
Article

Nobody's Innocent: The Role of Customers in the Doping Dilemma

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Abstract

Customers who boycott an organization after some scandal may actually exacerbate the fraud problem they would like to prevent. This conclusion is derived from a game-theoretic model that introduces a third player into the standard inspection game. Focusing on the example of doping in professional sports, we observe that doping is prevalent in equilibrium because customers undermine an organizer's incentives to inspect the athletes. Establishing transparency about doping tests is necessary but not sufficient to overcome this dilemma. Our analysis has practical implications for the design of anti-doping policies as well as for other situations of fraudulent activities.

Keywords

inspection game, doping, professional sports, scandals, cheating

Introduction

When fraudulent activities are detected in some organization, the customers have to make a decision. Either they continue the relationship with this organization or they boycott it. Behaving in the latter way, that is, reacting to scandals

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with a withdrawal of support, can be expected to reduce the extent of fraudulent activities (since the potential loss increases). As we will show in this article, however, the effect might just go into the opposite direction: Critical customers who withdraw support after a scandal unintentionally trigger fraudulent activities. This conclusion follows from a game-theoretic model that extends the standard inspection game by an additional player.¹ We carefully analyze and discuss this model focusing on the example of doping in professional sports.

Sport events, such as the Olympic Games, have grown to a size of substantial economic importance. Thereby the use of performance-enhancing drugs (doping) is considered as a risk for the sports industry. There are at least three reasons why it is socially desirable to reduce the extent of doping (cf. Preston & Szymanski, 2003). First, as it is well known, the use of performance-enhancing drugs can lead to serious health problems for the athletes. Second, athletes often serve as role models.² Thus, a doped athlete is neither in the best interest of parents nor would she give the right image for a sponsoring company. Closely linked to that point is the third argument: An important character of sport is that it becomes uninteresting if athletes systematically violate the rules.³ Given these arguments, it is not surprising that even the United Nations and the European Commission are interested in anti-doping policies.⁴ The most important scientific questions on doping concern (i) the actual extent of doping—whether the use of performance-enhancing drugs is an exceptional practice of some delinquent athletes or a common practice—and (ii) instruments to reduce the extent of doping.

Despite the rich set of anecdotal evidence, empirical studies about doping are rare. It seems very hard to collect data of high quality. Those few studies that try to assess the extent of doping empirically make estimations that often strongly exceed the public perception (Pitsch & Emrich, 2012; Pitsch, Emrich, & Klein, 2007; Striegel, Ulrich, & Simon, 2010).⁵ Theoretical approaches to the doping issue have acknowledged that decisions to dope are not independent of decisions of other actors such as other athletes or control agencies. Game theory provides tools to analyze such situations of strategic interaction. The primary focus is thereby given to the interaction among athletes. Since the pioneer work of Breivik (1992), this interaction is often modeled as a prisoner's dilemma, where to dope is the dominant strategy (cf. Bird & Wagner, 1997; Eber, 2008; Haugen, 2004).⁶ Extending this approach, game theory is also used to analyze the interaction between athletes and an organization which decides upon conducting doping tests. This is usually modeled as an inspection game (Berentsen, Bruegger, & Loertscher, 2008; Kirstein, 2014).⁷ In an inspection game, there is no pure strategy Nash equilibrium because athletes want to dope without being detected, while the control organization tries to detect doping without testing clean athletes. Thus, mixed strategy equilibria, (respectively, perfect Bayesian equilibria) are used, which predict an intermediate level of doping.

We build on the previous game-theoretic work on doping but take the analysis one level further by introducing *customers* as an additional player into the game. Customers are highly important because they finally make professional sports economically viable. Consider a sports event from which customers turn away their interest. This event does not only suffer of less ticket and merchandise revenues, it will also become less attractive for media companies that report from the event and for companies that sponsor the event. In the Appendix, we present several pieces of evidence for the importance of customers. In particular, the recent history of the Tour de France, the world's most famous cycling race, suggests that the reaction to the disclosures of systematic doping practices is the *withdrawal of support* from several stakeholders. For many other disciplines and events, this scenario has not happened, but it seems to be always present as a *threat*. Importantly, already the threat of withdrawing support is sufficient to significantly affect the incentives to dope, as we show in this article. Despite their essential role, previous studies (to the best of our knowledge) have not included customers as a player in an inspection game. This article closes this gap and explicitly analyzes the *role of customers* for the incentives to dope (to cheat in a different context).

In our model, customers support a sports event as long as there is no doping scandal. After a scandal, we assume that customers would withdraw their support (and contrast this case from the benchmark case of noncritical customers who always keep supporting). One might conjecture that the behavior of critical customers induces incentives for organizers and athletes to avoid doping since this increases the costs of doping for both athletes and organizers. However, our analysis reveals that the opposite is true: Under mild assumptions, the unique outcome of the game is that athletes dope, while organizers make insufficient effort to test them. Because our assumptions are very parsimonious, this result is robust against many changes in the specification of utility. The intuition is simply that customers who can withdraw their support constitute a threat to the organizers such that they avoid uncovering (the full extent of) doping.

We then investigate how to change the institutions in order to support a doping-free equilibrium. It turns out that establishing transparency serves this purpose: If customers can observe whether there were serious doping tests, even if they turned out to be negative, then there is a doping-free equilibrium. However, this equilibrium is not unique—there is still an equilibrium involving doping. To rule out all doping equilibria, it would be necessary to have a different kind of customer behavior, not only different institutions. We discuss the real-world predictions of this model and the practical implications of its results for currently debated anti-doping policies.

The remainder of the article is organized as follows: The second section presents the model. The third section establishes the main results, thereby characterizing the doping equilibrium. The fourth section studies a change of institutions that admits a doping-free equilibrium. The fifth section concludes.

