were conducted in the computer lab at the University of Innsbruck using z-tree (Fischbacher 2007). 180 subjects (55% of them female) were recruited via ORSEE (Greiner 2004) from the standard subject pool. We ran nine sessions of 20 subjects, and each session lasted for about one hour and ten minutes. The mean earnings per subject were 13.25 Euro.

\(^6\)To derive optimal contracts, we follow the approach of Lazear and Rosen (1981) and assume that the principal operates in a (buyer-side) competitive labor market under the zero-profit condition \( \Pi = 0 \).
# 4.2 Treatments

To address our research questions, we utilized a between-subjects design with two treatments which allow us to observe (i) the effects of self-selection for agents who choose one of the two incentive schemes (T-A) and (ii) the effect on an agent from being forced into one of these schemes by a principal (T-P). An overview of the treatments is given in Table 1.

The procedures that we used were identical for both treatments. Once subjects were seated in the lab, they were handed instructions on the rules of the experiment and how to work the computer interface. After these instructions were read out loud, the first part of the experiment began. Participants were randomly assigned at the beginning of the experiment one of the two possible roles (agents or principals) and their roles remained fixed throughout the entire experiment. In the first part, we wanted to give subjects experience with each mechanism so we had them play each tournament mechanism for five rounds where the order of which mechanism they played first was varied. This design aspect is important to make certain that subjects are choosing the mechanism they prefer. Without experience in both mechanisms, the choice may very likely reflect a perceived preference a subject has which may or may not be their actual preference. After the initial ten rounds, subjects who were in the role of an agent in treatment T-A chose their preferred mechanism for the remaining ten rounds while principals stayed inactive. Likewise, in the T-P treatment, principals chose their preferred mechanism for the agents only after round 10. Notice that those in the role of principal or agent could only choose a mechanism once and this choice remained for the entirety of the experiment. This was implemented to ensure that the mechanism choice was salient. This led to a total of 20 rounds, four of which were randomly selected for payment.

At the beginning of every round, subjects were matched in a group of three agents and one principal. In every round, agents decided on their effort level - they chose a number between 1 and 100 - where each level had an associated increasing marginal cost.

## Table 1: Treatment overview and number of observations.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Agents</th>
<th>Principals</th>
<th># of agents</th>
<th># of principals</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-A</td>
<td>choose mech.</td>
<td>do not choose mech.</td>
<td>45</td>
<td>15</td>
</tr>
<tr>
<td>T-P</td>
<td>do not choose mech.</td>
<td>choose mech.</td>
<td>90</td>
<td>30</td>
</tr>
</tbody>
</table>

\[1\] Sample instructions for T-A are given in the Appendix.

\[8\] In T-A, the principals stayed inactive for the entire first part, but they were able to observe the feedback of agents’ behavior and their payment if that round was randomly selected for payment.

\[9\] We implemented random re-matching in order to reduce reputation effects.

\[10\] A table showing the cost associated with each number was given to the subjects at the end of the
“total number” was the sum of their chosen number and a random number chosen by the program.\textsuperscript{11} Subjects knew the distribution of the random number, but did not know what other subjects had chosen when they made their decisions, i.e. the decisions were made anonymously and simultaneously. To determine the prizes, the total numbers of all agents in their group were compared. In the winner contest, the agent with the highest total number received the large prize while everyone else within the same group received a lower prize. In the loser contest, the agent with the lowest total number received the small prize and the others a higher one. The total profit for an agent in every round was calculated by subtracting the cost of the chosen number from the received prize. The principal’s payment was determined by the sum of the agents’ chosen effort minus the prizes the agents received.\textsuperscript{12}

In the experiment, subjects earned points where 2000 points equaled 1 Euro. After each round, agents were informed of the outcome of the random number, the prize they won, whether their number was highest in WIN or lowest in LOS, and their payoff if that round would be chosen for payment. Principals received information about the total numbers of the agents in their group and their payoff if that round would be chosen for payment. This information for all past rounds was shown again in a summary table to the subjects when they chose a tournament mechanism following period 10.

After the 20 rounds in the first part, we elicited subjects’ preferences for risk and loss aversion. To measure risk and loss preferences we used lottery procedures proposed by Dohmen et al. (2010, 2011) and Gächter et al. (2010), respectively. At the end of the experiment we also administered a short demographic questionnaire.

