A Field Experimental Comparison of Races & Tournaments

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# Executive Summary

In this paper we report the results of a field experiment conducted to compare the outcomes of three alternative competition situations: the *race*, the *tournament*, and the *minimum-quality* *tournament*. Agents were randomly sorted into groups in which they were competing one another to develop solutions to a given problem.

In a *race*, participants were competing for a prize to be awarded to the first to deliver a solution of quality equal or higher than a given level. In a *tournament*, participants were awarded a prize to deliver the best solution. In a *minimum-quality* *tournament*, participants were awarded a prize to deliver the best solution of quality equal or higher than a given level.

# Introduction

A wide range of economic situations are decided by either a race—a competition to be first—or a tournament—a competition to be best. Examples include international armed conflicts, political elections, patent races, lawsuits, career dynamics inside organizations, and so on. In such contests, agents exert some costly effort in order to be awarded a prize and often make such decision under uncertainty, e.g., uncertainty about the other agents types or actions.

The presence of such uncertainty has perhaps made very appealing for researchers to modeling these contests as an all-pay auction. Based on this analogy, a large body of game-theoretic works in economics have developed a number of predictions on what agents would do in equilibrium, suggesting possible solutions to important questions of contest design. For example, under what circumstances a tournament can maximize total effort? When to have single prizes or multiple prizes? How a minimum-quality requirement would affect total effort? What is the optimal prize to maximize the pace of development in a race?

Following the same analogy with the literature on auctions, races are a somewhat odd institution when the speed of work is not what the organizer is trying to achieve—as in an actual foot race. Suppose the value of a contests output varies with the time it is received. Then the organizer can simply choose a fixed time to end a contest that maximizes her payoffs. Then time is simply embedded in participants cost functions, but doesn’t introduce strategic uncertainty.

So it is at least legitimate to argue that races should give a worse output distribution than an equivalent tournament with a minimum quality requirement. In a race, participants have no incentive to deliver quality above the threshold. However, in a tournament all participants who can profitably deliver a quality above the threshold will compete and deliver output with qualities above the threshold.

Given the theoretical drawbacks of the race institution, why do we see them so often? Either our theory is not incorporating some relevant piece, or practitioners are not making optimal decisions.

Setting aside the theory, there are few empirical studies who test these theoretical predictions in the field. One of the difficulties is that, although we observe a rich variety of prize-based competitions, contests may differ widely (different time, different problems, different participants) and so it is very hard to compare them and identify cleanly the effect of competition structure alone on the outcomes. Lab comparison, on the other hand, do not compare tournaments and races and have other limitations (XXXX). Our field experiment is the first attempt to implement a clean identification strategy to compare these competition settings.

# Old Notes

Motivations to study races & tournaments are well summarized by the following picture:



FIGURE: Equilibrium bids from the Moldovanu & Sela (2001) model for a Tournament (black, solid) & a Race (red, dashed).

The picture shows the realized equilibrium bidding function of an extended version of Moldovanu and Sela (2001) model of tournaments competition.

As opposed to the original model, we consider that participants have to make 2 decisions: a costly bid *q* and some costly effort *t*to accelerate the time to submit.

It turns out that the solution of the extended model is very simple. In particular, conditional on exerting positive effort in the competition, bidding q=Q is a dominant strategy in any MS-race (likewise choosing t=0 is a dominant strategy in the MS-tournament). As a result, the bidding function is a step function in a race (red, dashed) and a continuous function in a tournament (black, solid).

The key observation is that no setting seems to dominate the other in terms of the quality of the final outcomes. In fact, suppose that the x-axis denotes the ability of the best participant registered to the competition. Then, there is an interval of values in the middle of the x-axis in which the race would do better, while for higher values the tournament would do better.

Thus, if we knew who registered to the competition we would also have known which setting to choose. But what competition format is best from an ex-ante perspective? The answer would depend on the distribution of abilities. This would require some computations, but if top-coders are relatively scarce, then a race may be a better option to consider.



FIGURE: distribution of abilities used to plot the bids in the previous figure

In sum, according to our extended MS model, it seems that outcomes in a race can be higher when the (expected) “intensity of competition” is somewhat low. Otherwise the tournament seems a better option.

Note, no prior works comparing races with tournaments—see lit. section at the end of this document—(Why?)

## Limitations

One obvious limitation of this setting is that MS may explain well a tournament setting, but not a race. In fact, a race is more a dynamic type of contest where participants could benefit a lot form feedback generated during the competition by others (e.g., stop exerting effort, waiting, etc.). On the other hand, we can use individual data to see if there is a good fit.

Overall, these economic models may fall in the category of works studying ``decisions under uncertainty`` where uncertainty is mainly determined by the actions of the other agents and concerns either the order of arrivals, i.e., who is going to be the first to achieve a certain performance, or the intensity of competition, i.e., how high the performance of others would be.

## Unit of analysis

The unit of analysis should be the group. We need many groups.

# Details of the Experiment on TopCoder

|  |  |  |  |
| --- | --- | --- | --- |
|  | Tournament | Race | Open issues: |
| Pre-contest | - | We need to set a quality threshold  Invite TopCoder experts to provide feedback on a reasonable quality threshold (“bootstrap”). | Can we set hard & easy thresholds?  **Pro**: more robust if we misspecify the threshold. **Contra**: can we extend the model? |
| Advertising | - |  |  |
| Submission Period | Two weeks. | Two weeks.  The submission period stops as soon as 2 members hit the quality threshold. |  |
| Prizes | Top 2 ranked solutions by quality. | First 2 solutions to hit the quality threshold. | Should #2 prize be the same of #1 prize?  Should we add a general prize across groups? No! |
| Provisional Score | The leaderboard shows the provisional score. | The leaderboard shows the provisional score.  In the background we compute the final score.  If someone hits the threshold we send notification to all participants in that group. |  |
| On each submission | Pop-up asking how many hours worked. | Pop-up asking how many hours worked. |  |
| Group size | If enough sample:  Groups of different size: 7 and 30 | If enough sample:  Groups of different size: 7 and 30 |  |
|  |  |  |  |
| Prevent cheating | Ex-post we control winning submissions | Ex-post we control winning submissions |  |

# Literature Review

## Theory

* Moldovanu & Sela (2001)
  + We extend to incorporate a race.
* Harris & Vickers (ReStud, 1985) “Racing with uncertainty”
  + Interplay of *uncertainty* in the outcomes of effort and *strategic interaction* between competitors.
  + Leaders make greater efforts as the gap with the followers widens.
* Fudenberg, Gilbert, Stiglitz, Tirole (EER, 1983)
  + When races are neck-to-neck and when degenerate into monopoly?
* Zizzo (IJIO, 2002)
  + lab. experiment on H&V predictions.
  + Not as predicted!
* Baye & Hoppe (GEB, 2003)
  + Tullock contest function races are equivalent to tournaments.

## Surveys

* Konrad (book)
* Decheneaux, Kovenock, Sheremeta (2012)
  + Dynamic contest: one paragraph on races. Mainly Zizzo’s results.

## Something to read

* Hoppe & Lehman-Grube (JET, 2005), “Innovation timing games: a general framework with applications“