Model

Considering benefits from professional sports, there is a large set of stakeholders: sports associations, team sponsors, event organizers, event sponsors, media, spectators, anti-doping agencies, doctors, politicians, and so on. In our model, we restrict attention to three types of players: athletes, organizers, and customers. Athletes can decide between doping and staying clean, whereas doping is defined as the use of illicit substances or methods.⁸

In our model, organizers represent those actors who decide whether to conduct serious doping tests or not. Thus, testing stands for systematically attempting to detect and punish doped athletes. An organizer in that sense is the World Anti-Doping Agency (WADA).⁹ In several disciplines, the National Anti-Doping Agencies (NADAs) have a major role in organizing doping tests of their athletes. In other disciplines, the sports associations or the event organizers are the key players in organizing systematic doping tests.¹⁰ Consequently, organizers in our model represent anti-doping agencies, as well as organizers of sports events and sports associations. Indeed, anti-doping agencies are not independent of these organizations (Eber, 2002; Preston & Szymanski, 2003); and with respect to the decision we study here, they have similar interests or they can simply not conduct serious tests without the collaboration of the event organizers or the sports associations.¹¹

Customers can decide upon staying a supporter or to withdraw support, for example, not to continue watching an event on TV, not to further buy merchandise products, or to quit a membership in a club of supporters. Besides spectators, we can also subsume sponsors and the media (who broadcast or report about the sport events) under the term customers. A withdrawal of each of these three actors can trigger the withdrawal of the two others. Sport events cannot survive without sponsors, withdrawal of the media restricts the access of the customers, and finally, sport is only attractive for sponsors as long as there are customers. To make the arguments as clear as possible, we focus on one representative customer and we also study only one representative organizer and one representative athlete (such that the strategic interaction between athletes is only presented in a highly reduced form). The extension to multiple players of a type would not qualitatively affect the results, but it would affect the ease of illustration. Therefore, we interpret the behavior of a representative player as the behavior of the athletes, the organizers, and the customers (in plural).

The timing of the players' actions is as illustrated in Figure 1. First, athletes decide on doping; then organizers decide on testing; and finally, customers decide upon staying. The information set of the organizers indicates that they do not observe the action of athletes. Thus, the moves of athletes and organizers can also be considered as being simultaneous. In our model, testing means that a doped athlete is detected and punished. If the history in this first stage is (*Dope*,

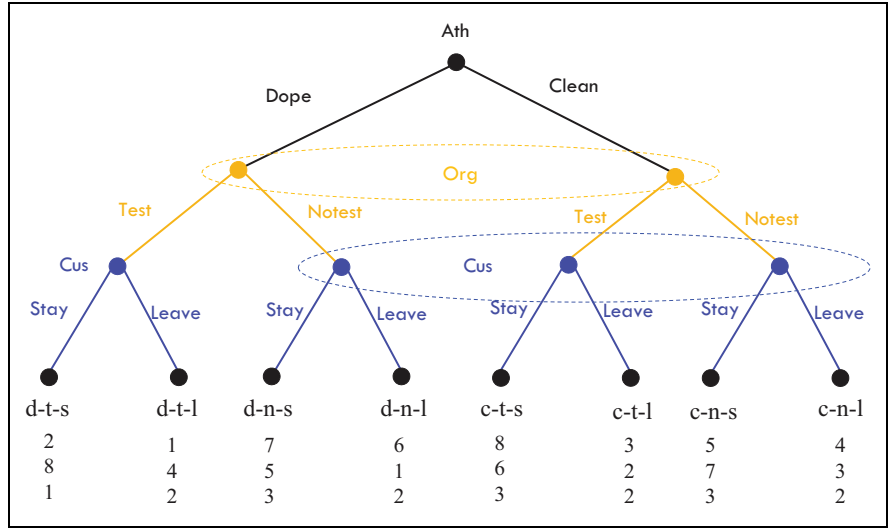


Figure 1. Structure of the game and an example for payoffs.

Test) we call it a “scandal.” All other histories, that is, (*Dope*, *Notest*), (*Clean*, *Test*), and (*Clean*, *Notest*), are no scandal. Since doping tests and their outcomes are not transparent to the public, customers cannot distinguish between the three possible histories if there was no scandal.¹² This is captured by the information set consisting of three nodes. As Figure 1 shows, this game has eight potential outcomes, which we label in the following way: d-t-s, d-t-l, d-n-s, d-n-l, c-t-s, c-t-l, c-n-s, and c-n-l as also illustrated in Figure 1. The depicted payoff vectors are in the order athletes, organizers, customers and only present one possible example.¹³

While athletes and organizers have two strategies each $\{\textit{Dope}, \textit{Clean}\}$, respectively $\{\textit{Test}, \textit{Notest}\}$, customers can choose between two actions in two information sets, which yields four strategies. We denote them by $\{SS, SL, LS, LL\}$, where, for instance, *LS* stands for action *Leave* in the first information set (after a scandal) and action *Stay* in the second information set (after no scandal). The wording “leave” is a bit strong in the sense that it is not necessary that customer support is fully lost with this action, but only that it becomes significantly smaller compared with the action *Stay*.

The Doping Equilibrium

In our analysis, we focus on pure strategies and employ the notion of subgame perfect Nash equilibrium (SPNE). When the extension to behavioral strategies, where

agents can continuously mix between actions, and the refinement of perfect Bayesian equilibrium yield different results, we make this explicit. We will introduce assumptions on the players' preferences step by step to clarify that mild assumptions are sufficient for some results (equilibrium), while stronger assumptions are needed for others (inefficiency).

Existence of a Doping Equilibrium

We are most interested in the kind of customers who withdraw their support after a scandal but not otherwise. This idea is covered by Assumption 1 which makes mild assumptions on the preferences of all the players.

Assumption 1: For the players' preferences, we assume the following:

Ath: $d-n-s \succ^{Ath} c-n-s$, that is, athletes prefer to dope if not tested; and $c-t-s \succ^{Ath} d-t-l$, that is, athletes prefer to be clean and tested, while customers stay, over being doped and tested, while customers leave.

Org: $d-n-s \succ^{Org} d-t-l$, that is, a scandal combined with the loss of customers is worse for the organizers than undetected doping where customers stay; and $c-t-s \succ^{Org} c-n-l$, that is, testing clean athletes with customers support is better for the organizers than not testing clean athletes when customers leave.

Cus: $d-t-l \succ^{Cus} d-t-s$, that is, customers prefer to withdraw support after a scandal; and $d-n-s \succ^{Cus} d-n-l$, $c-t-s \succ^{Cus} c-t-l$, and $c-n-s \succ^{Cus} c-n-l$, that is, customers prefer to stay if there is no scandal.

