Article

An Economist's Perspective on Match-fixing and Self-sabotage in Contests

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Abstract

In this note we provide an economist's perspective on self-sabotage in contests. When such self-sabotage is engineered at the behest of a third party for financial gains from betting markets, we see the twin problems of self-sabotage and betting corruption, which are known as the problem of match-fixing in sporting contests. We discuss the hidden incentives that different agents face in this environment. To curb match-fixing, legalization of betting would be a positive step followed by intelligent enforcement. Further, using a simple model we demonstrate that the risk of match-fixing diminishes with the number of teams involved in the contest.

Keywords

Sports betting, corruption, bribery, match-fixing, self-sabotage

Introduction

In the summer of 2000, the world of cricket was shaken by a series of revelations about how the then captain of the South African team was receiving money from international betting syndicates and bookmakers to make certain 'unusual' decisions, which appeared 'bold' to unsuspecting spectators but were essentially self-sabotaging. He had also offered money to some of his teammates to deliberately under-perform. Further revelations dragged two other star players' names into the scandal—the then captains of India and Pakistan. The main aim of the betting syndicates was to place large sums of money in the London betting market or the underground Asian market on 'very unlikely' events; but with secret agreements with the team captain(s) these unlikely events were made possible and bets were won. The 2000 betting scandal prompted the International Cricket Council to introduce anti-corruption vigilance (ahead of any other sports) across all of its major tournaments and in all participating countries. However, betting corruption did not go away. Some more scandals broke involving Pakistani players during their England tour in 2010 and Indian players in the domestic Indian Premier League matches during 2013. These episodes confirmed that the match-fixers are very much around, and it will be a constant battle between law enforcement and illegitimate bookies and betting syndicates, as much as it is a struggle for many players to resist temptations of easy money (BBC, 2013).[1] Incidentally, cricket is the only sport so far that has secured several convictions for match-fixing.

But the problem is not unique to cricket. In fact, there are no major sports in the world that have not been on the news for betting-related corruption. Horse racing in the UK has been marred in 2006 by allegations of fixing by some high-profile jockeys.[2] Tennis got its first major headline in 2007 when a top-ranked (within top 10) tennis player retired hurt (without any visible signs of injury) in a major ATP tournament handing over the match to his little known opponent.[3] In football if the latest scandal at the top level of FIFA is shocking, then the previous reports were even more damaging.[4] Evidence for corruption in US basketball leagues (Wolfers, 2006) and Sumo wrestling in Japan (Duggan & Levitt, 2002) is also available.[5] Last, but not least, snooker enthusiasts were shocked in 2010 when a video footage of a champion player emerged showing him to promise to lose a match in exchange for a large sum of money.[6]

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Given the overwhelming evidence on match-fixing, cheating and rampant fraudulent behaviours, no longer can we dismiss these as random phenomena. A serious exploration of the issues involved is in order, which broadly motivates this paper. We provide an informal analysis of the problem of match-fixing with the allowance of complex and covert interactions between various individuals.

Economic Incentives to Cheat

One may wonder why this is to be seen as an economic problem? The answer is: all contests unleash certain (hidden) incentives other than the obvious one—the prize or reward, and for economists understanding these incentives is vital. These incentives are negative, that is, incentives to cheat. The examples are too many: cheating in exams, taking anabolic steroid in sports, using chemical warfare in battlefields or killing civilians, committing electoral fraud by an incumbent political party and so on. An extension of 'cheating to win' is sabotaging or undermining the opponent's contesting capacity. Pre-emptive strike on enemy positions under some pretexts, preventing opposition parties to run their election campaign, or discriminating against minority students to disadvantage them in the labour markets and demanding women to spend time at home are some of the examples of some sort of sabotage; they undermine (unfairly) others' productive capacity. These negative incentives (i.e., cheating to win) work side by side with positive incentives, such as 'work hard' and 'compete fairly'. Which ones will be dominant depends on how large the prize is, how many prizes there are, what the punishment is for cheating and, of course, how robust the moral and ethical standards of the society are.

'Cheating to lose' is a completely different type of incentive. There are some exceptions where one may simply try to lose for no compensating gains. When one is forced to participate in certain programmes/contests either because of compulsory drafting rule (as is military service in some countries) or by some sort of peer pressure, deliberate under-performance may occur instinctively. A young musical talent may not like to continue her medical study that she joined under family pressure. Another example would be that of a government employee who might prefer to appear 'inefficient' to avoid excessive work in future (even though it is compensated by promotion). But the story of match-fixing involves a third party, an unscrupulous bettor who secretly offers a counter reward in exchange for under-performance. In this note, I aim to offer some discussion of this perverse incentive.