4.3 Calibration of parameters

For the calibration of parameters in the experiment we used a uniform distribution of noise on the interval $[-b, b]$. In this case, $\alpha_n = \bar{\alpha}_n = \hat{\alpha}_n = 1/(2b)$, so that the optimal contracts for the winner and loser tournaments are:

\[
\bar{V}_1 = \bar{e} + \frac{2b(n - 1)}{n}, \hspace{1cm} \bar{V}_2 = \bar{e} - \frac{2b}{n},
\]

\[
\bar{W}_1 = \bar{e} + \frac{2b}{n}, \hspace{1cm} \bar{W}_2 = \bar{e} - \frac{2b(n - 1)}{n}.
\]

\textsuperscript{11}The random number was chosen randomly and independently for each agent in every round.

\textsuperscript{12}To avoid losses due to the fact that agents under-contribute (compared to the equilibrium prediction of 73), the principal received an endowment of 6500 points in each round.
Furthermore, we use \( g(e) = (A - e)^{-r} - A^{-r}, \) with \( A, r > 0 \) for the cost function of effort.

Table 2 shows the parameters of the experiment that satisfy the constraints with the cost function.\(^{13,14}\)

### 4.4 Hypotheses

Following the theoretical model and our parameterization, we can formulate two main hypotheses that our experiment aims to test:

**Hypothesis 1:** Exerted effort is equal regardless of the incentive scheme chosen and the method used to select this scheme.

Hypothesis 1’s prediction that effort is not dependent upon the mechanism chosen or the method of how this mechanism came about relies on the equilibrium prediction that profits are not mechanism dependent (for either the principals or the agents) and do not depend on if agents self-select into the mechanism or one is chosen for them. This implies that subjects do not care which tournament mechanism is chosen (for them or by them) and as a result, the frequency that each mechanism is chosen will be equal regardless of the treatment.

**Hypothesis 2:** Efficiency is equal in both treatments and under both tournament conditions.

Because predicted effort and profit is the same in both mechanisms, Hypothesis 2 predicts that efficiency can be expected to be the same for all treatments and tournament types.

### 5 Results

#### 5.1 Mechanism choice

We will first analyze the agents’ choice of the preferred tournament scheme in treatment T-A. Table 3 shows an overview of the results - 38% of agents chose the winner (WIN)

\(^{13}\)Again, see Dutcher et al. (2013) for the complete calibration and restrictions.

\(^{14}\)There are minor discrepancies in Table 2 due to rounding. In the experiment, all the prizes and costs have been multiplied by 100 to avoid the decimals.
<table>
<thead>
<tr>
<th>Mechanism chosen</th>
<th>T-A</th>
<th>Prediction</th>
<th># of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIN</td>
<td>38%</td>
<td>50%</td>
<td>17</td>
</tr>
<tr>
<td>LOS</td>
<td>62%</td>
<td>50%</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 3: Choices of tournament mechanism in T-A.

and 62% the loser tournament (LOS).

The choices of subjects shown in Table 3 are not in support of Hypothesis 1. To understand this behavior, we will explore individual characteristics that may be useful to a manager in terms of the types of workers who select one mechanism over the other. One aspect of our experimental design we can take advantage of is the ability to separate a subjects by their revealed competitive preference. This is an important factor to examine since it may influence the overall effort exerted in the different tournaments. For instance, if the most competitive subjects select the LOS tournament, then the benefits of implementing a WIN tournament will be lessened. Therefore, we categorize subjects into three types – low, middle and high – based on their relative effort choice in the WIN practice periods. Low types are those who chose mean effort levels below 56 (33.33% of the cumulative distribution); middle types are classified as those who chose a number between 56 and 72.6 (67.78% of the cumulative distribution), and high types chose effort above 72.6. These types can be seen as a proxy for the competitiveness of a subject, because in WIN, the single top prize is given to the top performer.

Figure 1 presents the frequency of choices for WIN from the agents depending on their type. In this Figure we can see that the middle contributors choose the WIN tournament in 53% of the cases, whereas the low and high competitive subjects pick this incentive mechanism only 27% and 33% of the time respectively. This implies that 73% of the low and 67% of the high types sort into LOS.

