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# Team vs. Individual Tournaments: Evidence from Prize Structure in eSports

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18/01/2017
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ECOBAS

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# Tournament theory

We work our socks off in underpaying jobs in the hope that one day we'll win the rat race and become overpaid fat cats ourselves. Economists call this "tournament theory."

Tim Harford

"Why Your Boss Is Overpaid"

Forbes

2006

# Tournament theory

Lazear and Rosen, 1981

- Reward structure is based on relative rank rather than absolute levels of output
- Large salary dispersion can lead to greater effort and higher productivity
- “Optimum labour contracts in case of costly monitoring of workers efforts” (p.1)

# Tournament theory tests (I)

- How NASCAR drivers balance risk taking and crowding as they square off to determine a winner (Bothner, Kang, & Stuart, 2007)
- How judges sit on increasingly prestigious courts with the ultimate prize being the U.S. Supreme Court (Choi & Gulati, 2004)
- How contract growers vie to supply broiler chickens to Perdue and Tyson (Knoeber & Thurman, 1994)
- Explains compensation structures (Messersmith, Guthrie, Ji, & Lee, 2011)

* Based on survey of Connelly, B. L., Tihanyi, L., Crook, T. R., & Gangloff, K. A. (2014).

# Tournament theory tests (II)

- Golf (Ehrenberg and Bognanno, 1990) – size and the structure of prizes influenced player performance in golf tournaments
- Auto racing (Becker & Huselid, 1992; von Allmen, 2001; Depken & Wilson, 2004)
- Marathons (Frick and Prinz, 2007)
- Men's and women's tennis (Gilsdorf & Sukhatme, 2008a, 2008b)

There is support for the predictions of tournament theory but that the context of the competition introduces nuances

  – For example, Frick and Prinz (2007) find that spreading out the prizes to more competitors in a marathon may lead to a bigger and more competitive field.

# Team production

- Proper incentives issue becomes more complicated (Che & Yoo, 2001; Holmstrom, 1982)
- Alchian and Demsetz (1972) – incentives such that team members do not shirk their responsibilities or sabotage the efforts of the team
- Winter (2004) and Gould and Winter (2009) – individual team members may increase or decrease their effort in response to increased effort by teammates

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# Our study

- Existing literature focuses on *individual* sports
- We use data on elimination tournaments both for team and individual tournaments in minor and major events

1. Tournament theory holds both in team and individual competitions
2. There is a difference in prize structure between team and individual competitions
3. There is a difference between major and minor tournaments