The academic research on betting market has not dealt with this type of corruption until recently. The empirical literature has long been studying a regularity called the 'favourite-longshot' bias in betting. In this phenomenon 'favourites' are seen to generate on average higher returns than the 'longshots'. That is to say, favourites are comparatively under-priced and longshots are overpriced relative to their true probability of winning. If the efficient market hypothesis were to hold, this bias should not exist. But evidence is overwhelming suggesting a violation of market efficiency in betting. See Crafts (1985), Shin (1993), Winter and Kukuk (2008) and Vaughan Williams and Paton (1997) in support of the favourite-longshot bias, and Woodland and Woodland (1994, 2003) for evidence against it. As an explanation of the bias many reasons have been put forward (though very few rigorously tested), and one of these is insider betting. Shin (1991, 1992) was the first author to present a formal theoretical model of insider betting, very much in the spirit of insider trading in financial markets.[7]

However, evidence suggests that match-fixing is a much broader problem than insider betting. In the insider betting models, it is assumed that a specific bettor randomly and privately learns which team is going to win for sure, and then uses this privileged information profitably. But from all well publicized cases of match-fixing it is seen that such acquisition of information is not accidental; it is rather carefully planned (often through a corrupt and criminal network) and targeted. This perspective changes the arguments presented in earlier work. If efforts are undertaken to fix a match, then the efforts can be undone by creating opposite incentives by designing appropriate betting odds, betting rules and anti-corruption laws.

Bag and Saha (2011) were the first to offer a formal model of match-fixing within the framework of Shin (1991, 1992). The framework specifically mimics the setting of a *fixed odds* betting market (prevalent in the UK and its former colonies in Asia and Africa).[8] In a fixed odds market bookmakers post betting odds and receive wager (generally without restrictions on how much a bettor can bet).[9] These odds remain unchanged until betting closes. After the event, the bookmakers settle all the claims; they also need to be prepared for a very large payout (an extreme eventuality) and must maintain a deep pocket. In the Shin-type framework the ordinary bettors are naive in the sense that their beliefs about teams' winning chances are exogenously given, completely unrelated to the true winning probabilities that are known to the bookmakers and a 'special' punter. The special punter after secretly learning the identity of the winning team places his bet on it. Bag and Saha (2011) retain the same assumption about the ordinary punters, but limit the special punter's information gathering capacity. The special punter can probabilistically contact a team and bribe it to under-perform to some extent (but not necessarily lose with certainty) and then bet according to market incentives, which are controlled by the bookmakers.

Bag and Saha (2011) show two interesting results in the context of a competitive market: (a) Competition does not rule out match-fixing. (b) There are contests where bookmakers' competition rules out match-fixing but yields positive profit for the betting houses, which in turn reduce consumers' (i.e., bettors') surplus as well as their market participation. In their follow-up work (Bag & Saha, 2014, 2015) it is shown that in a monopoly environment the bookmakers themselves can (indirectly) orchestrate match-fixing by cleverly aligning the market prices. Some contests may be deliberately exposed to fixing, though all contests can be protected *albeit* at some costs. These apparently negative results are useful to highlight the fact that controlling match-fixing requires paying attention to an array of details, such as the betting market microstructure, sports regulation, players' reward structure and law enforcement.

Preventing Match-fixing

The most important question is: What can be done to prevent match-fixing? There are at least two ways to deal with this problem: (a) cautious pricing by the bookmakers, and (b) adoption of clever enforcement strategies. Regarding the issue of pricing, the work of Bag and Saha (2011, 2014) provides some useful insights. If market prices (i.e., the betting odds) are the main inspiring factor for match-fixing, then the same prices can be used to reverse the match-fixing incentives.

However, the notion of 'market price' is slightly complex in the context of betting. When one places a bet, one buys a claim on a pre-determined sum of money (as implied by the odds) conditional on the realization of the event backed by the bet. If the event does not realize, no claim can be made. Suppose two teams say, *A* and *B*, are playing, and bookmakers offer betting odds of 5:2 on team *A*'s win. This means if one bets 2/(2 + 5) rupees on team *A*, then in the event of team *A*'s win one will get back 1 rupee. That is to say, the price to pay in order to claim one unit of prize (i.e., 1 rupee) is 2/7 rupees. In short, we can call this a 'price' of the bets on team *A*. In the real world, gamblers face (and think in terms of) betting odds; bet price is just an economist's conversion to think of bets like any other financial assets or securities. In this specific example, a gambler would simply translate the betting odds by a statement like this: 'If I put 200 rupees on team *A*, I will get back 700 rupees if team *A* wins.'

Our general point is that in order to prevent match-fixing, the bookmakers will have to raise the bet 'prices' (as explained above) slightly higher than usual, so that the fixers cannot make easy money. Continuing with the example given above, if the bookmakers suspect that team *A* is likely to be bribed to under-perform, then they would raise the betting odds on team *A* from 5 : 2 to say 5 : 4, which translates into a price of 4/9 (2/7). The precise odds revision depends on a whole lot of things including the likelihood of match-fixing as perceived by the bookmakers.