Assumption 1 is easy to justify. The assumption that athletes dope if there are no tests follows from the standard assumption in the literature that the benefits of doping exceed the costs, even if there were tests (e.g., Maennig, 2002).¹⁴ Organizers might existentially depend on customers' support such that they would probably prefer any outcome where customers stay (i.e., $d-t-s$, $d-n-s$, $c-t-s$, and $c-n-s$) over any outcome where support is withdrawn (i.e., $d-t-l$, $d-n-l$, $c-t-l$, and $c-n-l$). This also means that testing is not too expensive in the sense that the withdrawal of customer support is worse than conducting tests. (This assumption need not be satisfied for sport events that do not belong to professional sports). The preference of the customers to leave after a scandal means that they are bothered by doping scandals, rather than enjoying them.¹⁵ Finally, customers' preferences to stay if there was no scandal reflect the general interest in sports based on the view that customers are unable to distinguish between undetected doping and clean sport even ex post. That is, their payoff of staying a supporter does not depend on whether $d-n-s$, $c-t-s$, or $c-n-s$ is reached because they cannot distinguish between them.¹⁶ And similarly, their payoff of withdrawing their support would not depend on whether outcome $d-n-l$, $c-t-l$, or $c-n-l$ is reached.¹⁷ Given Assumption 1, a customer will stay a supporter if and only if there was no scandal—the behavior under scrutiny. The following proposition shows that then outcome $d-n-s$ —that is, athletes dope, organizers do not test, and customers stay supporters—is an equilibrium outcome.

Proposition 1 (doping equilibrium): Under Assumptions 1 $s^* := (\text{Dope}, \text{Notest}, \text{LS})$ is a SPNE.

The proofs of this and all other propositions are collected in Online Appendix B. The intuition for Proposition 1 becomes apparent when considering the strategic interaction between athletes and organizers, given the customers' behavior. Using the example payoffs from Figure 1, the following Matrix 1 is induced by customers who stay if and only if there is no scandal. This can be contrasted with Matrix 2 that is obtained in the benchmark case that customers unconditionally stay.

		Org		
		Test	Notest	
Ath	Dope	1,4	7,5	(1)
	Clean	8,6	5,7	

		Org		
		Test	Notest	
Ath	Dope	2,8	7,5	(2)
	Clean	8,6	5,7	

In the benchmark case, best response dynamics always follow a cycle, as it can be seen from Matrix 2. This is the classic observation in the inspection game that there is no pure strategy Nash equilibrium. In mixed strategies, there would be an equilibrium where the probability of doping for our example payoffs is one over four. The strategic interaction in our model only differs from the benchmark case concerning the payoff in the upper left matrix entry, which is due to customers who leave after a scandal. As it can be seen from Matrix 1, this breaks the cycle of deviations (in the best response dynamics) and yields the equilibrium in pure strategies established by Proposition 1. In words, customers who leave after a scandal establish a threat to the organizers such that they prefer not to detect doped athletes, even if they had done so in case that the customers were uncritical (i.e., in the benchmark case where the customers always stayed). Thus, the explanation for our qualitatively new result is that the introduction of (critical) customers undermines the organizers' incentives to uncover (the full extent of) doping because organizers anticipate that they would suffer losses in the case of scandals. As a consequence, athletes are not seriously tested and therefore decide to dope.¹⁸

Next, we discuss the robustness (and the practical implications) of the finding.

Robustness of the Doping Equilibrium

Proposition 1 only serves as a clear empirical prediction if there are no other equilibria and if its statement is robust to specification details. We first address uniqueness of the doping equilibrium and then study its robustness with respect to a continuous

(instead of binary) action space, an imperfect test technology, and a different type of customer.

Uniqueness. Concerning uniqueness, we show that assumptions that are standardly made in inspection games are sufficient to exclude other equilibria.¹⁹ These assumptions are collected in Assumption 2.²⁰

Assumption 2 (inspection): In the inspection game, the following assumptions are made on the preferences of athletes and organizers:

Ath: $c-t-s \succ^{Ath} d-t-s$ and $c-t-l \succ^{Ath} d-t-l$, that is, athletes prefer not to dope if there are tests; and $d-n-s \succ^{Ath} c-n-s$ and $d-n-l \succ^{Ath} c-n-l$, that is, athletes prefer to dope if there are no tests.

Org: $d-t-s \succ^{Org} d-n-s$ and $d-t-l \succ^{Org} d-n-l$, that is, organizers prefer to test the athletes if those are doped; and $c-n-s \succ^{Org} c-t-s$ and $c-n-l \succ^{Org} c-t-l$, that is, organizers prefer not to test if athletes are clean.

Assumption 2 is partially redundant with Assumption 1, but further specifies that athletes prefer not to dope if tested and that organizers prefer to test if and only if athletes are doped. This reflects that organizers are willing to detect doping, while testing is costly. The example payoffs provided in Figure 1 satisfy both Assumptions 1 and 2.

Proposition 2 shows that the mild Assumption 1 and the standard Assumption 2 are powerful enough to rule out any equilibrium besides the previously found doping equilibrium.

Proposition 2 (uniqueness): Suppose Assumptions 1 and 2 hold. Then $s^* = (\text{Dope, Notest, LS})$ is the unique SPNE.

Next, we address robustness of this result against three natural variations of the model.

Continuous actions. In reality, customers might decide on the extent to which they still support, which is a richer action space than just the binary choice of *Stay* or *Leave*. In order to relax the assumptions of binary actions for each player, we consider behavioral strategies. Under Assumptions 1 and 2, however, this does not affect the result. In equilibrium, athletes dope with probability 1, organizers test with probability 0, and customers certainly leave after a scandal and stay in the absence of a scandal.

If customers *preferred* to partially reduce their support after a scandal, the question is whether the reduction is negligible such that we are in the benchmark case or whether the reduction is significant such as in our model where organizers try to avoid scandals (cf. Assumption 1: $d-n-s \succ^{Org} d-t-l$). In the former case, we would have an equilibrium in which players randomize, in the latter case, the doping result holds.