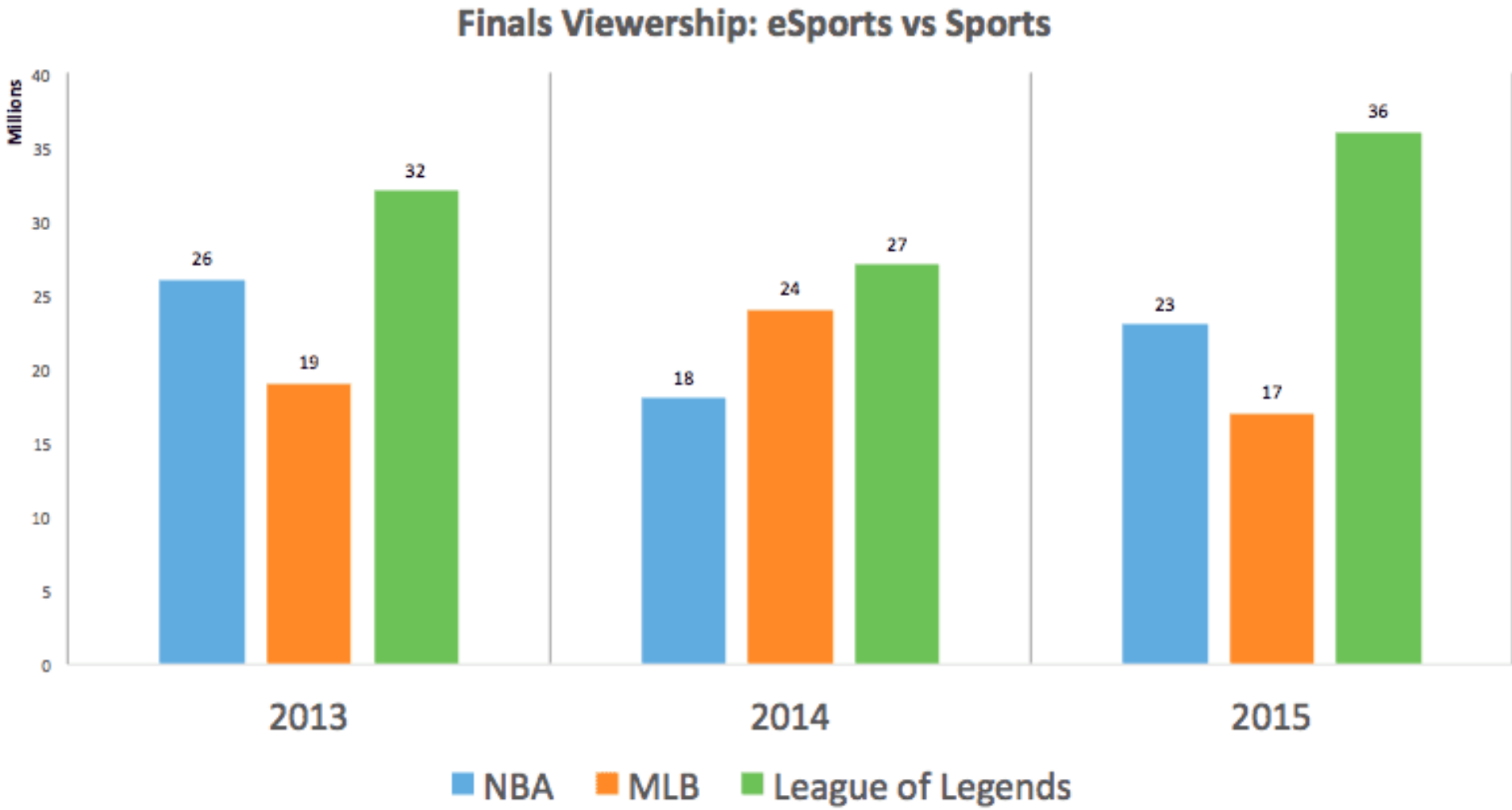
# Why it is important?

- Why tournament theory tests are important?
- Why tournament theory *in eSports*?
- Why it is important to analyze *team vs. individual* tournaments?

# eSports

- Competitive video gaming
- Dota2, Counter-Strike, StarCraft, WarCraft…
- Stanford University, 1972 – “Intergalactic Spacewar Olympics” (Hiltscher & Scholz, 2015)
- Approximately 115 million enthusiasts watched eSports in 2015 and another 115 million were occasional viewers
- The global eSports market is worth $748M and will reach $1.9B by 2018

# eSports




* http://blog.wardesports.com/esports-vs-sports-finals-viewership/


CDEC Gaming

# eSports tournaments

- Sequential elimination tournament
- The number of participants varies a lot, but the mode is 32
- Some teams/players are invited directly by the tournament organizers and the rest go through a qualification stage
- A winner of a match is determined by a best of three playoff system
- LAN (offline) vs. online tournaments
- Tournaments are usually organized by game producers to promote their games
  - The incentive is to maximize the entertainment value
  - The organizers are interested in maximizing the effort

# Tournament theory test

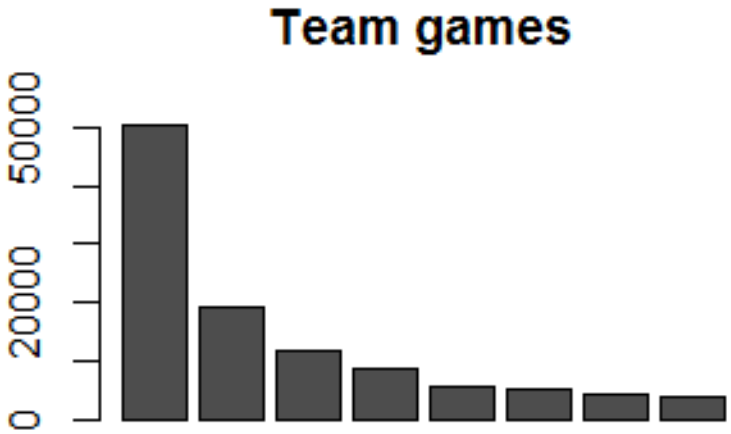
We test implications for the prize structure (Rosen, 1986 p. 705-706):