However, there is a cost of setting the prices too high. The bookmaker will lose business from the honest bettors. So there is a trade-off. If the market is dominated by honest bettors, the bookmakers will tolerate some risk of fixing, and prices will not be distorted too much. But more disturbingly, as we have seen in the papers cited above, neither in competition nor in monopoly market prices offer *full protection*. There are many contests that may remain vulnerable to poaching because of cut-throat competition among the bookmakers, or for profit motives of the bookmakers who may wish to defraud the honest and unsuspecting bettors through market manipulations.

In reality, monitoring the bettors' behaviours and betting pattern is as important as setting the betting odds. In the Western economies where betting is legal, betting companies do monitor the betting pattern; any unusual pattern of betting, for example heavy betting to back a very low-ranked team/player, can arouse suspicion, and law permits the betting companies to void all bets provided they gather some evidence of foul play.

In connection with the bet pricing problem, there is an issue of the information structure. In any financial markets, investors' beliefs about the future states of nature drive their calculation of expected returns and guide them to invest in particular assets (or portfolios); betting markets are no exception. So in environments where fixing can occur such factors should be taken into account by the ordinary bettors as well. In the nascent literature that has studied match-fixing with the motivation of betting, a simple assumption is made about honest/ordinary bettors. They are assumed to be naive in the sense that they are unaware of the possibility of fixing, and their beliefs about teams' chances are exogenous, completely unrelated to the Nature's draw of the teams' winning prospects. While they are similar to noise traders of stock markets, the assumption of exogenous beliefs seriously discounts the reality of many sports betting markets. Fans who keep track of their team's performance are generally knowledgeable about its strengths and weaknesses. Hence, their beliefs are not entirely naive.

However, relaxing this assumption and embedding a mass of rational bettors in a tractable model is a challenging task. Having said that, we need to keep in mind that betting can take place not just on 'who wins', but also on many little aspects of the contest, for example, scoreline betting in football (margin of win), runs scored in the first 10 overs of a cricket match, how many seats a political party will win in an election and so on. Most of these are called spot betting or live betting. The assumption of naive bettors can be applied to spot betting, but ideally should be relaxed in the case of win–lose betting. More generally, this is a question of imposing higher orders of rationality among the ordinary bettors. This remains a promising line of research.

The question of enforcement is an interesting one. In our previous work (Bag & Saha, 2011, 2014, 2015) we assumed that the anti-corruption agencies investigate the losing team with some exogenous probability and uncovers bribery with certainty. This assumption helped to keep the main problem of price determination tractable, but it is far from ideal. The probability of investigation (and/or of detection) should be made endogenous by linking it to the extent of self-sabotage that is chosen by the corrupt contestant.

More generally, the argument is that the enforcement agency should act rationally by extracting all available information in the economy. Two key inputs, namely the initial probability of winning of the bribed team and the market prices set by the bookmaker(s), should both be taken into account by the enforcement agencies. For example, if a team is chosen to be favourite by the mother nature, then a surprise defeat (i.e., defeat by a big margin) would call for a bigger probability of investigation. Similarly, the prices set by the bookmakers also reveal what information they might have regarding the threat of match-fixing. If a team's bet price is set too high (relative to its prior winning odds), then it reflects a fact that bookies are fearing attacks by match-fixers on that bet. On the other hand, if a price is too low, then it can be regarded as an invitation to the fixers. Bookies' price setting reflects their private signals regarding the activities of the fixers, and after extracting this information the enforcement agencies can respond with better strategies.

This takes us to an interesting line of inquiry; when the bookmakers know that their prices (which carry their information and beliefs) will be studied by the enforcement agencies, their price setting problem will turn into a signalling game between them and the enforcement agencies. The bookmakers may or may not then distort their prices. In particular, when they are indirectly exposing one bet to attack by the fixers, the last thing they want is attention of the enforcement agencies. They need to disguise their invitation to the fixers. This is a very important, but difficult, line of research.

Legalization of Betting

A related controversial point is legalization of betting. In India and most Asian countries other than horse racing and state/charity-run lotteries, no other gambling activities are regarded legal (barring off-shore casinos). This, of course, has led to a massive underground betting market. India's illegal cricket betting market probably receives much more bets than the UK's legal betting companies. The most important argument in favour of legalization is tax revenue, which is presently lost. It is hard to put a figure on this for obvious lack of data availability; still this could run up to millions of rupees for India. Legalization also helps decriminalization of the betting market. Licensed legal bookmakers will be in business for legal bettors. A particular advantage of legalization, we have argued in Bag and Saha (2015), is the availability of information to the enforcement agencies as well as ordinary bettors. The enforcement agencies can act rationally using the price and all other information as far as possible. However, there is also a need for prudent regulation that should not only regard betting as a legitimate financial investment, but also restrict certain unfortunate behaviours such as betting addiction and compulsive gambling.