Imperfect test technology. Unrealistically, we have assumed that the test technology is free of errors. Extending our game to allow for false-positive and false-negative tests that occur with some probability ε leads to a more realistic model, but not to a different result. As it can be shown using the example payoffs, the unique SPNE is that athletes dope, organizers do not test, and customers stay in the absence of a scandal as long as $\varepsilon < \frac{1}{2}$.²¹

Sophisticated customers. A crucial assumption throughout our analysis is that customers are unable to distinguish between undetected doping and clean sport even ex post such that they prefer outcome d-n-s over d-n-l. Our motivation is not the literal (game-theoretic) interpretation that customers infer that there must be a high level of doping but do not care as long as there is no scandal (even if this might be true for some media companies or sponsors who we also consider in the role of customers). Rather, we consider less sophisticated customers who do not draw these inferences and therefore stay supporters in the absence of positive doping tests, which is arguably much more realistic than customers who leave in that case. For example, most football fans do not seem to be trying to infer the underlying level of doping and to turn away their interest from competitions where it can be suspected that there are insufficient doping controls. However, it is a game-theoretically natural and economically interesting exercise to consider the effects of sophisticated customers who make the inferences by analyzing the situation of strategic interaction and react to their belief about doping.²² Let us briefly elaborate on this alternative (hypothetical) model, which is obtained when reducing the payoff of customers for outcome d-n-s sufficiently to let d-n-l be preferred. As detailed in Online Appendix C.1, there are no pure strategy SPNE in that model. Customers still leave after a scandal, but all other equilibrium choices are mixed actions. The equilibrium belief of customers is that if there is no scandal, then the probability of doping is exactly 50%, such that customers are indifferent between staying and leaving. The probability of doping in equilibrium is $p^* \approx 59\%$. This is smaller than in our model with naive agents, in which the pure strategy equilibrium predicts that all athletes (who are calculating dopers) dope. However, compared with the benchmark case, where customers stay unconditionally (which we also refer to as the inspection game), sophisticated customers lead to an increase in the probability of doping from 25% to 59%. Thus, the qualitative result, that the introduction of customers to the inspection game increases the level of doping, holds for both naive and sophisticated customers. The computed fractions of dopers, of course, depend on the absolute payoffs of the example and suggest that they have some cardinal interpretation.

In sum, it is a robust finding that the presence of customers who might withdraw their support accentuates the extent of doping. Let us now briefly discuss the interpretation and implications of this result.

Discussion of the Doping Equilibrium

The real-world prediction of our simple model is that the number of dopers is large, while the probability of a doped athlete to be caught and punished is close to zero. The real extent of doping within professional sports is hard to assess and thus remains highly controversial. Theoretically, there are strong incentives to use performance-enhancing drugs. In particular, if our second prediction holds—that the probability of being detected and punished is small.²³ The explanation that our model provides for doping is that organizers do not want to uncover the full extent of doping because they anticipate that they would suffer losses in the case of scandals.

Our argument that organizers lack the incentives for serious doping tests is in line with Eber (2002) who argues that organizers have a low effort bias, which becomes stronger the more the authorities weight the economic stakes of professional sport.²⁴ Within his model, athletes form rational expectations about the effort of authorities to prevent doping, which leads to a credibility problem of the organizers (Eber, 2002).²⁵

The prediction that organizers do not seriously test is also empirically difficult to assess. However, there are several pieces of evidence that support this view. For example, consider the anti-doping instrument called world anti-doping code (WADC). This is an international regulatory system that specifies test procedures, and lists of forbidden substances, and accredits doping labs. (The WADC is an instrument of the WADA and we assume for the moment that the WADA is free of incentives issues in the fight of doping.) Implementing the WADC in some discipline would contribute to establishing a strict anti-doping regime. As it turns out, however, the problem of the WADC is the lack of compliance on the part of the international sports associations (Emrich & Pierdzioch, 2013). For example, the following prominent sports associations are reported to refuse the WADC: the International Football Association (FIFA), the International Tennis Federation, and the International Cycling Association (UCI; Emrich & Pierdzioch, 2013).²⁶ Another indication that there need not be serious doping tests although many efforts in the fight against doping are claimed is the charter formulated by a movement called “change cycling now.” The movement consists of sports journalists, former cycling officials, and of former cyclists, including a Tour de France winner. The charter strongly requests that the organization responsible for doping tests becomes independent and thus indirectly accuses the current institution as not being so. The charter expresses this as a principle to create doping-free cycling in the future: “The responsibility for deciding who is tested, when they are tested, and what drugs they are tested for, must reside in an independent entity that is beyond the control of the UCI.”²⁷ Thus, even in cycling, where there is a long list of detected dopers, it seems that the probability of being detected when doped is not that high. We argue that in any discipline, there are incentives to put insufficient effort into the detection of dopers. Let us now return to our model and discuss efficiency.

Pareto Efficiency

Proposition 2 shows that the unique equilibrium outcome is d-n-s, which means that doping is prevalent. Whether this is a socially desirable outcome is not fully uncontroversial.²⁸ Let us discuss the assumptions that decide upon efficiency. In our model, the following assumption assures that d-n-s is indeed inefficient in the strong sense of being Pareto dominated.

Assumption 3: For the preferences of the three players, we assume the following:
 Ath: $c-t-s \succ^{Ath} d-n-s \succ^{Ath} d-t-s$, that is, athletes prefer being tested and clean over being not tested when doped over being tested and doped.
 Org: $c-t-s \succ^{Org} d-n-s$, that is, organizers prefer the testing of clean athletes over not testing doped Athletes.
 Cus: $c-t-s \succeq^{Cus} d-n-s$, that is, customers weakly prefer tested clean athletes over not tested doped athletes.

Note that Assumptions 1–3 are mutually consistent, for example, payoffs of Figure 1 satisfy all three assumptions. Assumption 3 is plausible, but arguably much more controversial than Assumptions 1 and 2. Athletes might dislike doping tests even if they are clean, because they have to be constantly available. However, we assume that athletes are better off by being tested and clean than being doped, for example, because doping would seriously affect their health. Organizers might have high costs of conducting doping tests and they might benefit from the performance of doped athletes such that we had $d-n-s \succ^{Org} c-t-s$. However, we take the view of benevolent organizers who prefer to detect doped athletes (as long as customers stay) such that the relation is just the opposite. Finally, for customers, we keep the view that they cannot distinguish between the outcomes that do not include a scandal. Thus, $d-n-s \sim^{Cus} c-t-s \sim^{Cus} c-n-s$.