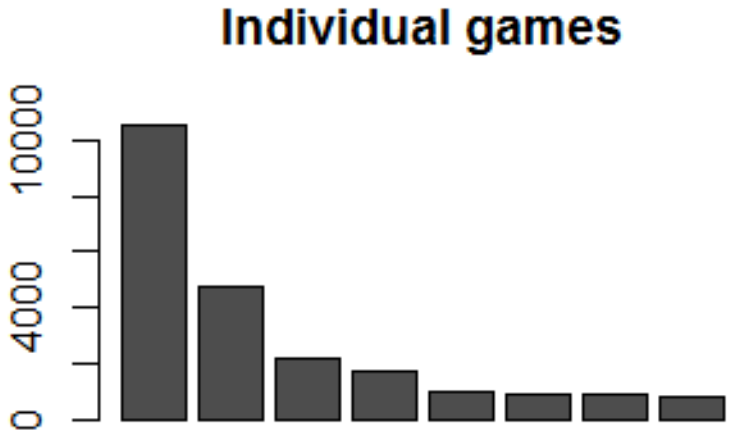
- the difference in prize (inter-rank spread) for the final stage contestants, relative to the lower stage contestants, should be large
- the function describing the relationship between prize and rank is convex if the participants are risk-averse

# Data

- eSports Earnings project
- An information on each  tournament prize distribution across ranks in dollars
- For the period from 1999 to 2014
- Nominal prizes are inflation adjusted using the official US inflation rates

# Prizes



# Herfindahl-Hirschman index

- $HHI_i = \sum_{i=1}^{n} \left( \frac{prize_i}{\sum_{i=1}^{8} prize_i} \cdot 100 \right)^2$
- $prize_i$ is the prize of the gamer of rank *i*
- *n* is the number of competitors that win a prize.
- The higher is the HHI, the bigger is the spread

