

Tournaments, Contestant Heterogeneity and Performance

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Introduction

Motivation

- Tournaments are widely used in business, innovation, politics, science and sports
 - Multiple participants compete for a reward/price with the winner determined by relative performance
- How to design a contest?
 - Tournament designer have different objective functions
 - Tournament designer have some leeway in several parameters (price money, structure, contestants)
 - A common feature in many tournaments is that contestants differ in ability

- Heterogeneity in contestant ability is detrimental for effort provision and performance (e.g. Lazear and Rosen, 1981)
 - Heterogeneity in contestant ability $\uparrow$ low ability contestant effort provision $\downarrow$
 - e.g. Brown, 2011
 - High ability contestant effort provision $\downarrow$
- We use data from professional darts tournaments to investigate **how contestant heterogeneity affects performance?**
 - We observe ability and individual performance without immediate interference between contestants

- We show results using a traditional linear regression framework and results using method from causal machine learning
 - performance of lower ability contestant ↓
 - performance of higher ability contestant ↑
- Does giving the lower ability contestant a headstart reduce the adverse incentive effects?
 - performance of the lower ability contestant ↑, no relation with contestant heterogeneity
- Are there spillover effects across stages of a tournament?
 - Ability of the opponent in the next round ↑, higher ability agent wins the current round ↓ (e.g. Brown and Minor, 2014, Deutscher et al. 2023)
 - performance of the higher ability contestant ↓

Context

- **A darts match:**
- A match consists of a number of legs
- $(K+1)/2$ legs needed to win the match
- The player who brings 501 points to zero first and finishes with a "double" wins the leg
- Two contestants play sequentially, with 3 darts per move



Empirical Strategy

- **A darts tournament:**
- Darts tournaments are usually single elimination tournaments
- Seeded players and the rest of players are placed via a lottery (Brown and Minor, 2014)
- Conditional on own ability, the quality of the opponent is "randomly" assigned



$$Y_{crt}^{F/U} = \alpha_1 + \beta_1 D_{crt} + \gamma_1 X_{crt} + \epsilon_{1,crt} \quad (1)$$

- Outcome
 - 3 darts average of first nine darts
- Treatment
 - Ability ratio
- Controls
 - Individual and Tournament controls
- Estimation
 - Linear Regression Framework
 - Non-parametric kernel method for continuous treatments (Kennedy, Ma, Mc Hugh and Small, 2017)

Results

Results Underdog

	(1)	(2)	(3)
Current ability ratio ¹	-15.015*** (2.994)	-15.197*** (3.007)	-14.924*** (2.999)
Favorite world ranking		-0.000 (0.000)	-0.000 (0.000)
Underdog world ranking		-0.001** (0.000)	-0.001** (0.000)
Favorite experience			0.028** (0.013)
Underdog experience			2.178** (1.063)
Round Fixed Effect (FE)	x	x	x
Tournament-by-Year FE	x	x	x
Individual FE	x	x	x
All Covariates			x
N	4776	4776	4776

Results Favorite

	(1)	(2)	(3)
Current ability ratio ¹	5.213** (2.526)	5.363** (2.447)	5.692** (2.573)
Favorite world ranking		-0.000 (0.000)	-0.000 (0.000)
Underdog world ranking		-0.000 (0.000)	-0.000 (0.000)
Favorite experience			2.354*** (0.689)
Underdog experience			0.008 (0.011)
Round Fixed Effect (FE)	x	x	x
Tournament-by-Year FE	x	x	x
Individual FE	x	x	x
All Covariates			x
N	4776	4776	4776

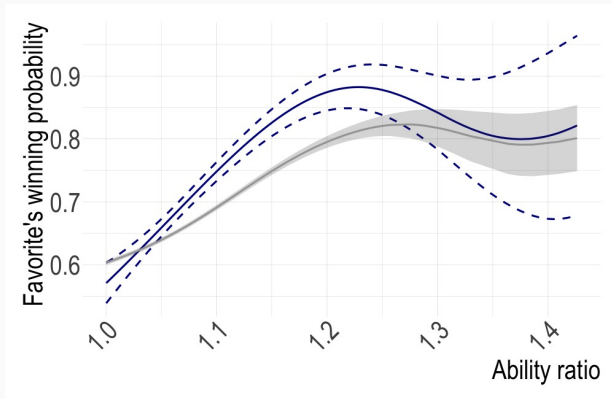
Results

	Performance within contest	Performance in first half	Performance in second half
	(1)	(2)	(3)
<i>Panel A: Favorite's performance</i>			
Ability ratio	5.692** (2.573)	12.255*** (3.490)	-2.078 (3.541)
<i>Panel B: Underdog's performance</i>			
Ability ratio	-14.924*** (2.999)	-13.148*** (4.077)	-17.113*** (3.931)
<i>Panel C: Mean (combined) performance</i>			
Ability ratio	-4.395 (2.791)	0.431 (3.657)	-10.035*** (3.882)
Round Fixed Effect (FE)	x	x	x
Tournament-by-Year FE	x	x	x
Individual FE	x	x	x
All Covariates	x	x	x
N	4776	4776	4776