Clearly, under Assumption 3, outcome d-n-s is Pareto dominated by outcome c-t-s. Thus, the unique equilibrium outcome in our model is not Pareto efficient. Outcome c-t-s, however, is not Pareto dominated by any other outcome as established by Proposition 3.

Proposition 3 (Pareto efficiency): *Suppose Assumptions 1 and 3 hold. Then outcome d-n-s is not Pareto efficient, while outcome c-t-s is.*

In this subsection, we have shown that we are indeed in a social dilemma situation. The unique equilibrium outcome, which involves doping, is Pareto dominated by a doping-free outcome. The next question is how the institutions can be changed such that the Pareto efficient outcome c-t-s becomes an equilibrium outcome. If the controversial Assumption 3 is not accepted, then the doping equilibrium need not be Pareto dominated. Still, however, it is of high interest to find conditions for a doping-free equilibrium.

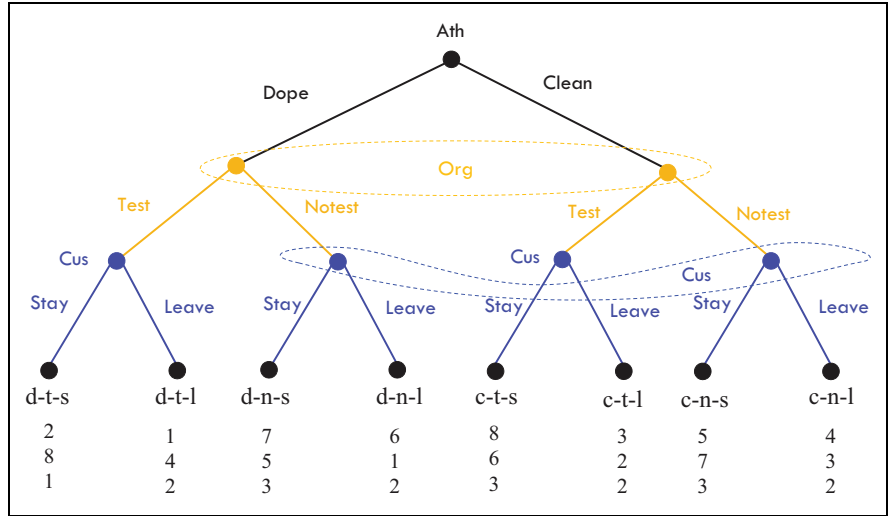


Figure 2. Structure of the game with well-informed customers and an example for payoffs.

Inducing a Doping-Free Equilibrium

We first establish the results and then discuss current policy suggestions in the light of the model.

Change of Customers' Information Structure

In order to induce an outcome without doping, we change the information structure in the game. In particular, we let the customers also be informed about doping tests that turned out to be negative. Consider the extensive game tree illustrated in Figure 2. As before, organizers decide on testing the athletes without observing whether there was doping or not. The customers then decide upon staying a supporter or leaving. The information they have for this decision now consists of three information sets: one is after a scandal (*Dope*, *Notest*), one after a negative test (*Clean*, *Test*), and one after no test, which consists of the two histories (*Dope*, *Notest*) and (*Clean*, *Notest*). This yields eight strategies for the customers, which we denote by $\{SSS, SSL, SLS, SLL, LSS, LSL, LLS, LLL\}$, such that the first letter stands for the action after a scandal, the second letter for the action after a negative test, and the third letter for the action if there were no tests. (The example payoffs in Figure 2 are as in Figure 1.)

In the game with less transparency (studied in the former section), under Assumptions 1 and 2, the unique equilibrium outcome involved doping. The following proposition shows that with more transparency, there is a doping-free equilibrium, as well.

Proposition 4 (doping-free equilibrium): Under Assumptions 1 and 2, there are two SPNE in the game with finer information structure: $\hat{s} := (\text{Clean}, \text{Test}, \text{LSL})$ and $s^{**} := (\text{Dope}, \text{Notest}, \text{LSS})$.

Proposition 4 shows that a change in the information structure in our model is sufficient to obtain a doping-free equilibrium. Thus, the social dilemma can be overcome by establishing transparency. The intuition for this result can be gained from the interaction of athletes and organizers, given customers who play *LSL*. This is represented in Matrix 3 using the example payoffs. Organizers do test, given that they lose customers in the absence of tests.

		Org	
		Test	Notest
Ath	Dope	1,4	6,1
	Clean	8,6	4,3

(3)

Considering behavioral strategies, there is a continuum of equilibria in which athletes are clean, organizers test, and customers stay after no tests with probability $r^* \leq \frac{3}{4}$ for the example payoffs. Thus, there are doping-free equilibria although the probability that customers leave in the absence of doping tests might be low.

However, the doping-free equilibria come with (at least) two caveats. First, they involve suboptimal behavior outside the equilibrium path. Indeed, after no test, the equilibrium strategy of the customers implies to leave (with positive probability), although this is not in line with Assumption 1.²⁹ Second, there is still another equilibrium that involves doping.

The two issues would be solved at once, if customers had different preferences. Suppose, hypothetically, that customers were more skeptical about doping practices and therefore insisted on the proof of clean sports in order to stay supporters. With such customers, the doping-free equilibrium \hat{s} was unique.³⁰ Moreover, there would be no more issue of suboptimal behavior outside the equilibrium path because the customers' threat to leave after no tests would then be credible.

It thus not only takes a better information level for the customers but also a change in preferences, that is, they would have to insist on doping tests in order to unambiguously induce incentives for a doping-free sport.