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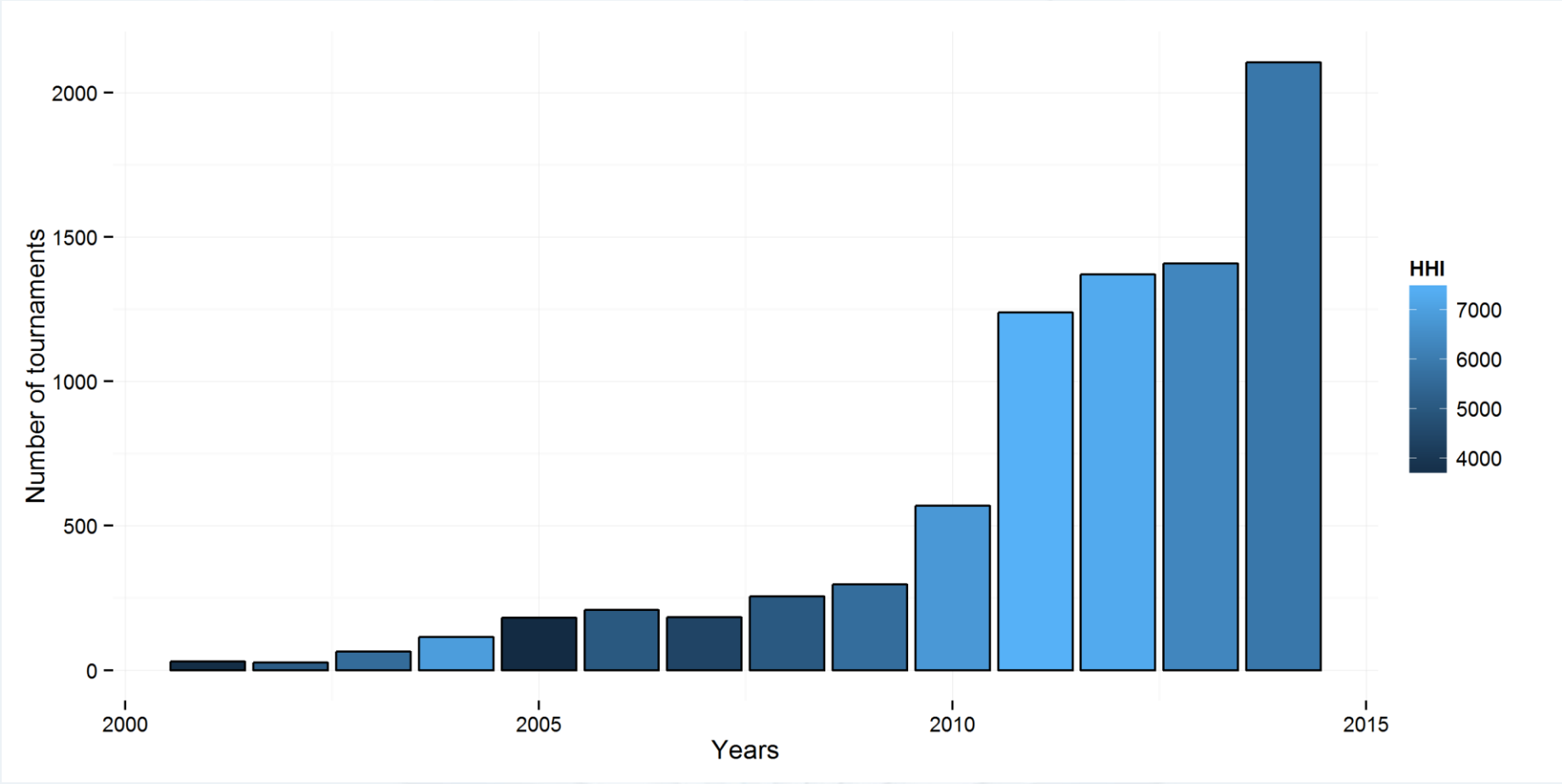
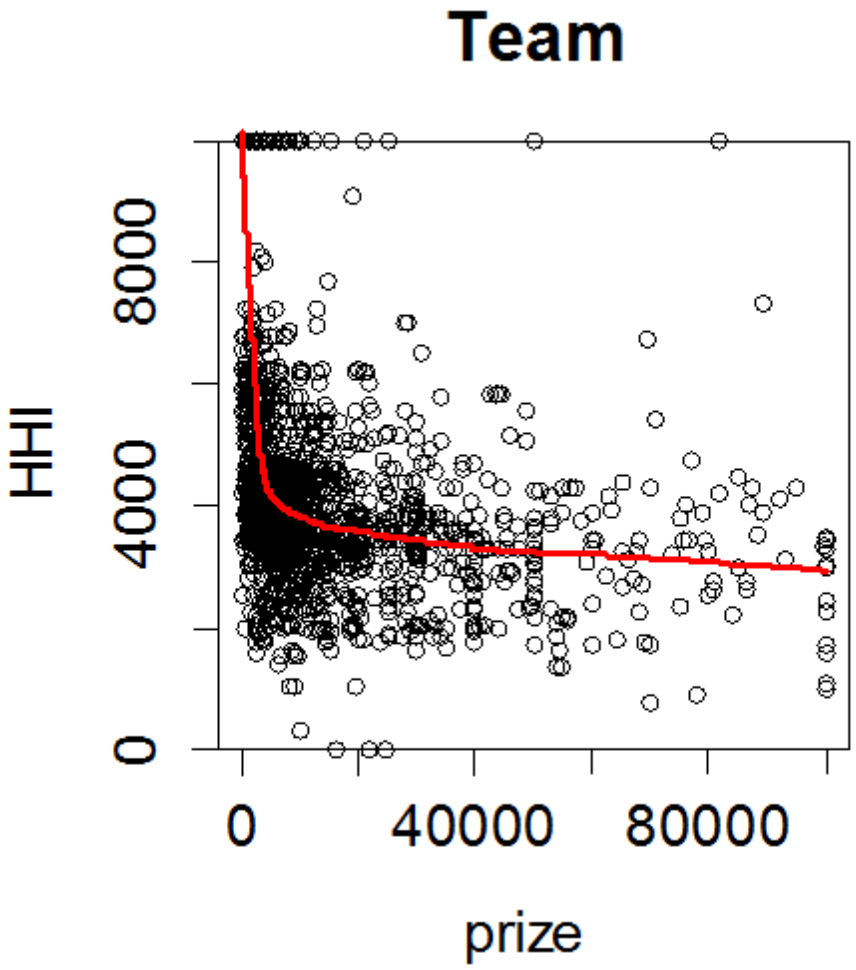
# Size and spread of prize

