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

Daniel Westmattelmann, Marius Sprenger, Sascha Hokamp & Gerhard Schewe

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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 Championschip: 60,000 US$

Background:

- Superstar effect (Rosen, 1981)
- → Minor differences in performance lead to large income differences
- Fight against doping focusses 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?**
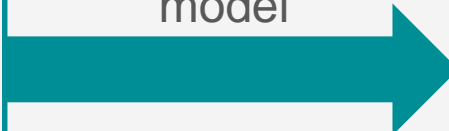
Why Agent-based Simulation Model?

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

Game Theoretical Background

	no-dope **B**	**dope**
no-dope	(3,3)	(1,4)
A **dope**	(4,1)	(2,2)

- Models focus on Fines, Bans, Whistleblowing and Prize Money.
- Complex models cannot be analytically solved.

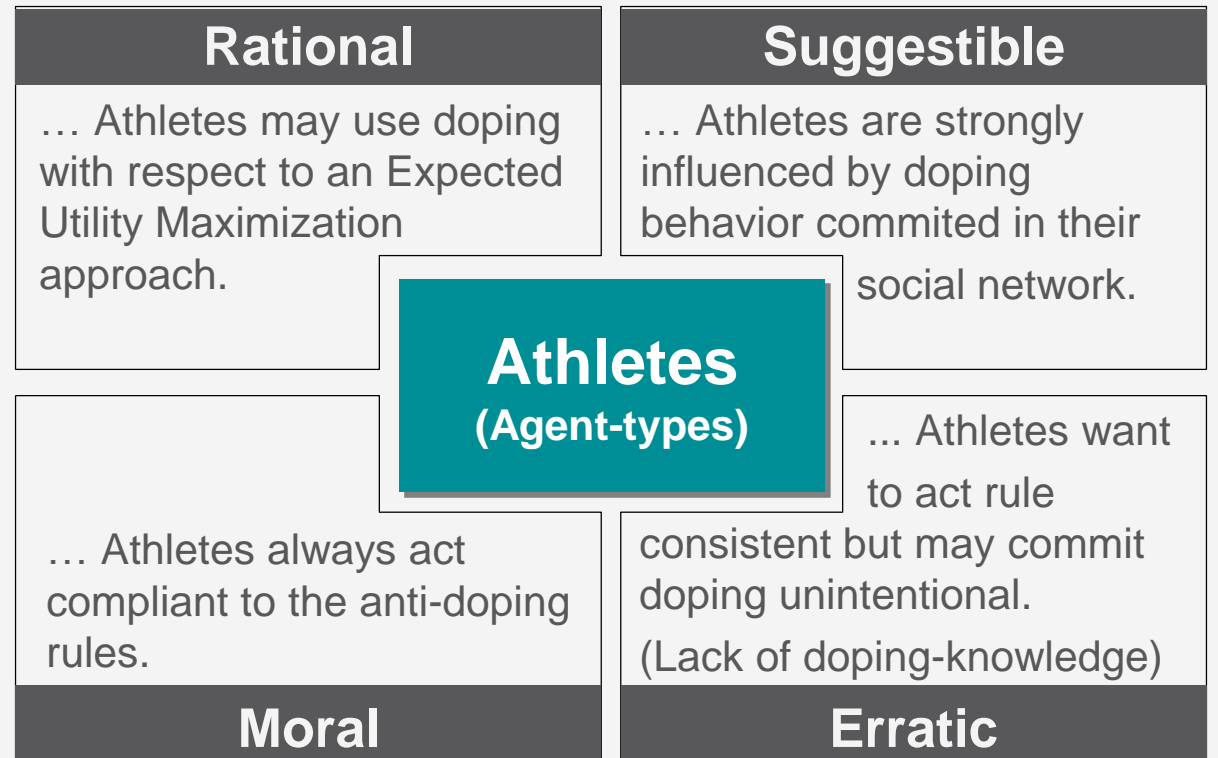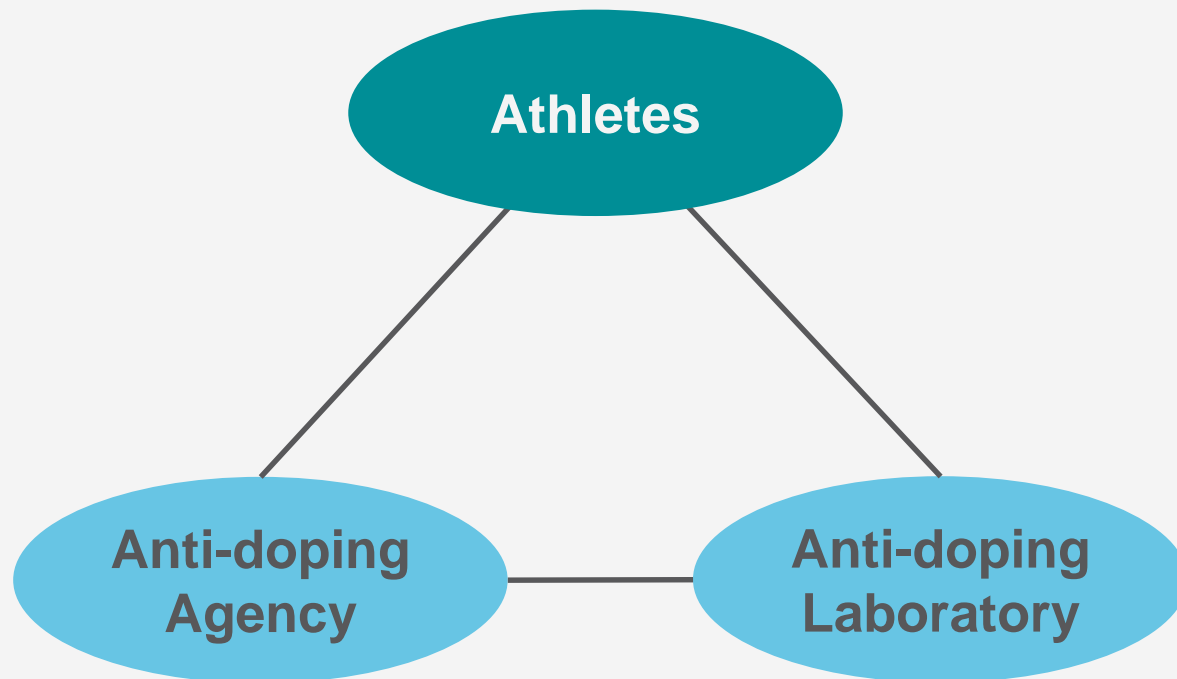Need for a computer-based model