Implications for Anti-Doping Policies

In the literature on doping incentives, various approaches are suggested to solve the doping issue. Many of them concern the change of incentives on part of the athletes. On one hand, it is suggested to change the punishments or to increase the fines for being doped (e.g., Haugen, 2004). In the light of our model, however, this approach is not effective since in equilibrium athletes are not tested and thus do not get punished. On the other hand, the suggestion is to decrease the benefits of doping, for example, by reducing the prize spread between different ranks or by reducing the

number of competitions (Eber & Thépot, 1999). But also decreasing the benefits of doping only affects the behavior of athletes if it succeeds in making doping less attractive than not doping (i.e., the payoff of doping must be reduced to such an extent that the ordinal preference that we assume in the model switches direction). This seems to be at least questionable.

Thus, for athletes, who are calculating dopers, any anti-doping instrument has to make sure that the probability that doping is punished is sufficiently high. In this article, we have identified the lack of the organizers' incentives to really implement such a regime. A rather radical solution to these misguided incentives is to replace the actors who are responsible for doping tests. Indeed, it is currently debated in several countries (among them Germany) whether to establish a legislation that makes the state and its body responsible for the prosecution of dopers.³¹ In some countries, for example, Belgium, this is already implemented. In principle, the proposed shift of responsibility is a solution to the lack of control since the police and the courts do not have the conflict of interest that NADAs and sports associations have. However, this approach is only fruitful if it is practically possible to fully circumvent the organizers, that is, if the collaboration of sports associations and NADAs is not crucial for the prosecution of doped athletes.

In the fourth section, we have elaborated on a different approach to fight doping. We show how customers can contribute to doping-free sports if they are sufficiently well informed. In particular, we require information about doping tests which admits customers to condition their support for the sports event on the presence of doping tests (as illustrated in Figure 2). Whether or not customers really insist on doping tests, then determines the extent of doping in equilibrium (Proposition 4). Thus, a direct implication of our model is that *transparency* about the doping tests and their outcomes should be established.

This requirement is not satisfied in professional sports today. Most of the data that are publicly available only contain cases of detected doping but not information about the extent of testing. For example, the Internet Anti-Doping Database created by Norwegian sports journalist Trond Husø contains more than 5,000 cases, but mostly of detected dopers. In the absence of doping scandals, this does not allow customers to discriminate between clean sports and undetected doping (such as illustrated in Figure 1).

One type of actors who is in principle capable of establishing transparency are sports associations that we study as organizers in our model. However, as argued previously, such organizations lack incentives to do so. Dilger and Tolsdorf (2004) and Striegel, Ulrich, and Simon (2010) assume that their lack of compliance is one reason why data on doping are so limited. In order to achieve more transparency, the WADA could open the access to their database called ADAMS. ADAMS was introduced to simplify the organization and realization of doping tests.³² Currently, only certain actors of the immediate sports environment are allowed to use ADAMS. Opening the access to ADAMS seems to be a cheap way to establish transparency, while such a policy might involve several new issues, including the

violation of privacy rights. Moreover, it can be difficult or costly to understand and interpret the data for customers. A much simpler suggestion is that the WADA makes public to which extent sports associations and NADAs comply with anti-doping standards. This could be a simple rating that gives customers a clear signal about which disciplines and events are credible in their fight against doping. Of course, this requires independence on part of the WADA, which is also doubted (cf. Eber, 2002; Preston & Szymanski, 2003), but, in principle, we conclude that there should be an independent rating or certifying agency that officially measures to which extent certain sports events have implemented an anti-doping regime. Whether or not doping prevails in the future is then dependent on the customers' preferences.

Concluding Remarks

In this article, we have extended the inspection game (cf. Avenhaus, Von Stengel, & Zamir, 2002) by a third player: customers, who can withdraw their support. As it is shown in the application of doping in professional sports, the behavior of critical customers accentuates the fraudulent behavior.³³ Customers who are ready to leave after a doping scandal undermine the organizers' incentives to test athletes on performance-enhancing drugs and to convict them on doping. As a consequence, athletes have stronger incentives to dope although this need not be in the best interest of any of the three types of players. Our analysis substantially strengthens the argument already outlined by Eber (2002) who comes to the following conclusion: The authority responsible for doping controls "may have some temptations to slacken its antidoping effort when confronted with doping affairs to preserve the economic value of the shows (e.g., the Olympic Games organized by the IOC [International Olympic Committee]). Knowing that, athletes may rationally not believe in strong antidoping policies and may then continue to choose high levels of doping." Our analysis of incentives suggests that the few spectacular cases of convicted dopers are not delinquent exceptions, but rather unlucky cheaters or scapegoats, because the probability of being detected when doped is low (cf. Preston & Szymanski, 2003). To elaborate on potential solutions for the doping dilemma, we show that a change in the information structure in our model serves to obtain a doping-free equilibrium (Proposition 4). The crucial change is to establish transparency in the sense that customers know whether there were negative tests or there were no serious tests (cf. Figure 2 vs. Figure 1). This allows customers and other stakeholders to condition their support on the presence of serious anti-doping tests. Practically, the required transparency could be established by a certificate or rating that shows which sports events have established a strict anti-doping regime.

However, our model is not restricted to doping and professional sports. In many different industries, for example, textile or food, customers do not know very well the production process of the goods that they buy. In particular, it is hidden whether

the producing companies complied with all standards and ethical norms—except if there is a scandal in the news. Scandals make public, for example, the use of child labor in the production of clothes, as well as the violation of hygienic standards in the food industry. After the detection of such fraudulent activities in some organization, there is a loss of reputation and critical customers may react with a boycott. There are not few contexts, where the agent who is able to detect the potential fraudulent activities is also affected by such a scandal. Consider a company in the role of the organizer, who has business relations with another firm (athlete) that does potentially not comply with certain ethical standards. Detecting norm violations would also undermine the reputation of the company itself. Customers who react with a boycott substantially increase the loss of the company and thereby undermine its incentives to uncover (potential) scandals.³⁴ When there is no other agent who is capable of detecting the fraud without the help of the company, the number of fraudulent activities might even increase. As our model shows, this outcome can be altered if customers are informed about control activities of all companies by some independent institution. Thus, transparency is necessary in order to overcome this type of social dilemma.