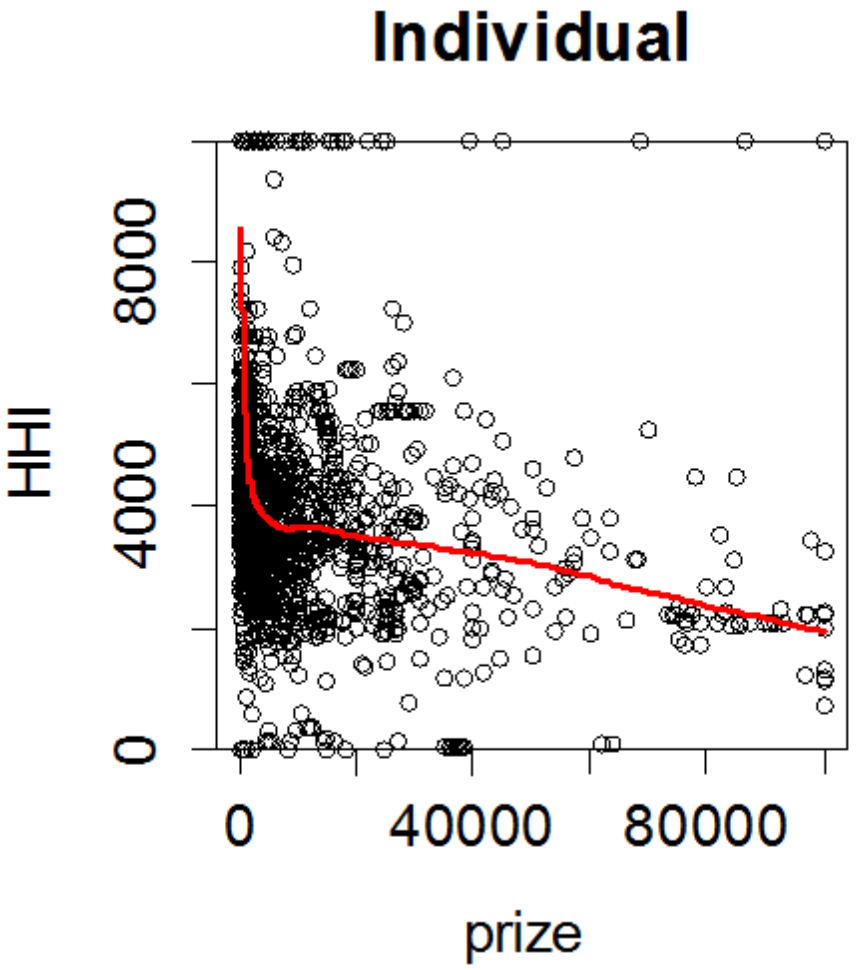


# Size and spread of prize

| Game type | Mean HHI | Mean prize |
|---|---|---|
| Individual game | 6,622 | 5,804 |
| Team game | 5,898 | 19,590 |
| Offline tournaments | 3,959 | 27,722 |
| Online tournaments | 7,854 | 2,076 |