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 & Tesfatison, 2005).
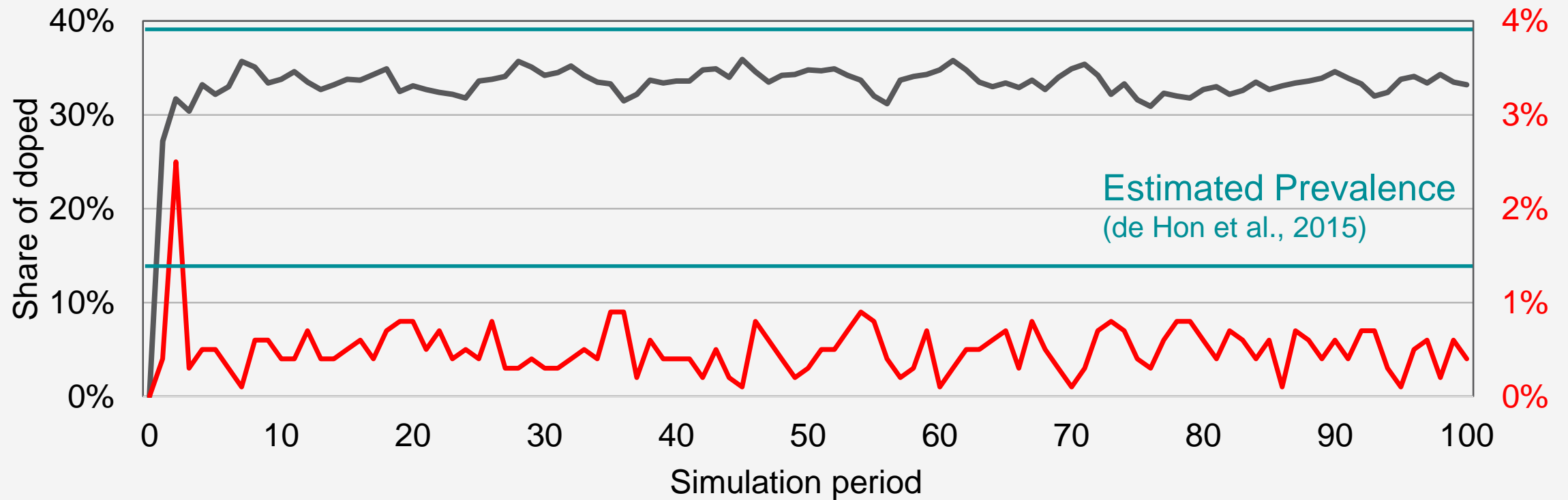
- **No magic, no game, … just MATH!!!**

Agent-based Model

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

Rational	Suggestible
… Athletes may use doping with respect to an Expected Utility Maximization approach.	… Athletes are strongly influenced by doping behavior commited in their social network.
… Athletes always act compliant to the anti-doping rules.	... Athletes want to act rule consistent but may commit doping unintentional. (Lack of doping-knowledge)
Moral	**Erratic**

Athletes (Agent-types)

Athletes

Anti-doping Agency

Anti-doping Laboratory

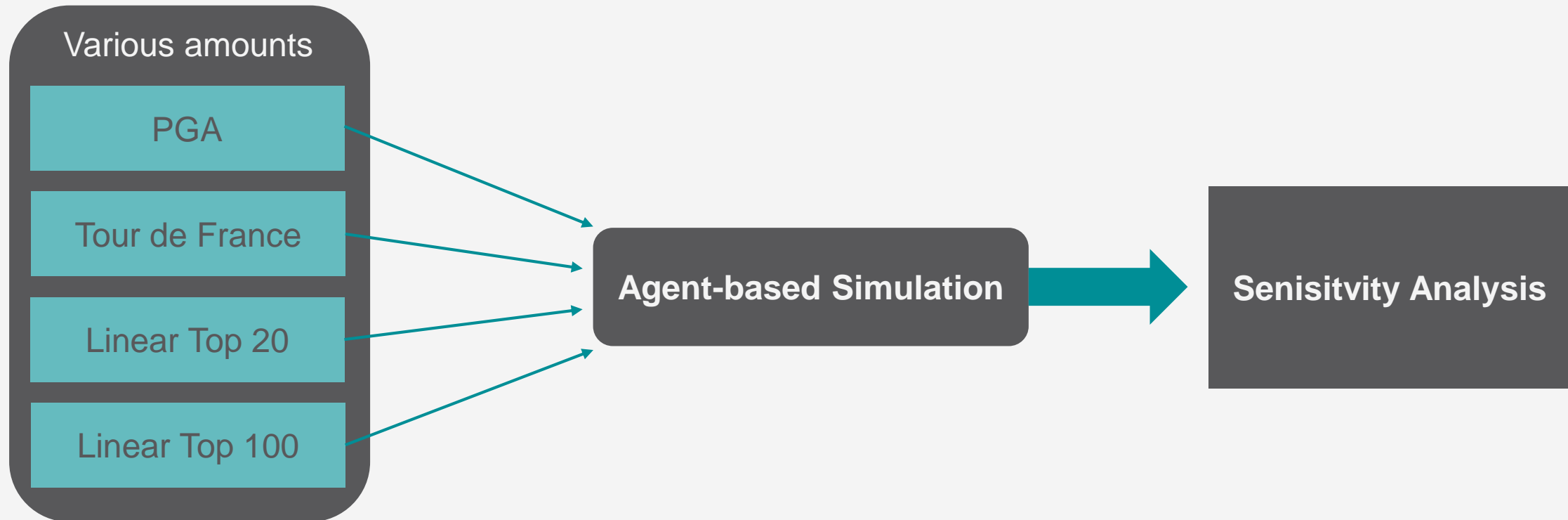Daniel Westmattelmann, Marius Sprenger, Sascha Hokamp & Gerhard Schewe