Appendix

Some Evidence on the Importance of Customers

Customers of a sports event do not only expect high performances from the athletes but also their compliance to the rules. During the Olympic Games in Barcelona 1992, for example, 91% of 475 interviewed spectators answered that they want to see high performances at the Olympic Games, but a majority of them (58%) considered doping as a *threat* to the Games (Messing and Müller, 1996). For the Olympic Games of Sydney 2000 and Athens 2004, the number of people who agree that doping is a threat has even increased to 69% and 82% (Messing, Mueller, & Schormann, 2008) and doping is considered as the most severe threat for Olympic Games, ranking above terrorism and corruption (Messing, Müller, & Schorman, 2004). This view is not restricted to spectators, but it is also predominantly shared by athletes, students of sports science, and media representatives (Tröger, 2006). But what is the actual “threat” that starts out from doping in sports? Probably such a scenario can be best studied in an event for which it is known that doping is widespread—such as the world’s most famous cycling tour, the Tour de France.

The recent exposure of the doping affair concerning the 7-times Tour de France winner (Lance Armstrong) is just one very spectacular case in a long list of disclosures. In 1998, a whole cycling team (Festina) was excluded from the Tour de France after a large amount of performance-enhancing drugs was found in a team car. In the 2006 Tour de France, an affair centered on a physician (Eufemiano Fuentes) led to the expulsion of several participants and some days after the Tour de France 2006, it

was detected that the winner (Floyd Landis) was positively tested on performance-enhancing drugs. The fact that, in this case, as well as in many other prominent cases, doping delicti became public after the Tour de France, implies that the customers' reaction to the scandal cannot be simply measured by a change of the audience ratings during one Tour (Van Reeth, 2013). One year after the Fuentes affair, the German public sector TV channel quit the live broadcast of that actual Tour de France when a German cyclist (Patrik Sinkewitz) was convicted on doping. Although this TV channel reported from the Tour de France again in the years 2008 until 2011, they finally quit in 2012. The reason for that was a sharp decline in the audience ratings from one year to the next. (While the market share amounted to 13% in year 2008, there was a decline to approximately 9% in 2009.) Not only TV channels, also sponsors reacted with exit. For example, the cycling team sponsor Phonak quit, after their team leader (Floyd Landis) was convicted of doping, and a German cycling team sponsor (Gerolsteiner) quit after two German cyclists (Stefan Schumacher and Bernhard Kohl) were found guilty. A majority of fans supports such reactions of sponsors and TV broadcasters (Solberg, Hanstad, & Thoring, 2010). In sum, the recent history of cycling demonstrates that the reaction to the disclosures of systematic doping practices is the *withdrawal of support* from several stakeholders. This is true for media companies, sponsors, and—last but not least—customers (spectators). It is a notable fact that there are customers who still support the Tour de France despite (or maybe even because of) the doping scandals. However, it seems undeniable that the organizers of the event have suffered substantial losses due to the withdrawal of support of many customers, sponsors, and media companies.

Similar scenarios of withdrawal of support have not happened in most of the other disciplines. As the Olympic Games in London show, the interest in sports and, particularly, in track, and field athletics is huge. This does not mean that track and field athletics is free of doping. For example, the U.S. sprinter Justin Gatlin who sprinted to his personal best in London has a background on doping delicti. Further, the two nearest rivals (Tyson Gay and Asafa Powell) of the star in track and field athletics, Usain Bolt, were convicted on doping in 2013. These cases are not that exceptional: Among 64 world class sprinters on the 100 meters track, Dilger and Tolsdorf (2004) found that 16, that is, 25%, have been convicted on doping somewhere in the period from 1997 until 2002. Also, the U.S. sports leagues for American Football and Baseball (National Football League and Major League Baseball) have to deal with some doping scandals. For example, baseball star Alex Rodriguez was suspended for 211 matches until the end of season 2014 because of the suspicion that he consumed banned drugs.

It seems that, despite such cases, the public perception in many disciplines is that most of the athletes do not use performance-enhancing substances. For example, in the year 1988, the most prominent 100 meters track star Ben Johnson was convicted on doping, while during the next Olympic Games (in Barcelona 1992) only every fourth or fifth spectator (22%) agreed that doping and manipulation are determining factors of the Olympic performances (Messing & Müller, 1996). In professional Tennis or Soccer, doping is rarely a topic at all.

Concerning the Tour de France, in contrast, most of the TV spectators (89%) in a survey assumed that doping is a common practice. (These figures are reported by a German newspaper and can be found at <http://www.zeit.de/online/2007/28/tour-de-france-medienkritik>, last accessed: July 30, 2014.)

If the public perception of clean sport is critical for customers and other stakeholders to keep their support, then organizers have strong incentives to avoid a list of scandals comparable to the one of the Tour de France. Hence, the critical role of customers lies in their potential to withdraw support. This is exactly the aspect of customers that is incorporated in our model.

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Notes

1. Inspection games are discussed by Dresher (1962), Maschler (1967), Tsebelis (1989), and Avenhaus, Von Stengel, and Zamir (2002), among others.
2. Results of an online survey reveal that spectators require that athletes serve as role models for a clean and doping-free sport (Emrich, Pierdzioch, & Pitsch, 2014).
3. As a survey on the Olympic Games shows, spectators, fans, and so on, want to see records and high performances but only under compliance of the rules (Messing & Müller, 1996).
4. The United Nations Educational, Scientific, and Cultural Organization has established a sizable fund dedicated to “the Elimination of Doping in Sport” (cf. <http://www.unesco.org/new/en/social-and-human-sciences/themes/anti-doping/fund-for-the-elimination-of-doping-in-sport/projects/>, last accessed: July 1, 2014). The European Commission and its member states are currently developing an anti-doping law based on the view that doping is “seriously undermining the principles of open and fair competition” (cf. http://ec.europa.eu/sport/policy/societal_role/doping_en.htm, last access: July 2014).
5. For example, Striegel et al. (2010) found an 8 times higher number of drug abuse than it is officially confirmed.