It is also possible to think of scenarios where the risk of match-fixing can actually *increase* after legalization. Once an underground activity is made legal, many ordinary citizens would be drawn to it possibly assuming that the state has put in place the required safeguards against frauds. While safeguards can be applied and well-advertised to the satisfaction of the general public, their effectiveness can only be tested by serious fraudsters. In effect, many bettors would overestimate the efficiency of the anti-fraud vigilance and may participate in betting vigorously, which will then attract the attention of the match-fixers.

Clearly, the legalization issue is so complex that on both sides there are some good arguments, and for that reason a proper discussion of it is beyond the scope of this article. Here it may suffice to highlight some pros and cons of legalization; see Table 1.

In the next section, I outline a basic model of betting for a contest that features three teams. The model provides a simple exposition of betting and bribery, and it adds to the existing literature on several dimensions. First, it extends the contest models to three parties and explicitly takes into account an externality in the form of increased winning

Table 1. Pros and Cons of Legalization of Betting

Pros	Cons
Increased tax revenues	More poor will bet
Transparency of betting operations	Increased risk of match-fixing
Scope for proper regulation	Regulation is very complex and difficult
Decriminalization	Increased risk of betting addiction

Source: Author's own.

prospect of all other teams including the non-target ones (i.e., teams on which the fixer will not bet). Second, the interaction between the fixer and the corrupt player(s) of the bribed team determines how much bribe is to be paid and how much self-sabotage is to be done. This way, the extent of self-sabotage is made endogenous. Third, by allowing the detection probability to depend on the extent of self-sabotage we have made detection also endogenous. Lastly, this exercise demonstrates and helps to understand that the number of teams is also an important factor in preventing match-fixing. Greater the number of teams, harder to rig a contest.

Economic Modelling of Match-fixing

There is a betting market populated by a large number of ordinary bettors who provide the main business. The market can be a monopoly or competitive. We do not explicitly model the behaviours of the betting houses/companies. Instead, we take the bet prices as given. One particular type of better, whom we call fixer, has the financial muscle and secret links to reach out to corruptible players and engineer match-fixing. This agent's financial wealth is $z < 1$ and we will assume that his initial information about teams' winning chances are as good as the bookmakers' and the team players' information.

The contest involves three teams with prize of w for each individual member of the winning team.[10] In the absence of any external influence, the probability that team i will win is p_i, $(0 < p_i < 1)$; there is no possibility of a draw. That is, $p_1 + p_2 + p_3 = 1$. These probabilities are drawn by Nature, and the draw is observed by the bookmaker, the fixer and the team players.[11]

Teams cannot *increase* their own probability of winning; but they can *decrease* it through match-fixing. One can build an underlying story of team effort that backs up the winning probability.[12] However, nothing is lost if we restrict our attention to the team probability. We assume that each team has one or more corrupt player(s) who can be bribed to secretly under-perform to a mutually agreed extent so that the team's winning probability drops to λp_i; $(1 - \lambda)$ is the extent of self-sabotage.

When one team 'under-performs', the probabilities of other teams' winning will be enhanced. If there were only two teams, team 1's under-performance will automatically increase the probability of team 2 winning. With three or more teams, the gains of the other (two or more) teams may or may not be equal. Different scenarios are possible. For example, in a round robin league, where everybody plays everybody, under-performance by one team is likely to benefit everybody else. But in a knock out tournament the benefit of under-performance may accrue only to the neighbouring contestants who are due to meet soon following the outcome of under-performance. We keep aside this complication and assume that all other teams benefit equally.

Without loss of generality, consider the case of team 1 being bribed.[13] The altered probabilities are then configured as:

$$p_1' = \lambda p_1,\ p_2' = p_2 + \frac{(1-\lambda)p_1}{2},\ p_3' = p_3 + \frac{(1-\lambda)p_1}{2}. \quad (1)$$

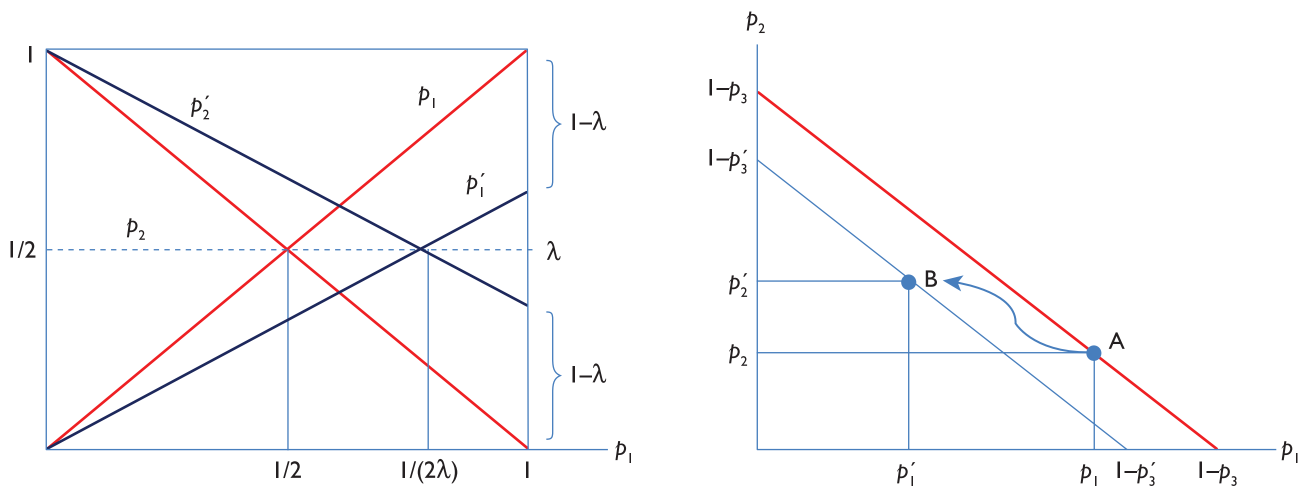
Clearly, $0 \le p_i' < 1$ and $p_1' + p_2' + p_3' = 1$. Team 1's loss of winning probability is equally split up between two other teams.