Robustness Checks

- Ability controls Individual – Year FE 2 – year avg
- Treatment definition Difference in abilities Odds based
- Outcome definition Categories
- Sample definition Without treatment outliers
- Estimation Causal machine learning
- Heterogeneous effects Heterogeneity

Results



(a) Favorite win

Table

Further Results

- A widespread solution to the adverse incentive effects in heterogeneous tournaments are interventions that bias the contest success function and reduce the effective level of heterogeneity among contestants
 - Affirmative action policies (e.g. to fight discrimination) are frequently used
 - limited evidence from the field
- We exploit that one of the players is "given" a head start (Goller, 2022)

Biased Contests

	Favorite win	Favorite	Performance Underdog	Average
<i>Panel A: Baseline effect</i>				
Underdog headstart	-0.076*** (0.017)	-0.245 (0.278)	0.682*** (0.202)	0.265 (0.169)
<i>Panel B: Interaction effect</i>				
Ability ratio	1.405*** (0.187)	6.808*** (2.530)	-17.583*** (3.827)	-3.886 (3.065)
Underdog headstart	-0.119 (0.286)	2.235 (4.783)	-5.036 (5.084)	1.381 (3.576)
Ability ratio x headstart	0.041 (0.267)	-2.349 (4.506)	5.426 (4.818)	-1.059 (3.384)
Round Fixed Effect (FE)	x	x	x	x
Tournament-by-Year FE	x	x	x	x
Individual FE	x	x	x	x
All Covariates	x	x	x	x

Multistage Tournaments

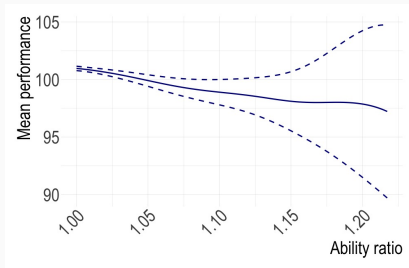
- In many settings tournaments are not one shot events
 - Does the strength of future contestants affect current effort provision?
 - Anecdotal evidence that only the current stage matters
- IV approach that exploits unexpected upset together with the tournament schedule
- Strength of next opponent $\uparrow$, favorite win $\downarrow$
 - Favorite performance $\downarrow$

Conclusion

- → **Optimal heterogeneity depends on tournament objective**
- We make several contributions to the theoretical literature on contests and our results have practical implications
 - Against theoretical predictions we find that heterogeneity increases performance of favorites
 - Underdogs profit from a head start, no response from favorites
 - Contestants seem to be forward looking
 - Favorite performance decreases with in the quality of the next opponent (Favorites win less often)

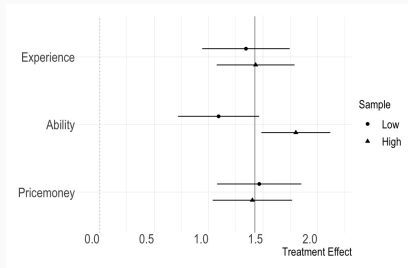
Thank you
(enzo.brox@unisg.ch)

Results



(b) Mean

Back



(c) Favorite win

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	(1)	(2)
<i>Panel A: Favorite win</i>		
Ability ratio	1.421*** (0.155)	1.424*** (0.158)
<i>Panel B: Contest length</i>		
Ability ratio	-0.347*** (0.053)	-0.347*** (0.054)
<i>Panel C: Number max. performance</i>		
Ability ratio	-5.616*** (1.587)	-4.991*** (1.553)
All FE	x	x
All Covariates		x
N	4776	4776

Table 1: Robustness checks (1/2)

	Performance within contest	Performance in first half	Performance in second half
	(1)	(2)	(3)
<i>Panel A: Treatment variable in differences</i>			
<i>A.1: Favorite's performance</i>			
Ability difference	0.078** (0.032)	0.162*** (0.044)	-0.021 (0.044)
<i>A.2: Underdog's performance</i>			
Ability difference	-0.173*** (0.036)	-0.159*** (0.049)	-0.192*** (0.048)
N	4776	4776	4776

Table 2: Robustness checks (1/2)

	Performance within contest	Performance in first half	Performance in second half
	(1)	(2)	(3)
<i>Panel B: Individual-by-Year Fixed Effects</i>			
<i>B.1: Favorite's performance</i>			
Ability ratio	5.428* (3.299)	14.288*** (4.190)	-4.955 (4.422)
<i>B.2: Underdog's performance</i>			
Ability ratio	-11.084** (5.387)	-13.215** (6.652)	-8.852 (7.207)
N	4776	4776	4776