# Prize pool and HHI




* Red line is locally-weighted polynomial regression

# Tournament theory test: methodology

- Lambert et al. (1993) and Conyon et al. (2001)
- $\log(prize_{ij}) = \alpha + \sum_{j=1}^{7} \beta_j rank_{ij} + \gamma \cdot totalprizespaid_i + \sum \beta_g game_{ig} + \sum \beta_k country_{ik} + \sum \beta_t year_{it} + \varepsilon_{ij}$

$$\beta_7 \geq 0$$
$$(\beta_6 - \beta_7) \geq \beta_7$$
$$(\beta_5 - \beta_6) \geq (\beta_6 - \beta_7)$$
$$(\beta_4 - \beta_5) \geq (\beta_5 - \beta_6)$$
$$(\beta_3 - \beta_4) \geq (\beta_4 - \beta_5)$$
$$(\beta_2 - \beta_3) \geq (\beta_3 - \beta_4)$$
$$(\beta_1 - \beta_2) \geq (\beta_2 - \beta_3)$$

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# Team vs. individual test: methodology

$$\log(prize_{ij}) = \alpha + \sum_{j=1}^{7} \beta_j rank_{ij} + \gamma \cdot totalprizespaid_i +$$

$$\sum_{j=1}^{8} \beta_j rank_{ij} \cdot team + \sum_{j=1}^{7} \beta_j rank_{ij} \cdot online +$$

$$\sum_{j=1}^{7} \beta_j rank_{ij} \cdot online \cdot team +$$

$$\gamma_t \cdot totalprizespaid_i \cdot team + \gamma_o \cdot totalprizespaid_i \cdot online + \gamma_{to} \cdot totalprizespaid_i \cdot online \cdot team +$$

$$\sum \beta_g game_{ig} + \sum \beta_k country_{ik} + \sum \beta_t year_{it} + \varepsilon_{ij}$$