At first glance, this choice seems counter-intuitive but the reason these subjects do not choose the WIN tournament is quite rational given their preferences. In the WIN tournament, the subjects who have a preference to compete at a very high level will consistently choose a very high effort level in order to win. We observe that this is exactly the case; in the five practice rounds, the average effort choice of these subjects was about 81.3 (remember equilibrium is 73). Paired with the costs associated with such high effort choices, the profit to these agents should be higher in the LOS tournament where there is no pressure to win and the competition is only to avoid being the last. This is what we find: those who are very competitive made 3435 points in the five practice WIN periods and made 4813 points in the five practice LOS periods. Likewise, an agent who prefers
not to compete to be the best will do very poor in the WIN tournament because the
effort they choose will, in most instances, not be high enough to ever win the contest.
Thus, they will be constantly stuck with the lowest prize. On the other hand, in the
LOS tournament, they can choose a lower number and still have a chance to not be last
and gain a higher price than the lowest one in the WIN contest. Again, this intuition
is confirmed as we see that the low types made an average of 4154 points in the WIN
tournament and 5261 points in the LOS tournament.

5.2 Effort

Turning now to chosen effort, we expect no difference in behavior in WIN versus LOS,
and also when agents self-select into a tournament mechanism versus when principals
select a specific tournament for them. Figure 2 displays agents’ average effort each period
(following the practice rounds) for both WIN and LOS for both treatments. There are
45 subjects in T-A, with 28 (17) self-selecting into LOS (WIN), and 90 in T-P, where
36 (54) are selected to participate in LOS (WIN). For each period, a single point in the
figure represents the average of these observations, leading to a total of 1,350 data points.
From this table, there is an obvious difference in agents’ behavior after sorting into their
preferred mechanism: the average effort in WIN is always below that in LOS. What is
also evident is that effort is much higher when the WIN contest has been chosen for the
agents than when it has been chosen by the agents. This pattern is reversed – albeit with
Figure 2: Agents’ mean effort over time by treatment and tournament mechanism.

![Graph showing mean effort over time by treatment and tournament mechanism]

**Table 4**: Average effort by mechanism and treatment. Reported p-values are from a two-sided t-test.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>WIN</th>
<th>LOS</th>
<th>Overall</th>
<th>WIN vs. LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-A</td>
<td>58.39</td>
<td>69.42</td>
<td>65.25</td>
<td>p = 0.06</td>
</tr>
<tr>
<td>T-P</td>
<td>66.23</td>
<td>65.76</td>
<td>66.04</td>
<td>p = 0.90</td>
</tr>
<tr>
<td>T-A vs. T-P</td>
<td>p = 0.17</td>
<td>p = 0.32</td>
<td>p = 0.81</td>
<td></td>
</tr>
</tbody>
</table>

milder differences – when we consider the two LOS contests.

Table 4 shows the mean effort by treatment and the results of pair-wise comparisons using t-tests where each subject’s average contributions for all 10 periods are treated as one observation. In T-A, LOS generates a much higher effort than WIN (58.39 vs. 69.42, p = 0.06). In T-P we find no significant differences in the mean effort exerted between these two mechanisms (66.23 vs. 65.76, p = 0.90). Overall effort is the same in both treatments (65.25 vs. 66.04, p = 0.81), but a difference appears when comparing effort choices between the tournament types but these differences are not significant.

In order to implement a cleaner test of effort choices, and to understand how individual characteristics affect effort choices, Table 5 presents the results of random effects regressions for both treatments and tournament types. The explanatory variables are dummies for WIN (this implies that the baseline is LOS for the first two models), treatment T-P (the baseline is T-A in the latter two models), low and high contributors (the middle types are the baseline in all models), interaction dummies for WIN X Low, WIN X High, T-P X Low and T-P X High (in the first two and second two models respectively)
and a subject’s aversion to risk and losses. We use the same types’ classification for the competitiveness of the agents as in the previous section.

With Model T-A (first column in Table 5) we can see that when agents are able to select their preferred mechanism, the low types who selected WIN contributed significantly less than low types who selected LOS. In Model T-P, we see that this effect goes away, but we see that 1) effort of the middle types is lower in the WIN treatment, 2) low types contribute less than middle types and 3) high types contribute more in the WIN than in the LOS. These results are summarized in Results 1 and 2.

**Result 1:** Allowing agents to choose their preferred incentive scheme results in the uncompetitive types who chose WIN and contributing less effort than the same types who chose LOS.

**Result 2:** When agents are forced into an incentive scheme, lower effort in the WIN is seen in for the middle competitive types while high competitive types contribute higher effort and the uncompetitive types contribute lower effort than all others.