In Figure 1 we depict how as a result of bribery p_1 is distorted downwardly and other teams' probabilities are increased. In panel (a), we provide the case of two teams. When $p_1 \to 1$, the rigged probability of team 1's winning converges to λ while that of team 2 converges to $1 - \lambda$. In panel (b), we consider the case of three teams. With team 3's probability of winning initially held at p_3 we read p_1 and p_2 from point A. After bribery, as p_1 falls to p_1', p_3 rises to p_3' and hence the line $1 - p_3$ shifts down. The revised p_2 is then read from point B. The probability point moves from A to B. Clearly, $p_2' > p_2$ and $p_3' > p_3$.

Player's Incentive to Self-sabotage

Suppose each team has one corrupt player and he can secretly reduce the team's winning chance up to $\lambda_0 p_i$, where λ_0 is the minimum value of λ that he is capable of ensuring. If he is a pivotal player, like the captain of a cricket team, or the goalkeeper in football, the lowest limit for him could be $\lambda_0 = 0$; otherwise, $\lambda_0 > 0$. Thus, a bribed player will choose a λ from the interval $[\lambda_0, 1)$.

But bribery is risky. An investigation is likely with probability α and a financial penalty of F would follow. The probability of investigation, we assume, is a convex and increasing function of the extent of self-sabotage: $\alpha = a(1 - \lambda)^2$, where $a > 0$ is a parameter. Thus, denoting



a: Two teams

b: Three teams

Figure 1. Rigged Probabilities

Source: Author's own.

$\delta = 1 - \lambda$ we write the expected penalty of bribery as $a\delta^2F$. The justification for the increasing detection probability is that enforcement agencies are watchful and it is harder to inflict greater self-sabotage without leaving clues and arousing suspicion.[14]

A corrupt player's payoff from bribery and self-sabotage is $u = \lambda p_i w + B - a\delta^2F$, while his honest payoff is $p_i\, w$. He will agree to bribery if

$$\lambda p_i w + B - a\delta^2 F \geq p_i w \Rightarrow B \geq (\delta aF + p_i w)\delta, (\equiv \underline{B}). \quad (2)$$

$\underline{B}$ is the minimum bribe the player is willing to accept to under-perform to the extent of $(1 - \lambda)$ or δ. Greater the extent of self-sabotage δ is, higher the minimum bribe he must be paid. Similarly, a higher penalty on cheating (F) or higher prize money (w) would push up the minimum bribe. Also, if p_i is sufficiently high, say greater than 1/3, then team i is a favourite, and the player would demand a much higher bribe than would be the case if team i was not favourite.

However, the actual bribe received by the player as well as the extent of self-sabotage δ are both likely to be determined by some sort of bargaining, such as Nash bargaining, between the player and the fixer. The player is risk neutral and tries to maximize his monetary payoff which is his expected bribe income (including bribe) net of the expected fine, over and above his reservation income which is simply given by expected prize from the honest contest. Thus, his objective function is $v = u - p_i w$ or

$$v = B - \delta(p_i w + \delta aF). \quad (3)$$

The Match-fixer's Incentive to Offer Bribe

The fixer's main motivation is to profit from betting by using the superior information he generates privately through bribery. So if team 1, for example, is bribed, he is going to place his bets on team 2 or team 3 depending on which one offers the highest expected profit, and the profit must be large enough to cover the bribe he has paid. If the net expected profit from bribing and betting exceeds the profit from placing his bets honestly, then and only then offering the bribe is worthwhile.

A bet is described by a ticket or claim, which can be bought at price $\pi_i(< 1)$ that promises to pay 1 rupee if team i wins, otherwise nothing.[15] If the fixer bets 1 rupee on team i, he buys $\frac{1}{\pi_i}$ tickets, each of which yields 1 rupee with probability p_i. Thus, his expected gross earning is $\frac{p_i}{\pi_i}$. If his total wager is z rupees, his total expected profit is $EI_0 = \left[\frac{p_i}{\pi_i} - 1\right]z$. $EI_0 > 0$ if and only if $p_i > \pi_i$.