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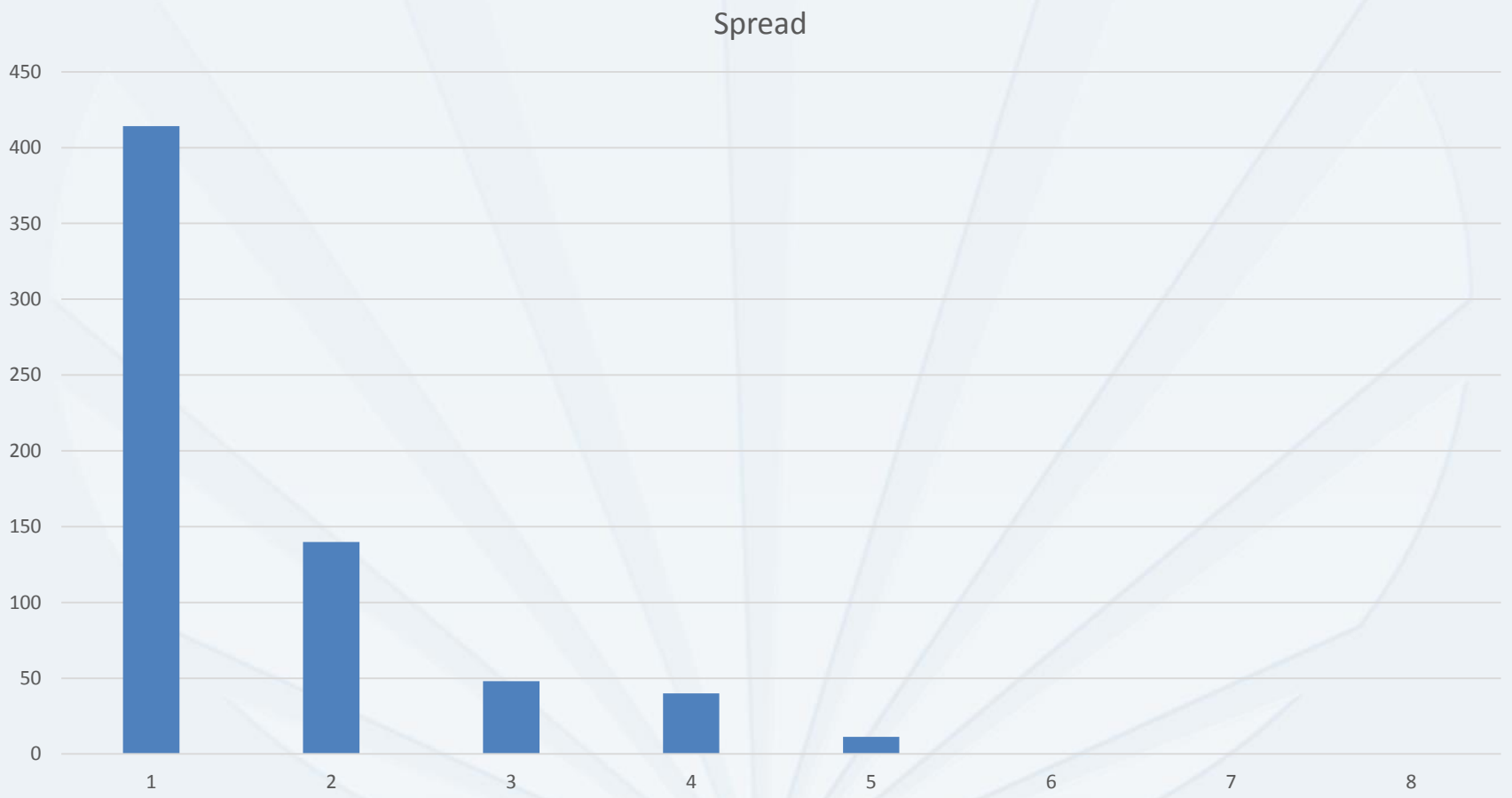
# Empirical results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Offline + Online | | | Offline | | | Online | | |
| | All | Team | Individual | All | Team | Individual | All | Team | Individual |
| Rank 1 | 1.6372*** | 1.6967*** | 1.9684*** | 2.0027*** | 1.9668*** | 2.2974*** | 1.4851*** | 1.5502*** | 1.5196*** |
| | (0.0440) | (0.0625) | (0.0475) | (0.0475) | (0.0711) | (0.0501) | (0.0726) | (0.1062) | (0.0817) |
| Rank 2 | 0.8747*** | 0.9559*** | 1.1886*** | 1.2409*** | 1.2413*** | 1.5028*** | 0.7214*** | 0.7854*** | 0.7564*** |
| | (0.0441) | (0.0628) | (0.0476) | (0.0475) | (0.0712) | (0.0501) | (0.0728) | (0.1068) | (0.0817) |
| Rank 3 | 0.3921*** | 0.5206*** | 0.6367*** | 0.6497*** | 0.6882*** | 0.8419*** | 0.2978*** | 0.4596*** | 0.2860*** |
| | (0.0451) | (0.0635) | (0.0493) | (0.0476) | (0.0712) | (0.0508) | (0.0758) | (0.1106) | (0.0867) |
| Rank 4 | 0.3365*** | 0.3380*** | 0.5591*** | 0.5292*** | 0.4976*** | 0.6736*** | 0.2337*** | 0.2065* | 0.3219*** |
| | (0.0476) | (0.0666) | (0.0523) | (0.0501) | (0.0740) | (0.0537) | (0.0792) | (0.1155) | (0.0912) |
| Rank 5 | 0.1077** | 0.1561** | 0.1248** | 0.1465*** | 0.1644** | 0.1587*** | 0.1276 | 0.2286* | 0.0818 |
| | (0.0528) | (0.0749) | (0.0571) | (0.0545) | (0.0825) | (0.0568) | (0.0923) | (0.1340) | (0.1053) |
| Rank 6 | 0.0819 | 0.1118 | 0.1023* | 0.1190** | 0.1230 | 0.1326** | 0.0772 | 0.1350 | 0.0600 |
| | (0.0535) | (0.0773) | (0.0571) | (0.0550) | (0.0843) | (0.0568) | (0.0941) | (0.1432) | (0.1046) |
| Rank 7 | 0.0201 | 0.0233 | 0.0220 | 0.0402 | 0.0535 | 0.0315 | -0.0186 | -0.0520 | 0.0037 |
| | (0.0551) | (0.0813) | (0.0577) | (0.0563) | (0.0880) | (0.0561) | (0.1006) | (0.1635) | (0.1054) |
| Total prizes paid | 0.0010*** | 0.0008*** | 0.0271*** | 0.0009*** | 0.0008*** | 0.0217*** | 0.0319*** | 0.0222*** | 0.0468*** |
| | (0.0001) | (0.0001) | (0.0008) | (0.0001) | (0.0001) | (0.0006) | (0.0018) | (0.0016) | (0.0010) |
| Game dummies | Included | Included | Included | Included | Included | Included | Included | Included | Included |
| Year dummies | Included | Included | Included | Included | Included | Included | Included | Included | Included |
| Country dummies | Included | Included | Included | Included | Included | Included | Included | Included | Included |
| Constant | 6.5930*** | 5.4775*** | 4.7299*** | 5.9804*** | 5.2573*** | 4.1936*** | 5.7334*** | 5.4583*** | 5.5613*** |
| | (0.3203) | (0.3390) | (0.1819) | (0.3274) | (0.3596) | (0.1475) | (0.2040) | (0.2203) | (0.1989) |
| Observations | 17,435 | 7,549 | 9,886 | 10,895 | 5,011 | 5,884 | 6,540 | 2,538 | 4,002 |
| $R^2$ | 0.6018 | 0.5104 | 0.7066 | 0.6289 | 0.5500 | 0.7536 | 0.6095 | 0.4931 | 0.5551 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

