Money Matters:
The Impact of Prize Money on Doping Behavior – An Agent-based Analysis

Daniel Westmattelmann, Marius Sprenger, Sascha Hokamp & Gerhard Schewe
Economics of Doping

Winner’s prize at major events:
• Wimbledon: 2,200,000 £
• PGA: 1,766,500 US$
• Tour de France: 500,000 €
• Ironman Hawaii: 125,000 US$
• NYC Marathon: 100,000 US$
• IAAF World Championships: 60,000 US$

Background:
• Superstar effect (Rosen, 1981)
  → Minor differences in performance lead to large income differences
• Fight against doping focuses on deterrence
  So far there are insufficient findings regarding:
  → Impact of prize money on doping behavior

Key Question
How does the amount of prize money and its distribution impact the doping behavior of top athletes?
Why Agent-based Simulation Model?

Using agent-based modelling, methodological constraints can be overcome.

Game Theoretical Background

<table>
<thead>
<tr>
<th></th>
<th>no-dope</th>
<th>B</th>
<th>dope</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>no-dope</td>
<td>(3,3)</td>
<td>(1,4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>(4,1)</td>
<td>(2,2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Agent-based Modelling

- Incorporates elements of human and social behavior.
- A system-behavior evolves (Emergence)
- Has potential to become ‘a third way of doing science’ besides argumentation and formalization (Axelrod & Tesfation, 2005).
- No magic, no game, … just MATH!!!
Agent-based Model

The agent-based model is based on 3 interacting objectives and 4 types of athletes are distinguished.

- Rational
  - ... Athletes may use doping with respect to an Expected Utility Maximization approach.

- Suggestible
  - ... Athletes are strongly influenced by doping behavior committed in their social network.

- Moral
  - ... Athletes always act compliant to the anti-doping rules.

- Erratic
  - ... Athletes want to act rule consistent but may commit doping unintentional. (Lack of doping-knowledge)
ABM Results – Status Quo

The simulation data matches the estimated doping prevalence.

Estimated Prevalence
(de Hon et al., 2015)
Analysis Process

Amount and distribution of prize money are varied ceteris paribus.

Various amounts
- PGA
- Tour de France
- Linear Top 20
- Linear Top 100

Agent-based Simulation

Senisitvity Analysis
Considered Prize Money Distributions

The prize money functions used differ enormously.

<table>
<thead>
<tr>
<th>Rank</th>
<th>PGA</th>
<th>Tour de France</th>
<th>Linear Top 20</th>
<th>Linear Top 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.39%</td>
<td>50.31%</td>
<td>10.00%</td>
<td>1.99%</td>
</tr>
<tr>
<td>2</td>
<td>6.58%</td>
<td>20.12%</td>
<td>9.20%</td>
<td>1.97%</td>
</tr>
<tr>
<td>3</td>
<td>4.70%</td>
<td>10.06%</td>
<td>8.70%</td>
<td>1.95%</td>
</tr>
<tr>
<td>4</td>
<td>3.76%</td>
<td>7.04%</td>
<td>8.20%</td>
<td>1.93%</td>
</tr>
<tr>
<td>5</td>
<td>3.29%</td>
<td>5.03%</td>
<td>7.70%</td>
<td>1.91%</td>
</tr>
<tr>
<td>6</td>
<td>2.91%</td>
<td>2.31%</td>
<td>7.20%</td>
<td>1.89%</td>
</tr>
<tr>
<td>7</td>
<td>2.63%</td>
<td>1.16%</td>
<td>6.70%</td>
<td>1.87%</td>
</tr>
<tr>
<td>8</td>
<td>2.44%</td>
<td>0.76%</td>
<td>6.20%</td>
<td>1.85%</td>
</tr>
<tr>
<td>9</td>
<td>2.35%</td>
<td>0.45%</td>
<td>5.70%</td>
<td>1.83%</td>
</tr>
<tr>
<td>10</td>
<td>2.25%</td>
<td>0.38%</td>
<td>5.20%</td>
<td>1.81%</td>
</tr>
</tbody>
</table>
Money Matters: The Impact of Prize Money on Doping Behavior

ABM Results – PGA Tour

![Graph showing the share of doped athletes over the simulation period. The graph compares different prize money levels (PM) for the PGA tour.](image)

![Graph showing the share of total prize money by rank in the tournament. The graph indicates the share of total prize money for the PGA.](image)
ABM Results – Tour de France

Money Matters: The Impact of Prize Money on Doping Behavior

Daniel Westmattelmann, Marius Sprenger, Sascha Hokamp & Gerhard Schewe
ABM Results – Linear Top 100

Money Matters: The Impact of Prize Money on Doping Behavior

Daniel Westmattelmann, Marius Sprenger, Sascha Hokamp & Gerhard Schewe
Sensitivity Analysis

Doping is not primarily influenced by the amount of prize money, but rather by distribution.

- Doping rate varies between about 25 and 33% depending on distribution.
- The amount of prize money has little impact on the doping rate.
  → Doping in recreational sport
- Prize money function with consistently large slope leads to more doping.
- Linear prize money functions with flat slope lead to lowest doping rate.
Conclusion
By using ABM the influence of prize money on doping behavior could be determined appropriately.

Recommendations
Federations and organizers of mega events should adjust their prize money distribution
- Prize money should be distributed more evenly among all athletes.
- Amount of prize money does not have to be adjusted.
- This “Anti-doping measure” is free of charge.

Further steps
- Analyzing new Anti-Doping Concepts before launching
  → Intelligent Testing
- Computer simulations are powerful and cost efficient
Money Matters: The Impact of Prize Money on Doping Behavior – An Agent-based Analysis

Daniel Westmattelmann, Marius Sprenger, Sascha Hokamp & Gerhard Schewe