The third model in Table 5 (WIN), is concerned with trying to understand how the treatments affect the WIN mechanism. We see in this Model that low types who select the winner mechanism contribute less than all others. Counter to WIN, the low types who were forced into the LOS mechanism contributed much less than those who chose it. The middle types on the other hand respond positively to being forced into LOS compared to those who chose it.

**Result 3:** When agents are forced into LOS, less (middle) competitive types exert lower (higher) effort than the same types who chose LOS.

With these fruitful insights into subjects’ behavior depending on the selection mechanism used, we can now explain the observed differences between the two tournament types. When agents sort into a specific contest, the contributed effort is higher in LOS than in WIN, which is the result of two effects: 1) all three types contribute about the same effort levels when they select LOS, whereas 2) the low types contribute much less in WIN (compared to LOS) but the difference between the high types and the middle ones is rather small. The level of contribution is not statistically different for both tournament types when a contest is selected for the agents. This finding is due to the fact that low types contribute less in both mechanisms, whereas middle and high types provide about the same effort in LOS, but in WIN the effort of the high types is higher, while the middle types lower their levels compared to LOS. The huge increase when agents are selected into
<table>
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<td></td>
<td>(5.899)</td>
<td>(3.954)</td>
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<td></td>
<td>(4.532)</td>
<td>(5.869)</td>
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<td>(12.921)</td>
<td>(8.057)</td>
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<td>T-P X Low</td>
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<td>29.440**</td>
<td>-21.060***</td>
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<td>(7.417)</td>
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Table 5: Individual random effects regressions on effort with robust standard errors (in parentheses), clustered at the individual level. ***, ** and * represent significance at the 1, 5 and 10 percent levels respectively.
WIN compared to when they self-select a mechanism is the result of higher contributions from the low types. In the loser mechanism, again the lowest competitive types are the drivers for the higher overall effort in T-A, while the middle and high contributors remain unchanged again, the low types providing significant higher effort levels when they sort into this pay scheme.

5.3 Efficiency

Hypothesis 2 states that both tournament mechanisms are equally efficient, since predicted effort and the prize money per subject are identical in both mechanisms and treatments. From a group perspective, this hypothesis implies equal combined gains to the principal and the agents. Remember that total profit for the principal is the sum of contributed effort from the agents minus the prizes paid out, and the payoff for each agent is the received prize minus the cost to the agent of providing the chosen level of effort.15

In Table 6 we present overall efficiency, defined as the gains of three agents and one principal for the last ten rounds. We see that in T-A the more efficient mechanism is LOS ($p < 0.01$, Mann-Whitney U test) whereas in T-P it is WIN ($p = 0.01$). These significant results are driven by the distribution of chosen numbers and the associated increasing marginal cost to the agents. As an explanation for this result, Figure 3 presents the distribution of effort choices for the last ten rounds. The pattern for the two tournament mechanisms is similar to the finding reported by Dutcher et al. (2013) and seems to show a robust behavior in Lazear-Rosen contests: in WIN some subjects give up competing for the high prize and contribute very low effort levels, while others still keep competing for the single high prize resulting in a seemingly U-shaped distribution of contributed effort, which implies a higher variance compared to LOS. Contrary to this, in LOS we find effort levels to be more normally distributed with a very low number of low or high contributors, leading to a lower variance. Subjects’ main objective seems to be avoiding the last place, which would result in receiving the single relatively low prize.16

Comparing the two treatments by tournament type, we also find significant differences (T-P is more efficient in WIN; T-A is more efficient in LOS). We also observe a significant difference between the two treatments, where the treatment in which the agents can choose their preferred mechanism is more efficient than when it is chosen for them ($p =$

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15 More formally, a principal’s profit in the winner tournament is $\Pi_{WIN} = n\bar{e} - V_1 - (n-1)V_2$ and the payoffs for all agents are $\bar{e}_{WIN} = V_1 + (n-1)V_2 - nc(\bar{e})$, which leads to the overall efficiency of $n\bar{e} - nc(\bar{e})$. The same calculation holds true for the loser tournament.

