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Doping in Teams: A Simple Decision Theoretic Model

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ABSTRACT

Background. There are many examinations of doping in individual sports but less so in team sports.

Methods. A simple decision theoretic model is constructed and analysed for the doping incentives and decisions of team member in professional sports.

Results. Depending on the detection probability and the punishment of dopers, team sports members do not dope at all, at a medium or at the maximal level. The whole team has a higher incentive than an individual team member that at least some of its members dope.

Conclusion. The doping incentives are different in team sports compared to individual sports. That there are less proven cases of doping in team sports could be because doping is less effective or because the incentives to cover it are higher than in individual sports.

Keywords: decision, doping, incentive, sport, team.

INTRODUCTION

There are not many proven cases of doping in team sports besides bicycling with its peculiarities. There are even fewer academic studies of doping in teams although the financial stakes are much higher in professional team sports than individual sports. To the best of my knowledge, there is no theoretical model of doping in teams as yet, although it would be relevant not only in sports but also for other kinds of fraud as in creative accounting or political promises. If one models teams as acting like one man, the extensive literature of doping by individual athletes can be applied. Then there should be the same incentives for doping. One reason for finding less doping in team sports could be that it is less effective in these sports because there are important skills like a feel for the ball or social competence that can be less enhanced by doping. Nevertheless, more physical strength and endurance are advantages in team sports, too, such that drugs boosting them could be quite attractive.

The following theoretical model tries to capture the most important aspects of doping in a team context. In the next section the doping decision of one team member is analysed. The third section is about the doping interests of a whole team. The last section concludes.

Doping Decision by a Team Member

It is assumed that there are several (at least two) sport teams that participate in a Tullock contest. This means team i wins the prize G with the probability

$$(1) \qquad \frac{M_i}{M_i+M_{-i}} \cdot \frac{M_i}{M_i+M_{-i}} \cdot \frac{M_i}{M_i+M_{-i}}$$

Mi is the strength of team i, e.g. its market value, M-i is the combined strength of all other teams. In reality there can be several prizes, making the model more complicated without changing the main results.

Team member j gets g, a fraction of G, in case of a win. His (or her, but most and the best paid professionals in teams sports are males) market value mj is part of Mi. It consists of his given talent and optimal (maximal) effort that is observable. At least the performance is observable and shirking regarding the effort is not worthwhile for most professional sportsmen. However, shirking by the way of doping could be worthwhile because j is paid a fraction a of his perceived mj that may also include unobservable doping d. Thus the only decision of j is about his doping level d ≥ 0. Therefore he maximises his utility

$$(2) \qquad U_j = \frac{M_i+d}{M_i+d+M_{-i}} g + a(m + d) - q(d)S.$$

q(d) is the probability that his doping is detected, and S denotes the punishment in case of detection. S may also include health effects and *q(d)* includes then the risks for them.

In the following a linear relationship between *q* and *d* is assumed:

$$(3) \qquad q(d) = rd$$

with $q(d) = 1$ for $d \geq \frac{1}{r}$.

The doping levels of all other players are taken as given and part of Mi and M-i. A game theoretical analysis in which every doping decision depends on all others is much more complicated and probably less realistic, especially if there are many teams and sportsmen. Every single team member can only observe his own doping and the public performance of the other players. This performance is important for him and his team, not its source in talent, effort or doping.

The first-order condition for the optimal *d** for j is:

$$(4) \qquad \frac{\partial U_j}{\partial d} = \frac{M_{-i}}{(M_i+d^*+M_{-i})^2} g + a - rS = 0.$$

The first term is positive such that doping will be maximal if

$$(5) \qquad a \geq rS.$$

Otherwise, the following holds:

$$(6) \qquad d^* = \sqrt{\frac{M_{-i}g}{rS-a}} - M_i - M_{-i}.$$

If (6) is negative, that is

$$(7) \qquad (M_i + M_{-i})^2 > \frac{M_{-i}g}{rS-a},$$

then *d**=0.

This means that depending on the parameters everything is possible, no doping at all, some doping or even the maximal possible amount of doping if the punishment for doping is lower than its gains even if one is caught.

Doping Interests of a Team

At least European sport teams do not maximise profits but want to win the tournament including G. Therefore a team wants to maximise its market value, perhaps increased by *d*:

$$(8) \qquad U_i = \frac{M_i+d}{M_i+d+M_{-i}} G + M_i + d.$$

As long as no more than two team members are caught doping there is no formal penalty for the team but only for the caught individuals. That means a team as well as its coach and functionaries have some interest in doping of at least one or two of its members. This lowers the risks of doping by any or even all team members for the team because it is unlikely that all of them are caught at the same time. Moreover, doping by only one or two team members is risk free for the rest of the team such that it is strictly better for the team than no doping at all. If three members dope all the same amount *d* (in this case not included in *Mi*), the utility of the team is:

1 Waddington/Malcolm/Roderick/Naik (2005) find that English football players use much more recreational than performance enhancing drugs, whereas Malcolm/Waddington (2006) indicate that there are systematic doping programmes at some leading European football clubs.

2 Moral values and social expectations are also important in the doping decision, see Sipavičiūtė/Šukys (2019), and they could be different between team and individual sports.

3 See Tullock (1980).

4 In the following analysis doping d by j is not included in M i .

5 It is possible to model disutility of effort and possible shirking (in long-term contracts). See for shirking in sports for example Krautmann (1990), Frick/Dilger/Prinz (2002) or Berri/Krautmann (2006).

6 For doping in a simple game structure (of the Prisoners' Dilemma) see Berentsen (2002) or Haugen (2004). For a general decision-theoretical model see Dilger/Tolsdorf (2004) or Dilger/Frick/Tolsdorf (2007).

$$(9) \quad U_i = \frac{M_i+3d}{M_i+3d+M_{-i}} G + M_i + 3d - q(d)^3 S_j.$$

Comparing (9) with (2), a team profits more from d than its members as long as Sj is not very over-proportional higher than S. Moreover, it does not matter for the team whether three, more or even all team members are caught because the penalty for the team is the same. Given doping by many other team members, to abstain by oneself is less worthwhile.

CONCLUSIONS

For the individual team members it is most important what doping brings for sure (*a*) in relation to the detection probability (*r*) and punishment (*S*). The rewards for team success (*g*) are less important because there is a market for players and their talents. This model assumes that the individual market value influences the payments to a player and can itself be increased by doping.

The whole team profits by doping of one or two teammates because there is no penalty for it. Even if three or more team members are doping it is not sure whether all of them are caught. For other teammates the effect of doping by one of them is ambivalent. The winning probability of the team increases but their own place in the team or even league could suffer if others get better by doping (more).

That there are so few convicted dopers in team sports could mean that doping is not worthwhile there. Even if the incentives for effective doping could be higher than in individual sports, doping is less effective in team sports and the competition could be less intense. Alternatively, the detection probability is very low, especially since the incentives for covering up doping including political reasons are even greater in team sports than in individual sports. Therefore, it would be most important to change these incentives to make doping less attractive not only for team members but also for whole teams, their trainers, clubs and sports officials.

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[7] In (9) it is assumed that the detection probability of each team member is independent of each other. If this is not the case, the cumulated detection probability for three sportsmen could be higher.

[8] Less competition makes doping less attractive because both a sure winner and a certain loser do not have to take the risks of being caught doping, cf. Dilger/Tolsdorf (2010).

[9] Morente-Sánchez/Zandonai/Zabala Díaz (2019) present empirical evidence that doping could be more prevalent in football than officially acknowledged.

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