In this article, we do not explicitly model the bookmaker's choice of prices π_i or the price formation process. It depends on the market structure and the information available to the bookmakers. It has been shown in the literature (Shin, 1991) that if the betting market is a monopoly, $\pi_i > p_i$ will always hold for all i; but if it is competitive and there is a threat of match-fixing, then setting $\pi_i < p_i$ for some (but not all) i can be optimal for bookmakers (Bag & Saha, 2011).

However, to keep matters simple, we assume that $p_i < \pi_i$ and, therefore, the fixer's default option is not to bet at all, that is, $EI_0 = 0$. So if the fixer is to place a bet, he must bribe

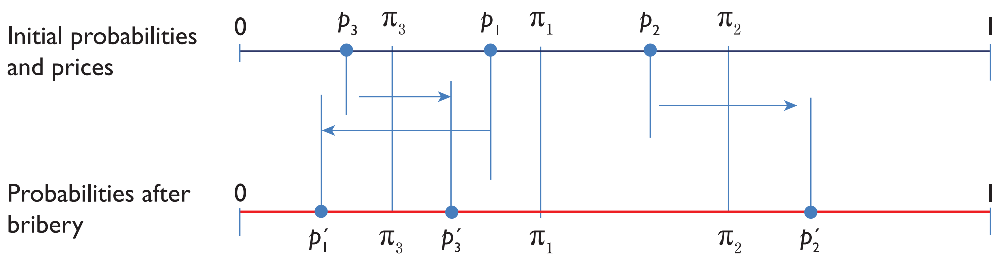


Figure 2. Feasibility of Betting in a Three-team Contest

Source: Author's own

a team first. Essentially, this is a simpler way of motivating bribery in our model.

Now let us examine his incentive for bribery. For the sake of concreteness, suppose he has been able to contact the corrupt player of team 1 and considers betting on any team other than team 1. If the bribe agreement is successful, he will face improved probabilities of winning of the other two teams, (p_2', p_3'), which will be his private knowledge.

Suppose the fixer finds that betting on team 2 is optimal. After having bribed team 1, betting on a team 2 he gets a surplus that is large enough to cover the total cost of bribery.

In Figure 2, we depict the feasibility of betting. The top line shows the alignment of three initial probabilities and the market prices. All prices are above the respective team's initial probability of win. Hence, the fixer cannot ordinarily bet; his returns would be negative. If he bribes team 1, then p_1 drops to p_1' while p_2 and p_3 rise to p_2' and p_3', respectively. The bottom line shows the alignment of the rigged probabilities relative to the prices. p_2' and p_3' exceed π_2 and π_3, respectively, so that betting on either teams (2 or 3) becomes feasible.

We have assumed that team 2 provides the best opportunity of betting. As shown in Figure 2, suppose p_2' exceeds π_2 much more than p_3' exceeds π_3. Hence, betting on team 2 is preferred, if the positive returns are large enough to cover the bribe and expected penalty of bribery. That is to say, if betting on team 2 is optimal, it must yield the highest positive 'net profit' and it is given by

$$EI = \left(\frac{p_2'}{\pi_2} - 1\right) z - B - a\delta^2 F.$$

Note that having bribed team 1 when bets are placed on team 2, team 3 characteristics become irrelevant to the fixer. In his expected profit function, the third team's information does not figure in, except that in p_2', the number of non-bribed teams enters (which is 2) through the rule of equal probability gain.

Bribe Negotiation

The fixer and the corrupt player secretly negotiate the bribe amount B and the extent of self-sabotage δ. The simplest way of solving the bargaining problem is to apply the Nash bargaining procedure, which we do not present here, but informally discuss the solution.

Generally, in any bargaining, players can be thought to have two key factors that determine to what extent the bargaining outcome would go in their favour. These two are bargaining power and outside option. The outside option is essentially what they can do if they break away or reach a stalemate or get stuck in a disagreement. Stronger the outside option, more favourable the bargaining outcome. In the present context, the player's expected prize money (conditional on win) is his outside payoff, so he must get a bribe at least that. In addition the bribe must cover the expected penalty from getting caught. But how much greater, that depends on his bargaining power or negotiation skills. Thus, a player with reasonable skill of negotiation should get a bribe amount that covers at least the prize money and the expected penalty, plus some surplus.