16 Notice that efficiency is lower when high effort is provided from an agent due to the associated increasing marginal costs.
<table>
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<th>Group gains</th>
<th>Exp. gains</th>
<th>T-A</th>
<th>T-P</th>
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<td>110,462</td>
<td>123,816</td>
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<td>LOS</td>
<td>164,460</td>
<td>133,012</td>
<td>116,203</td>
<td>( p &lt; 0.01 )</td>
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<tr>
<td>WIN vs. LOS</td>
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<td></td>
<td>( p &lt; 0.01 ) ( p = 0.01 )</td>
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<tr>
<td>Overall</td>
<td>124,493</td>
<td>120,771</td>
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<td>( p = 0.04 )</td>
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</table>

Table 6: Expected and actual group gains by treatment and tournament mechanism. There were 15 groups in T-A and 10 groups in T-P. P-values refer to Mann-Whitney U tests.

Figure 3: Categories of effort deciles for the last ten periods.
0.04). This is due to the behavior of agents with respect to effort provision and mechanism choice: when they are able to sort into a mechanism, low and high contributors are mainly choosing LOS while middle types do not prefer one of the two in a statistically meaningful manner.

*Result 4:* The preferred mechanism is more efficient for both the agents and the principals. Overall, efficiency is higher when agents are able to self-select into a specific tournament mechanism than when one is selected for them.

### 6 Discussion and conclusion

Our paper attempts to cleanly compare the choices of agents and principals between different tournament mechanisms under the same equilibrium predictions. The two mechanisms we have used, winner and loser, represent the two polar cases of any tournament mechanism employed. We find that agents self-select more often into the loser than the winner tournament. There are several drivers behind this result. For the mechanism selection by the agents, those who are classified as mildly competitive do not differentiate between the two mechanisms. On the other hand, most of the subjects classified as very competitive or not competitive at all choose the loser mechanism much more often.

Looking at productivity following the selection procedure allows us to gain some insights into subjects’ behavior. We have found that chosen effort is higher for agents who sort into the loser pay scheme compared to the winner pay scheme. However, behavior changes drastically in the winner pay scheme when the selection is done by a principal. Forced participation from the agents in this mechanism leads to substantially higher levels of effort. Additionally, when a mechanism is selected for the agent, the two incentive schemes are statically indistinguishable in terms of effort levels. This has direct implications for organizations since effort correlates directly to profit.

We have also computed efficiency, defined as the combined gains to the agents and the principal in a given group, and found that the preferred mechanism is always the more efficient one, regardless of how it is selected. Overall, efficiency is higher when agents have the opportunity to self-select into their preferred scheme.

Giving workers the possibility to choose from a set of incentive mechanisms leads to a strong sorting effect of employees. Our results indicate that different tournament mechanisms attract different types, and thus have direct implications to managers. These results provide some evidence on how managers can influence the sorting from a preferred class of employees into a specific work environment or even introduce a change in the composition of workers.
7 References


8 Appendix

Instructions for T-A WIN first:

Welcome to an experiment on decision making. We thank you for your participation!

The experiment will be conducted on the computer. All decisions and answers will remain confidential and anonymous. Please do not talk to each other during the experiment. If you have any questions, please raise your hand and we will come by and answer it.

During the experiment, you and the other participants will be asked to make a series of decisions. Your payment will be determined by your decisions as well as the decisions of the other participants according to the following rules.

Today’s experiment consists of several parts. The instructions for the first part are given below.

The first part consists of 3 steps. The first two steps consist of 5 rounds each and the third step of 10 rounds. From these 20 rounds, the computer will choose 4 rounds at random that determine your payoff. You will not be told which rounds will be paid until the conclusion of all parts of the experiment. During the experiment you will be earning tokens. At the end of the experiment, tokens will converted to Euros at a rate of 2000 tokens = 1 Euro.

The computer will assign you randomly one of two roles, A or B. Below you will find the instructions for role A.

Role A (15 participants)

Rounds and Groups:
At the beginning of each round you will be randomly matched in a Group with 2 other participants. This means that in each round the groups are re-matched, so that they will not be the same (unless by chance). You will never be told the identity of those in your Group and they will never be told your identity.

Tasks:
Your task in today’s experiment is to choose a number between 1 and 100. You will enter your chosen number in the blank box on your computer screen labeled “Number Chosen” and then hit “Continue.” The sheet labeled “Decision Costs” shows you the cost in tokens associated with each number. Notice that higher the number chosen, the higher the associated cost. Each member in your Group has the same cost sheet as you. In each round, all Group members choose his/her numbers simultaneously. You will not know the number chosen by any of your Group members when you make your choice and likewise, they will not know the number you chose when they make their choice.
After all group members have made their choice, the computer will draw a random number between -44 and 44, independently for each member of your group. All numbers in this range are equally likely and each number drawn does not affect the number drawn for someone else in your Group. This number will be added (or subtracted) from your chosen number to make your total number.