ABM Results – Status Quo

The simulation data matches the estimated doping prevalence.

Analysis Process

Amount and distribution of prize money are varied ceteris paribus.

Various amounts

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

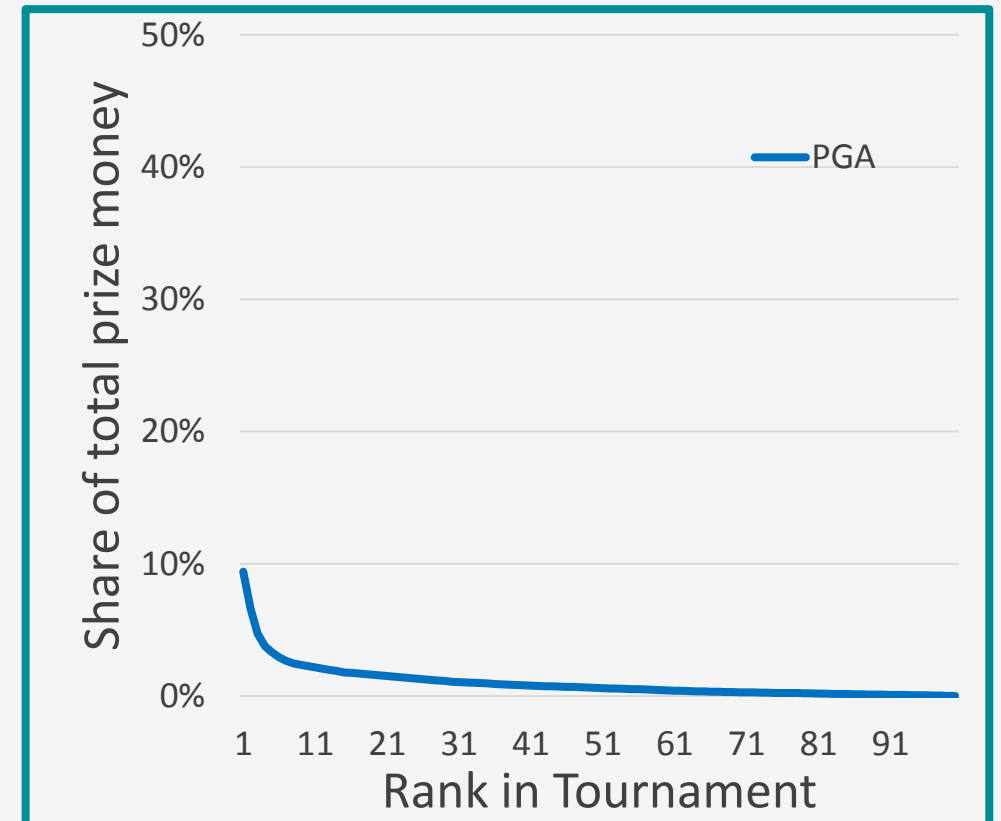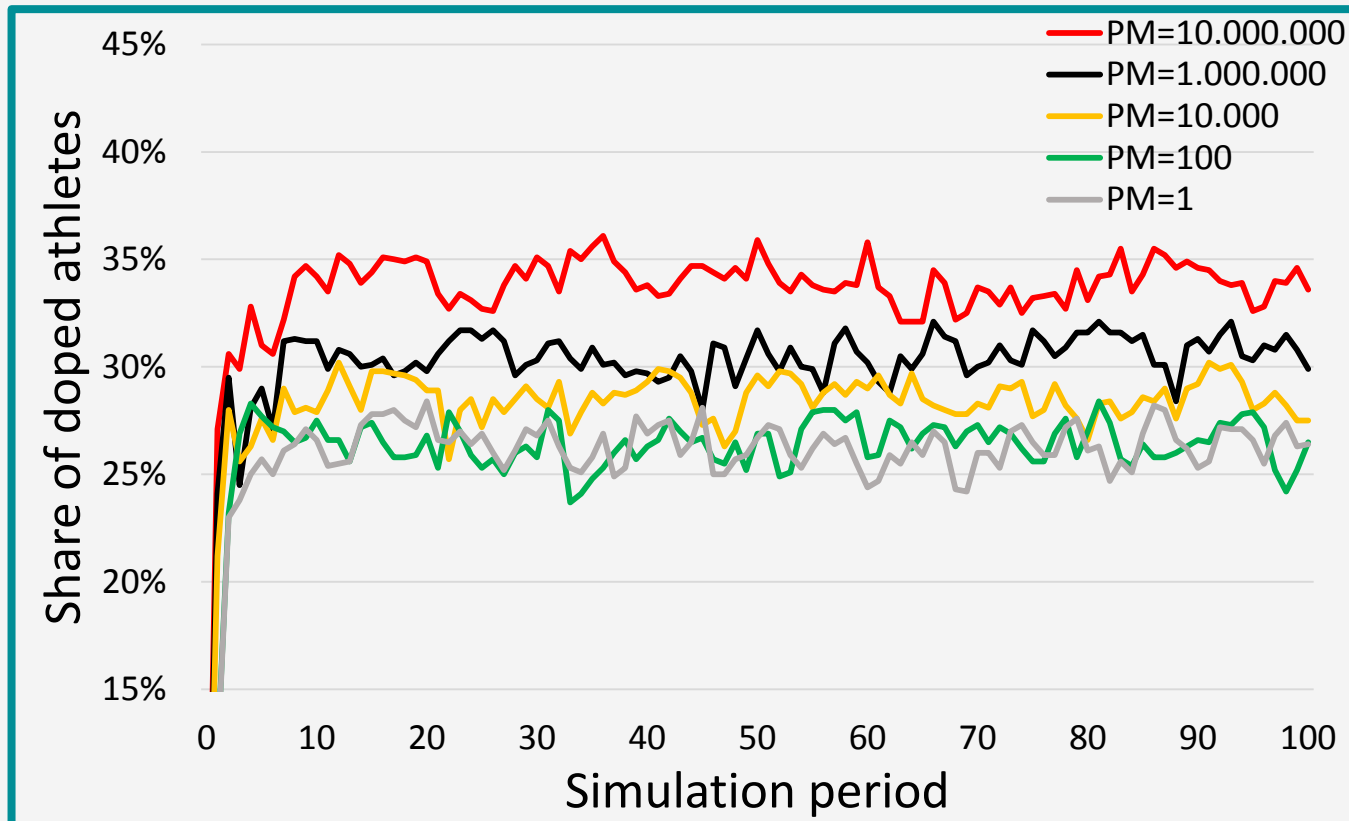**Agent-based Simulation** → **Senisitvity Analysis**