But what about the sabotage? Generally, the optimal sabotage would be such that total gains from sabotage will be maximized. Total gains are calculated by adding up the fixer's payoff EI and the corrupt player's (i.e., saboteur's) payoff v as follows.

$$v + EI = B - \delta(p_1 w + \delta a F) + \left(\frac{p_2'}{\pi_2} - 1\right) z - B - a\delta^2 F$$

$$= \left(\frac{p_2'}{\pi_2} - 1\right) z - \delta p_1 w - 2a\delta^2 F.$$

The first term is the expected financial gain from betting (on team 2) after agreeing to sabotage team 1's play, the remaining two terms capture the cost of sabotage in the form of expected penalty and loss of prize money. Under bargaining the players will try to maximize the total net gain (i.e., the above expression) and then split the gain in the form of bribe. We skip the mathematical details for the sake of simplification of analysis. But the intuition is clear.

Two-team Contests

An important point is that optimal self-sabotage in a two-team contest would be greater than the optimal self-sabotage in a three-team contest. The main reason is that in the case of three teams, the effect of bribery is not fully internalized. Part of the 'stolen' probability is lost to the third team, on which no bets are placed. Some of the effect of bribery goes waste in a three-team model and in fact this is a general problem in all multi-team contests. In a two-team contest, the probability of team 2's win increases by the full amount of sabotage. Hence, the player will undertake greater sabotage and this in turn will increase the attractiveness of match-fixing.

The main aim of the exercise shown in this section is to illustrate the complexity of modelling match-fixing. If researchers wish to build a model to control match-fixing in the real world, they must pay attention to five key aspects: ordinary bettors' strategy, fixer's strategy, contestants' actions, bookmakers' pricing and enforcement policies. By focusing only on the player-fixer interactions we have derived some interesting insight about the number of contestants and optimal structure. Clearly, a much richer structure is needed for a more satisfactory analysis.

Conclusion

In this article, we have set a modest objective—discuss the general issues relating to self-sabotage in contests and suggest some remedies. We then provide a sketch of a basic model of three-team contest assuming exogenous betting prices. We show that in contests involving more than two teams, the risk of match-fixing is somewhat less than in the two-team contests. One implication of this result is that bilateral matches (such as, bilateral cricket series) are more risk-prone than multi-team tournaments (such as, the cricket World Cup) of similar prize money. As the problem of match-fixing is complex involving multiple actors acting on different (and often conflicting) incentives, preventing match-fixing requires coordinated actions on the part of the enforcement agencies, sports governing bodies and bookmakers. A first step in this direction is legalization of betting, which is likely to generate significantly large benefits to the economy, but it also requires political will on the part of the lawmakers.

Notes

1. See http://news.bbc.co.uk/sport1/low/cricket/719743.stm.
2. See 'Race-fixing Probed in Fallon Trial' and similar reports at http://www.channel4.com/news/articles/sports/racefixing+probed+in+fallon+trial+/894147.
3. See reports such as 'Tennis Chiefs Battle Match-fixers' and 'ITF Working with ATP, WTA and Grand Slam Committee to Halt Match-fixing in Tennis' (http://news.bbc.co.uk/sport1/hi/tennis/7035003.stm; http://www.signonsandiego.com/sports/20071009-0552-ten-tennis-gambling.html).
4. In March 2009, Uefa president Michel Platini warned: 'There is a grave danger in the world of football and that is match-fixing.' Uefa general secretary promised to set up a 'betting fraud detection system across Europe to include 27,000 matches in the first and second division in each national association.' See http://news.bbc.co.uk/sport2/hi/football/europe/7964790.stm. Latest, police carried out 50 raids in Germany, the UK, Switzerland and Austria: 'Prosecutors believe a 200-strong criminal gang has bribed players, coaches, referees and officials to fix games and then made money by betting on the results.' See the report dated 20 November 2009, available at http://news.bbc.co.uk/2/hi/8370748.stm.
5. Wolfers (2006) estimated that about 500 games between 1989 and 2005 (nearly 1 per cent of all games) in NCAA Division one basketball were affected by gambling related corruption. Snooker also got tainted by the revelation of bribery (see http://news.bbc.co.uk/2/hi/uk_news/8656637.stm).
6. The video may still be available in http://www.youtube.com/watch?v=CNIZOeyfWtI.
7. Betting corruption in sports has been only suspected of, without being conclusively proven—see Duggan and Levitt (2002) and Preston and Szymanski (2003). Some studies have tried to go further such as Wolfers (2006), Winter and Kukuk (2008) and Strumpf (2003).
8. This framework is not designed for *parimutuel* markets, which are common in Europe and the USA. In these markets the bookmaker is mainly an organizer, bringing together two sides betting against each other on an event. The winning side takes the losers' wagers and distributes the pot among the winners in proportion to their individual wager share. The bookmaker gets a commission from the winners. Market odds in this setting keep changing with the volume of bets coming in.
9. Gambling regulation nowadays require betting companies to keep an eye on the bettors' financial capacity. They should not bet beyond their budgets. This may result in some restrictions on how much a given individual can bet.
10. This can also be seen as three-horse racing.
11. Implicitly we assume that the large number of ordinary bettors do not get to see the Nature's draw of p_i. Either they have exogenous beliefs, or their beliefs are very noisy around p_i.
12. Suppose Mother Nature assigns e_i effort or contribution to each player of team i leading to a total contribution of E_i effort. The probability p_i matches with effort distribution in the following way:

$$p_i = \frac{E_i}{E_1 + E_2 + E_3},\ i = 1, 2, 3.$$

13. When probabilities are evidently linked to effort, the altered probabilities can be written as

$$p_1' = \frac{E_1'}{E_1' + E_2 + E_3},$$
$$p_2' = \frac{E_2}{E_1' + E_2 + E_3},$$
$$p_3' = \frac{E_3}{E_1' + E_2 + E_3},$$

where $E_1' < E_1$. Further denoting $\lambda = \left(\frac{E_1'}{E_1}\right)\left(\frac{E_1 + E_2 + E_3}{E_1' + E_2 + E_3}\right) < 1$, and $\gamma = \frac{E_1 + E_2 + E_3}{E_1' + E_2 + E_3} > 1$ we can write: $p_1' = \lambda p_1$, $p_2' = \gamma p_2$, $p_3' = \gamma p_3$. The gains of the other teams are here equi-proportional.

14. In the controversial ATP match between Russian Nikolay Davydenko (ranked 7th at that time) and Argentinian Martn Vassallo Argello (ranked in the 70s at that time) in Sopot, 2 August 2007, Davydenko won the first two sets comfortably, and then suddenly withdrew from the match citing a foot injury. This aroused suspicion and indeed provoked investigation. It also emerged after the online British gambling company, Betfair, complained of irregular heavy betting from Russia in the match that Davydenko did have some connections with the alleged Russian syndicate.
15. In the real world, bet prices are expressed in terms of betting odds, such as $k : l$ on a particular team's win. This means, if one bets $l/(k + l)$ rupee on that team's win, one should get back 1 rupee if that team wins. Thus, $l/(k + l)$ is the price of the bet in our terminology. Alternatively, π_i is the price of the bet on team i, then the betting odds of team i's win is $\frac{1 - \pi_i}{\pi_i} : 1$.

References

Bag, P.K., & Saha, B. (2011). Match-fixing under competitive odds. *Games and Economic Behavior, 73*(2), 318–344.

Bag, P.K., & Saha, B. (2014). Match-fixing in a monopoly betting market. *Mimeo*, National University of Singapore. Retrieved from http://profile.nus.edu.sg/fass/ecsbpk/stf_ecsbpk.htm (accessed on 20 July 2015).

Bag, P.K., & Saha, B. (2015). Corrupt bookmaking. *Mimeo*, National University of Singapore. Retrieved from http://profile.nus.edu.sg/fass/ecsbpk/stf_ecsbpk.htm (accessed on 18 July 2015).

BBC (2013). Indian cricketers arrested over spot-fixing allegations. Retrieved 16 May 2013, from http://www.bbc.co.uk/news/world-asia-india-22549897

Crafts, N. (1985). Some evidence of insider knowledge in horse race betting in Britain. *Economica, 52*(207), 295–304.

Duggan, M., & Levitt, S.D. (2002). Winning isn't everything: Corruption in Sumo wrestling. *American Economic Review, 92*(5), 1594–1605.

Konrad, K. (2000). Sabotage in rent-seeking contests. *Journal of Law, Economics and Organization*, *16*(1), 155–165.

Preston, I., & Szymanski, S. (2003). Cheating in contests. *Oxford Review of Economic Policy, 19*(4), 612–624.

Shin, H. (1991). Optimal betting odds against insider traders. *Economic Journal, 101*(408), 1179–1185.

Shin, H. (1992). Prices of state contingent claims with insider traders, and the favorite-longshot bias. *Economic Journal, 102*(417), 426–435.

Shin, H. (1993). Measuring the incidence of insider trading in a market for state-contingent claims. *Economic Journal, 103*(420), 1141–1153.

Strumpf, K.S. (2003). Illegal sports bookmakers. *Mimeo*. Retrieved from http://www.unc.edu/~cigar/ (accessed on 10 July 2015).

Vaughan Williams, L., & Paton, D. (1997). Why is there a favourite-longshot bias in British racetrack betting markets. *Economic Journal, 107*(440), 150–158.

Winter, S., & Kukuk, M. (2008). Do horses like vodka and sponging? On market manipulation and the favorite-longshot bias. *Applied Economics, 40*(1), 75–87.

Wolfers, J. (2006). Point shaving: Corruption in NCAA basketball. *American Economic Review* (*Papers and Proceedings*), *96*(2), 279–283.

Woodland, L.M., & Woodland, B.M. (1994). Market efficiency and the favorite-longshot bias: The baseball betting market. *The Journal of Finance, 49*(1), 269–279.

Woodland, L.M., & Woodland, B.M. (2003). The reverse favourite-longshot bias and market efficiency in major league baseball: An update. *Bulletin of Economic Research, 55*(2), 113–123.