# All sample



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Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

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# Results: Team vs. individual

| | (1) Online interactions | | (2) Team interactions | | (3) Team and online interactions |
|---|---|---|---|---|---|
| … | | … | | … | |
| Rank 1 × Online | -0.4668*** | Rank 1 × Team Game | 1.2802*** | Rank 1 × Team Game × Online | 0.4331*** |
| | (0.0859) | | (0.1137) | | (0.070) |
| Rank 2 × Online | -0.4684*** | Rank 2 × Team Game | 1.3184*** | Rank 2× Team Game × Online | 0.3642*** |
| | (0.0860) | | (0.1136) | | (0.071) |
| Rank 3 × Online | -0.2906*** | Rank 3 × Team Game | 1.4181*** | Rank 3 × Team Game × Online | 0.3829*** |
| | (0.0888) | | (0.1147) | | (0.084) |
| Rank 4 × Online | -0.2434*** | Rank 4 × Team Game | 1.3352*** | Rank 4 × Team Game × Online | 0.0893 |
| | (0.0929) | | (0.1182) | | (0.101) |
| Rank 5 × Online | 0.0022 | Rank 5 × Team Game | 1.6285*** | Rank 5 × Team Game × Online | 0.1010 |
| | (0.1061) | | (0.1282) | | (0.137) |
| Rank 6 × Online | -0.0244 | Rank 6 × Team Game | 1.6041*** | Rank 6 × Team Game × Online | 0.0489 |
| | (0.1079) | | (0.1297) | | (0.147) |
| Rank 7 × Online | -0.0514 | Rank 7 × Team Game | 1.5753*** | Rank 7 × Team Game × Online | -0.1041 |
| | (0.1137) | | (0.1327) | | (0.166) |
| Total prizes paid | 0.0312*** | Rank 8 × Team Game | 1.5764*** | Rank 8 × Team Game × Online | -0.0223 |
| × Online | (0.0018) | | (0.1320) | | (0.148) |
| | | Total prizes paid × | -0.0253*** | Total prizes paid × | -0.0048** |
| | | Team Game | (0.0007) | Team Game × Online | |
| | | | | | (0.002) |
| Game, Year, | | | | | Included |
| Country | Included | | Included | | |
| dummies | | | | | |
| Constant | 6.3985*** | | 5.3487*** | | 5.2186*** |
| | (0.3230) | | (0.2696) | | (0.283) |
| Observations | 17,435 | | 17,435 | | 17,435 |
| R-squared | 0.6690 | | 0.6760 | | 0.715 |

# Conclusions

- Prize structure in eSports follows tournament theory
- Online versus offline matters, team versus individual matters and “all interactions” matter
  - there is a difference between motivation of group and individual
  - this difference is conditional on the level of competition

# Limitations

- Results obtained in the framework of this project may not be transferable to other sports because of the unique features of eSports
- We assume the competition organizers design tournaments to maximize player effort

# Thank you for your attention!

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