Considered Prize Money Distributions

The prize money functions used differ enormously.

Rank	PGA	Tour de France	Linear Top 20	Linear Top 100
1	9,39%	50,31%	10,00%	1,99%
2	6,58%	20,12%	9,20%	1,97%
3	4,70%	10,06%	8,70%	1,95%
4	3,76%	7,04%	8,20%	1,93%
5	3,29%	5,03%	7,70%	1,91%
6	2,91%	2,31%	7,20%	1,89%
7	2,63%	1,16%	6,70%	1,87%
8	2,44%	0,76%	6,20%	1,85%
9	2,35%	0,45%	5,70%	1,83%
10	2,25%	0,38%	5,20%	1,81%

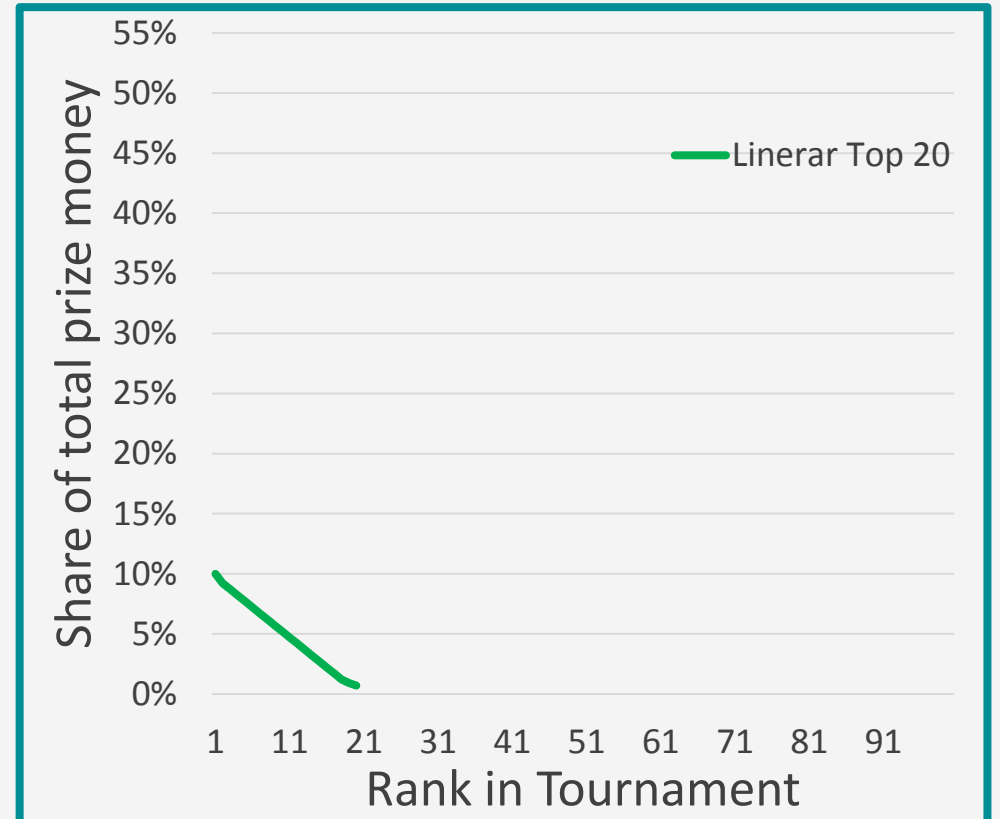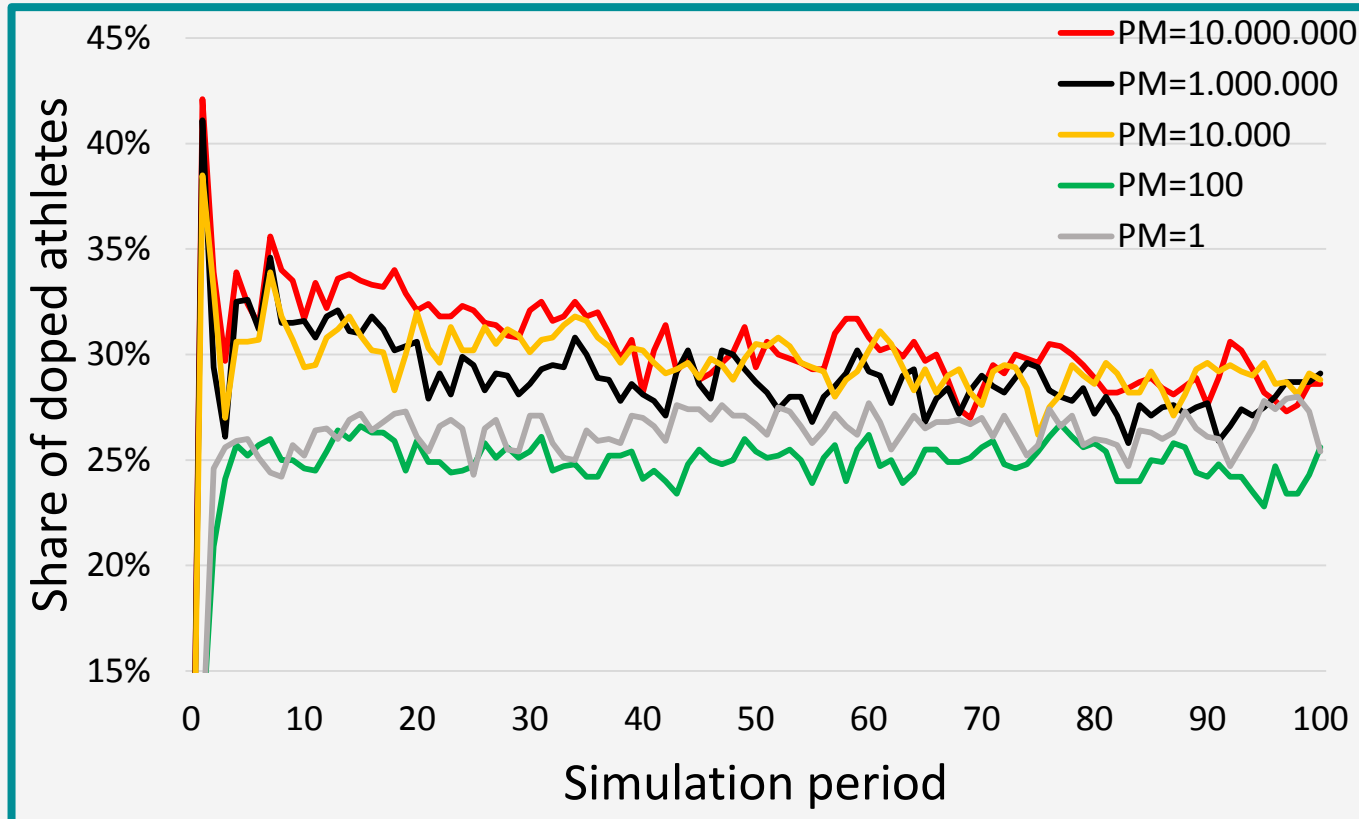Daniel