**Payoffs:**
There are two payment schemes. Within the first 5 rounds you will play in pay scheme 1 and in the next 5 rounds in pay scheme 2.

**Method 1**
The computer will compare your total number to the total number of those in your Group. The person with the highest total number will receive 13,200 tokens while the remaining 2 members of the group will receive 4,400 tokens. The cost of each chosen number will be subtracted from this amount to give you the total payment for each round should that round be chosen for payment.

At the end of each round you will be shown the random number chosen for you, your resulting total number, and whether your total number is higher than anyone’s in your Group.

**Example:**
Let’s go through an example. Suppose you chose the number 60 and the other members of your group chose 44 and 90. Suppose also that the random number drawn for you was 26 and the random number drawn for the other members of your Group were 12 and -41 respectively. This would mean your total number is 60 + 26 = 86. The total numbers of the other group members would be 56 and 49. In this example, you have the highest total number and thus would receive 13,200 - 996 = 12,204 tokens if this round would be randomly chosen for payment. Notice that the 996 tokens corresponds to the cost associated with a chosen number of 60.

If on the other hand, you had chosen 27 and all other chosen numbers and random draws remained the same, you would have a total number of 27 + 26 = 53. This would mean you would have the second highest total number and would receive 4,400 - 229 = 4,171 tokens if this round would be randomly chosen for payment.

**Method 2**
The computer will compare your total number to the total number of those in your Group. The person with the lowest total number will receive 1,466 tokens while the remaining 2 members of the group will receive 10,267 tokens. The cost of each chosen number...
number will be subtracted from this amount to give you the total payment for each round
should that round be chosen for payment.

Example:

Let’s go through an example. Suppose you chose the number 60 and the other mem-
bers of your group chose 44 and 90. Also suppose that the random number drawn for
you was -26 and the random number drawn for the other members of your Group were
12 and -41 respectively. This would mean your total number is 60 - 26 = 34. The total
numbers of the other group members would be 56 and 49. In this example, you have
the lowest total number and thus would receive 1,466 - 996 = 470 tokens if this round
would be randomly chosen for payment. Notice that the 996 tokens corresponds to the
cost associated with a chosen number of 60.

If on the other hand, you had chosen 80 and all other chosen numbers and random
draws remained the same, you would have a total number of 80 + 26 = 54. This would
mean you would have the second lowest total number and would receive 10,267 - 2,763 =
7,504 tokens if this round would be randomly chosen for payment.

Role B (5 participants)

Rounds and Groups:

At the beginning of each round you will be randomly assigned to a 3-person Group
within role A. This means that in each round the groups are re-matched, so that they will
not be the same (unless by chance). You will never be told the identity of those in your
Group and they will never be told your identity.

Tasks and Payoffs:

You are initially endowed with 6,500 tokens in this part. In each round you observe,
the final number of all three group members and your profit (or loss) in tokens for that
round, if this round would be randomly selected for payment. Your payment is based on
the sum of the chosen numbers of the three group members (multiplied by 100), minus
the prices paid out.

Example:

Suppose your group members chose the numbers 60, 44 and 90 within payment method
1. This would sum up to 194, and multiplied by 100 gives 19,400 minus the high price of
13,200 and twice the lower price of 4,400. This gives 19,400 - 13,200 - 2 * 4,400 = -2,600
tokens. This would mean that you receive 6,500 - 2,600 = 3,900 tokens if this round would
be randomly selected for payment.

Suppose your group members chose the numbers 60, 44 and 90 within payment method
2. This would sum up to 194, and multiplied by 100 gives 19,400 minus twice the higher price of 10,267 and the lower price of 1,466. This gives 19,400 - 2 * 10,267 - 1,466 = -2,600 tokens. This would mean that you receive 6,500 - 2,600 = 3,900 tokens if this round would be randomly selected for payment.

As a final point, once you have made your decisions or have taken note of the results, please hit the continue button. No one can move to the next round until everyone in the experiment has clicked on this button so make sure to pay attention to the screen to keep the experiment moving along.

Are there any questions?
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