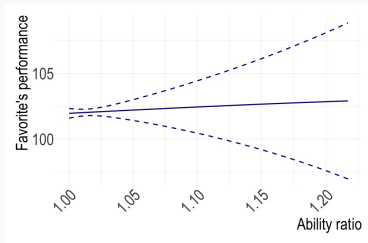
Table 3: Robustness checks (2/2)

	Performance within contest	Performance in	
		first half	second half
	(1)	(2)	(3)
<i>Panel C: Control directly for ability instead of individual FE</i>			
<i>C.1: Favorite's performance</i>			
Ability ratio	3.906 (2.469)	10.944*** (3.513)	-4.257 (3.126)
<i>C.2: Underdog's performance</i>			
Ability ratio	-9.606** (3.720)	-10.522** (4.871)	-8.808* (4.748)
N	4776	4776	4776

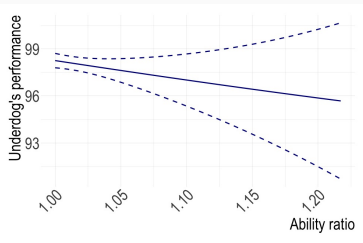
Table 4: Robustness checks (2/2)

	Performance within contest	Performance in first half	Performance in second half
	(1)	(2)	(3)
<i>Panel D: Remove top 1% of ability ratio (treatment outliers)</i>			
<i>D.1: Favorite's performance</i>			
Ability ratio	7.073** (2.864)	14.846*** (3.774)	-1.781 (3.871)
<i>D.2: Underdog's performance</i>			
Ability ratio	-13.477*** (3.206)	-12.978*** (4.501)	-14.392*** (4.485)
N	4776	4776	4776

Results



(d) Favorite



(e) Underdog

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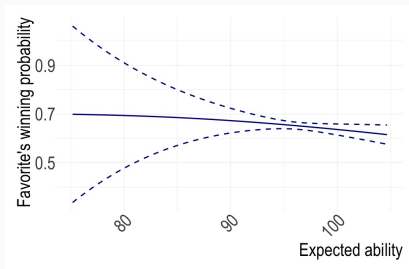
Mean Performance

Table 5: Results for within contest performance, 3-darts scores per leg

	<u>> 100 per leg</u>	<u>> 140 per leg</u>	<u>180 per leg</u>
	(1)	(2)	(3)
<i>Panel A: Favorite's performance</i>			
Ability ratio	0.331*** (0.111)	0.109 (0.077)	0.044 (0.056)
<i>Panel B: Underdog's performance</i>			
Ability ratio	-0.574*** (0.115)	-0.388*** (0.099)	-0.158*** (0.053)
<i>Panel C: Mean performance</i>			
Ability ratio	-0.171 (0.109)	-0.138* (0.083)	-0.092* (0.050)
Round Fixed Effect (FE)	x	x	x
Tournament-by-Year FE	x	x	x
Individual FE	x	x	x
All Covariates	x	x	x
N	4776	4776	4776

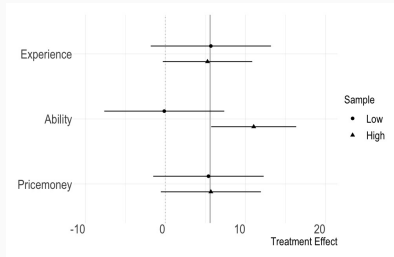
	(1)	(2)	(3)
<i>Panel A: Favorite's performance</i>			
Current ability ratio ¹	0.268*** (0.044)	0.289*** (0.043)	0.297*** (0.045)
Favorite world ranking		-0.001 (0.001)	-0.001 (0.001)
Underdog world ranking		-0.000** (0.000)	-0.000** (0.000)
Favorite experience			2.744*** (0.728)
Underdog experience			0.000 (0.003)
<i>Panel B: Underdog's performance</i>			
Current ability ratio ¹	-0.224*** (0.058)	-0.223*** (0.058)	-0.209*** (0.059)
Favorite world ranking		-0.000 (0.000)	-0.000 (0.000)
Underdog world ranking		-0.000* (0.000)	-0.000* (0.000)
Favorite experience			0.018 (0.013)
Underdog experience			2.042** (1.032)
Round Fixed Effect (FE)	x	x	x
Tournament-by-Year FE	x	x	x
Individual FE	x	x	x
All covariates			x
N	4769	4769	4769

Figure 1: Favorite win, future opponent

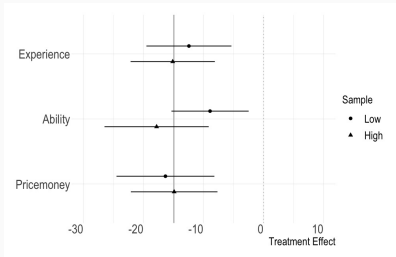


Notes: Non-parametric kernel regression. Based on Table ??, column (2). The blue line shows the expected winning probability for different levels of the expected ability of the next opponent. Dashed lines show the 90% confidence intervals.

Results



(a) Favorite



(b) Underdog

Favorite Win

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