Westmattelmann, Marius Sprenger, Sascha Hokamp & Gerhard Schewe
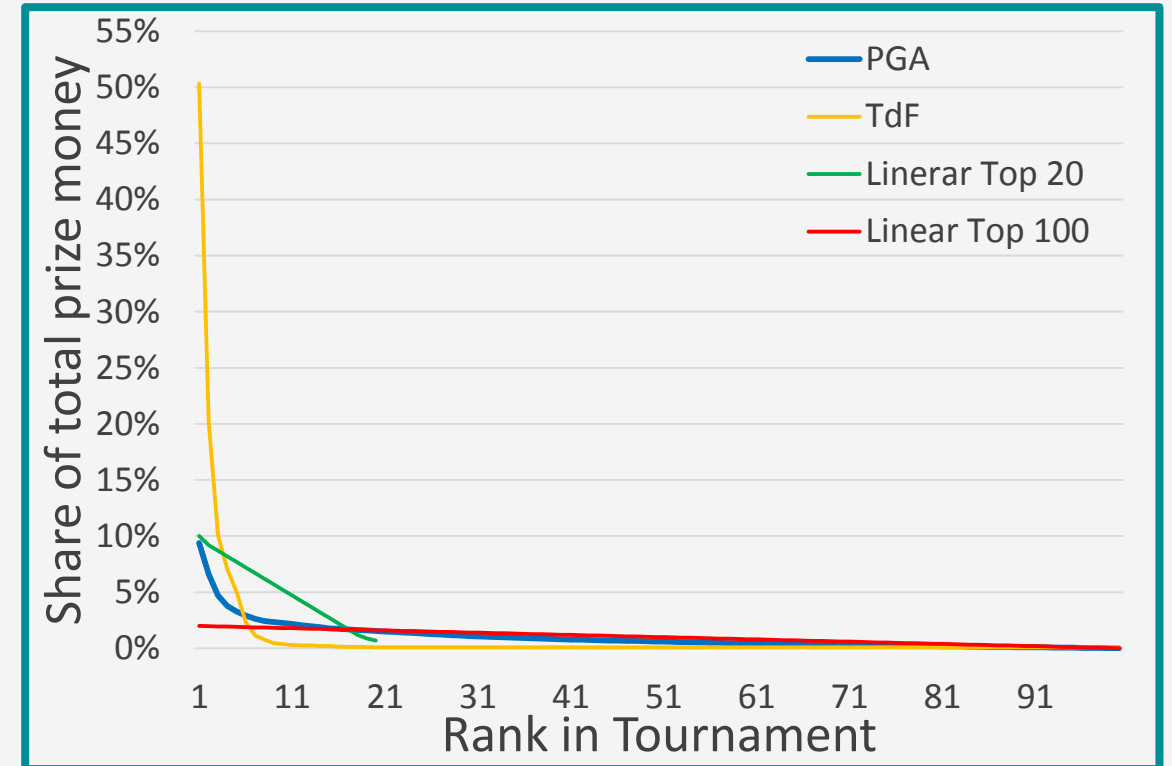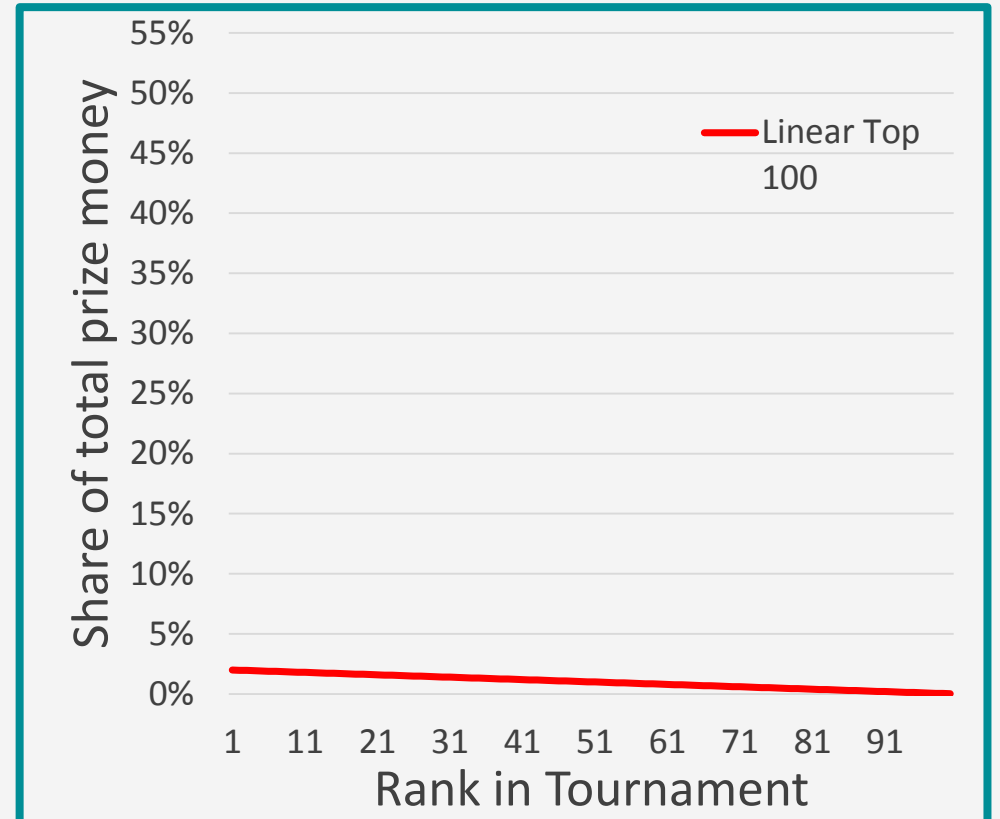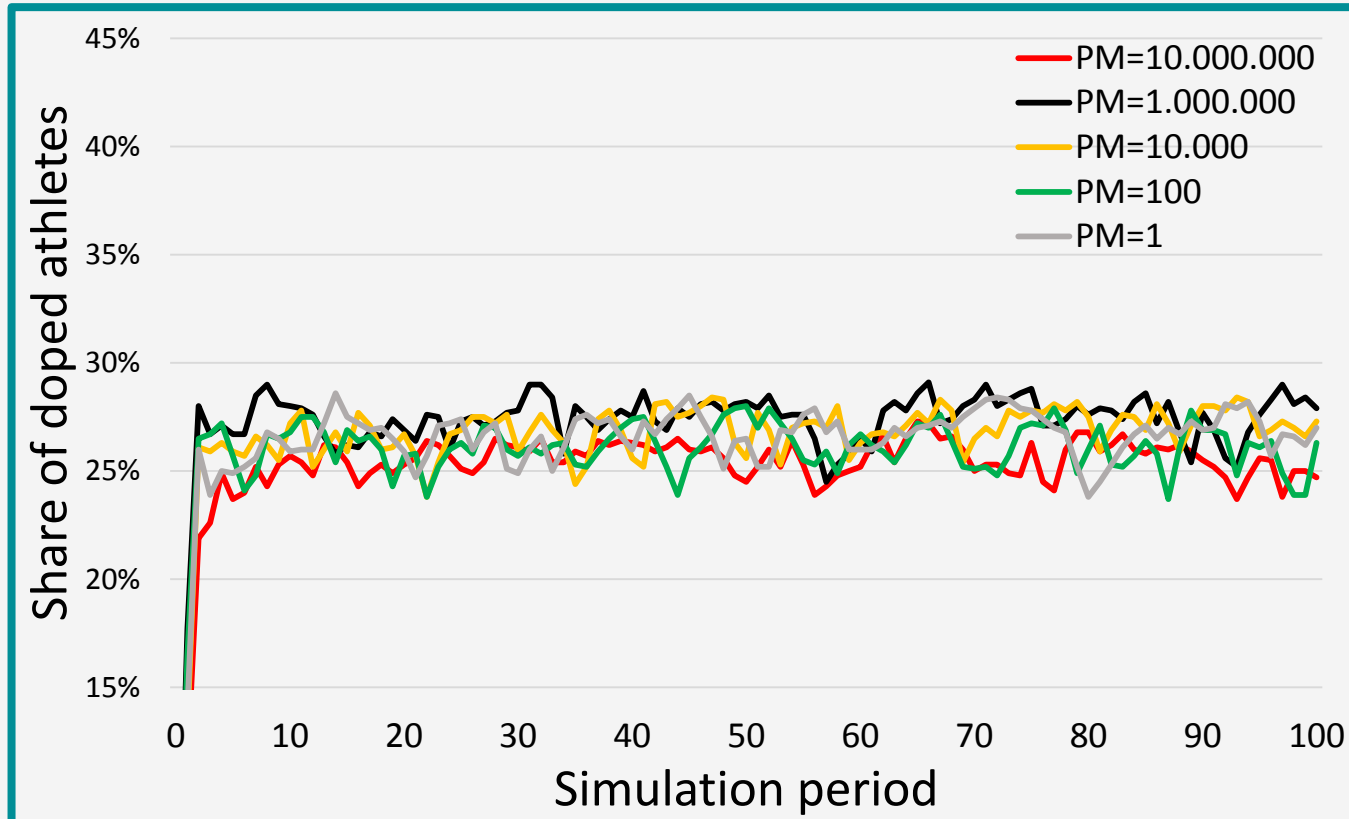
ABM Results – PGA Tour