6. Interaction among heterogeneous athletes is analyzed by Berentsen (2002), Berentsen and Lengwiler (2004), and Kräkel (2007).
7. The fact that in the inspection game there is only one athlete does not mean that the ideas from the strategic interaction between athletes are neglected. In particular, it is assumed that under no controls, athletes prefer to dope, which is based on considerations of competition among athletes.
8. The definition of doping is itself an issue that is worth a discourse (cf. Eber, 2006). The binary decision to dope or not to dope is a simplification of a set of decisions that might also be considered as gradual. The simplification can be justified by at least two reasons. First, it is often unambiguous whether an athlete uses illicit substances or not. Second, there is a subjective interpretation of whether the athlete considers that he or she cheats or not.
9. The World Anti-Doping Agency (WADA) is an international institution founded in 1999 in Lausanne. Its main task is the worldwide coordination of anti-doping activities such as detection, deterrence, and prevention. Moreover, the WADA coordinates doping tests with National Anti-Doping Agencies.
10. For a richer description of the institutional setting, see Emrich and Pierdzioch (2013).
11. Eber (2002) suspects that even the WADA is not independent: “The problem is that WADA [. . .] is a product of the IOC [International Olympic Committee] and is probably far from being independent of it.”
12. The fact that sometimes sport events publicly announce the number of tests they have carried through does not contradict this assumption. Still, customers do not know whether the athletes have been seriously and systematically tested.
13. The specification of explicit payoffs or utility levels forces us to make many assumptions that are not at all necessary for the derivations of the model implications. The set of assumptions we will really use leaves room for many preference orderings and only one of them is represented by the example payoffs in Figure 1. The advantage of such a parsimonious approach is that eventually derived results are robust against changes of specification details.
14. This interaction between several athletes is often modeled as a prisoner’s dilemma. There the dominant strategy is to dope, as we assume this behavior here for the case of no tests and one representative athlete. In reality, there are also athletes who are unconditional nondopers (Pitsch, Frenger, & Emrich, 2010). Their (trivial) behavior is not studied within our model.
15. In reality, there might be customers who enjoy (doping) scandals. We will consider such customers and, equivalently, uncritical customers, who always stay supporters, as a benchmark later on. However, we study a more critical kind of customers here.
16. Basically, this assumption also means that customers do not respond to what they infer about the behavior of other players. Alternatively, we could assume that customers also withdraw their support in absence of positive doping tests, if they infer the use of doping by analyzing the situation of strategic interaction. This alternative assumption and its implications are discussed in the “Robustness of the Doping Equilibrium” subsection.
17. A similar interpretation holds if we consider sponsors and media companies in the role of the customers. Moreover, there is a second interpretation of this assumption for these

actors. It might be that they are able to distinguish *ex post* between different outcomes but do not strongly care about doping as long as it is not officially detected.

18. This result is not due to other explanatory factors since under our assumptions testing can be almost costless, the benefits of doping need not be high, and the disutility of being detected can be huge. Importantly, our argument is not that doped athletes produce higher performances which creates utility for the customers or organizers, although this idea would not alter the result.
19. In an inspection game, an inspectee has to decide whether to comply or deviate from a norm, while an inspector can choose between inspecting or not inspecting the action. To embed this standard game into our notation, we would consider the athlete as the inspectee, the organizer as the inspector, and for the customers which are standardly excluded, we would assume constant behavior. That is, our model differs from the standard inspection game only in that customers sometimes withdraw support, while standardly customers always stay supporter or, alternatively, they never support.
20. Usually, the inspection game is represented by numerical payoffs. This implies additional assumptions to the ones collected here. However, those additional assumptions are neither consensual in the literature, nor are they necessary for our results (as long as we obtain pure strategy equilibria).
21. The proof of this claim can be requested by the authors. The issue of imperfect test technology in doping tests is investigated by Kirstein (2014). He studies a game, in which the enforcing agency receives an informative but imperfect signal about whether an athlete is doped or not.
22. We thank an anonymous referee for this suggestion.
23. In the absence of serious controls, athletes are in the classic (prisoner's) dilemma because they either can get a competitive advantage by doping or they have to assume that their rivals are doped (cf. Breivik, 1992).
24. Of course, there are also other reasons, why detected doping leads to losses. For example, a national sports association might have an interest that athletes from its country are successful in international competition.
25. Concerning customers' perceptions, one way to increase the public credibility of anti-doping activities might be to detect doping cases but very few of them. Indeed, we have not included the idea that the conviction of a few athletes enhances the credibility of clean sport. We have focused on the main effect, which is that the conviction of many athletes undermines the credibility of a sports event or even of a whole discipline. Importantly, we are not arguing that organizers are unwilling to fight against doping, but simply that they have strong incentives not to fully uncover doping activities.
26. The WADA does not have effective instruments to punish organizations that do not comply.
27. The full charter can be found at <http://www.changecyclingnow.org/wp-content/uploads/2012/12/Charter-of-the-Willing.pdf> (last access: July 30, 2014).
28. Savulescu, Foddy, and Clayton (2004) discuss several arguments concerning the usefulness of anti-doping rules and conclude that performance-enhancing drugs should be

- legalized. Concerning fairness, they find that legalization is in line with the “spirit of sport” because it is still the aim to find the best athlete among all competitors.
29. Subgame perfection simply does not rule out this incredible threat. The notion of perfect Bayesian equilibrium would do so and only render s^{**} as an equilibrium.
 30. This observation is formally shown in Online Appendix C.2.
 31. The discussion caught new fire with the recent case of Lance Armstrong.
 32. ADAMS has four main tasks: First, athletes are required to enter their actual whereabouts and other users will be informed about actual infringements against reporting standards (athlete’s whereabouts). Second, it is also possible to manage medical exceptional permissions (Therapeutic Use Exemptions Management). Third, ADAMS informs about doping tests, infringements, and sentences (Information Clearing House). Finally, ADAMS is supposed to ease the scheduling of doping tests and the preparation of doping profiles (Doping Control Platform).
 33. Other counterintuitive results of the inspection game are already known (Andreozzi, 2004; Friehe, 2008; Holler, 1993). They concern the indifference of the mixed strategy Nash equilibrium, which implies that a change of payoffs for one player does not affect the equilibrium behavior of this player, but only its opponent’s. Maximin strategies are used to address this issue (cf. Aumann & Maschler, 1972; Holler, 1990).
 34. There is empirical evidence on a similar issue in the context of juridical judgments: An increase in the defined punishment, for example, from prison sentence to capital punishment, can lead to a reduction in the number of convictions.

Supplementary Material

The online appendices are available at <http://jse.sagepub.com/supplemental>

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