ABM Results – Tour de France
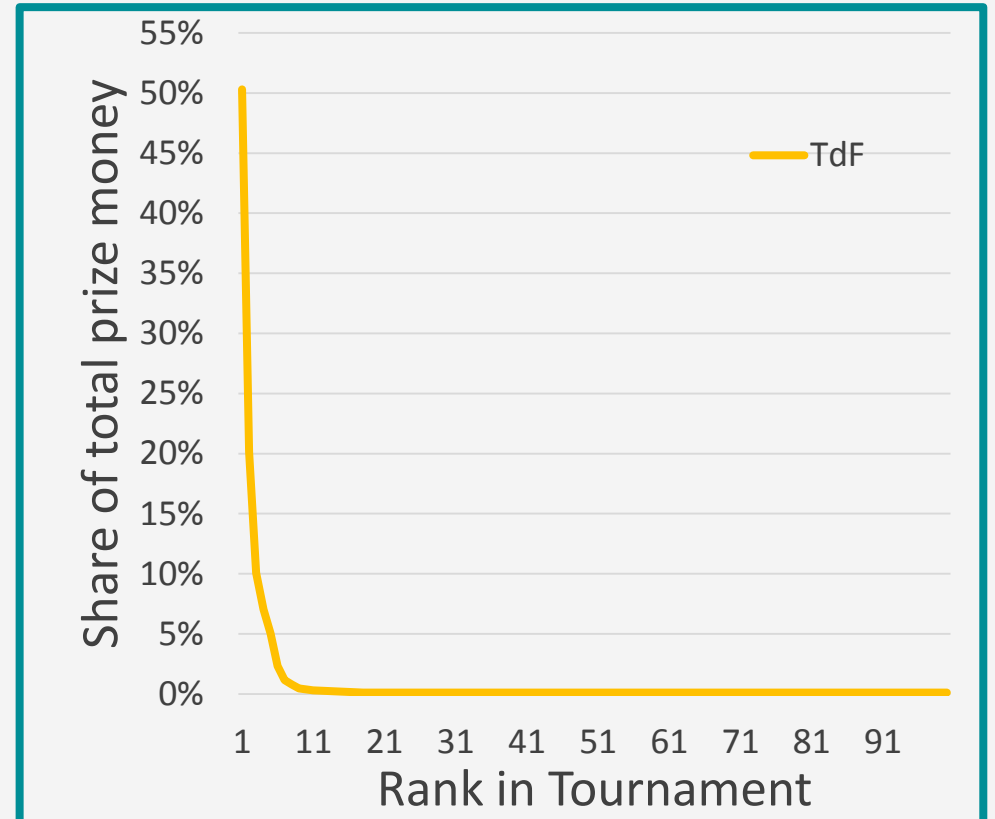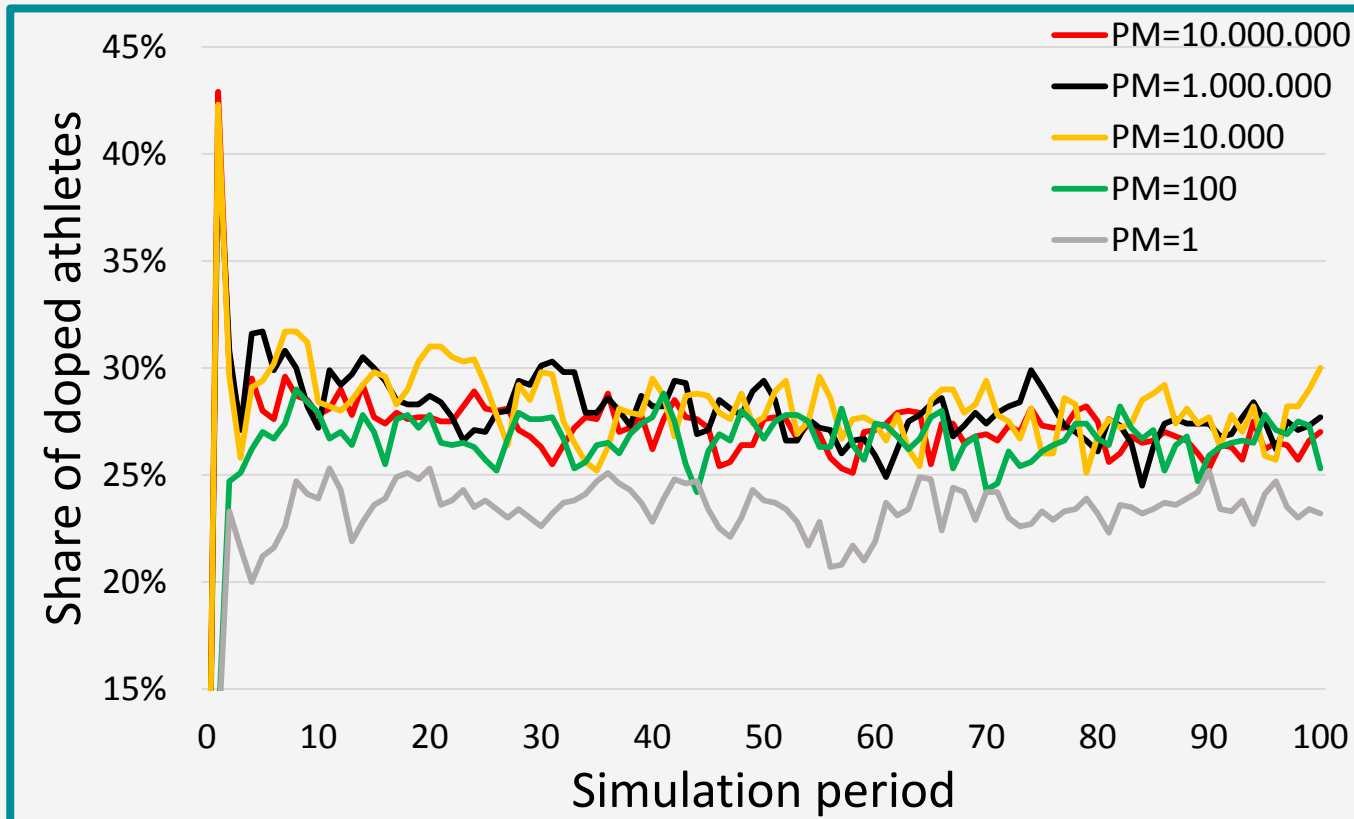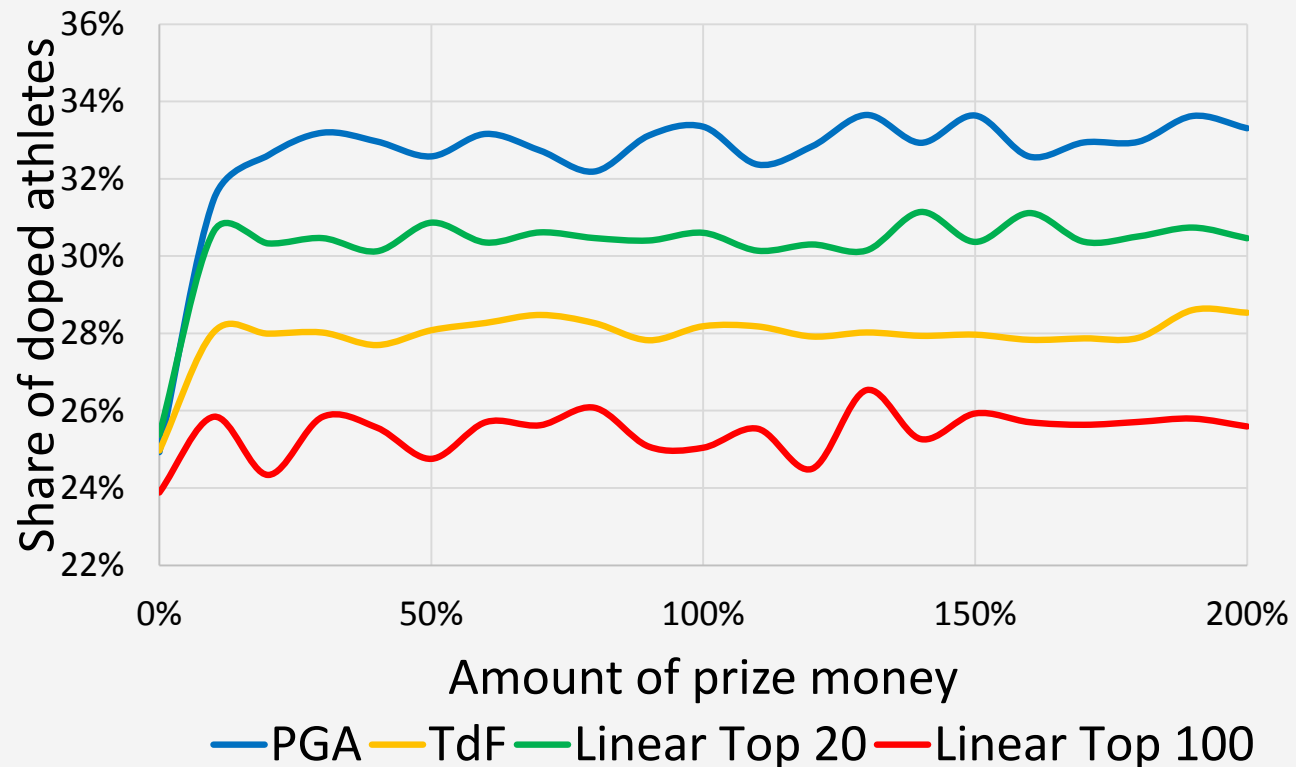
ABM Results – Linear Top 20

ABM Results – Linear Top 100

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**

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