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Auctioning the NFL Overtime Possession

Yeon-Koo Che
Terry Hendershott

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Columbia University
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Yeon-Koo Che* Terry Hendershott†

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Abstract: In an National Football League overtime, a coin is tossed to determine which team will receive the kick off. In the sudden death format starting on offense has a significantly higher chance of winning. This makes coin tossing one of the most climatic moments and immediately confers an advantage to one team. Proposals to improve the ex post fairness by guaranteeing each team one possession reduce the efficiency and excitement of the sudden-death format. We propose a simple approach motivated by economics: the coaches of opposing teams bid on the yardage from its end zone at which his team would begin offense, with the low bidder winning the offense right. For instance, if coaches of teams A and B bid 18 and 21 yards, respectively, team A would win and begin its offense at 18 from its end zone. This note analyzes the equilibrium outcome of such an auction and discusses its properties.

*Department of Economics, Columbia University; email: yc2271@columbia.edu.
†Haas School of Business, UC-Berkeley; email: hender@haas.berkeley.edu.

1 Introduction

In the National Football League (NFL), games ending in a tie are determined by sudden-death overtime where the first team to score wins. Sudden death is an efficient means to decide a game which is violent and exhausting. It is certainly preferable to the parody of the game used to break ties in college football.[1] However, the sudden death nature confers a significant advantage on the team who has the first possession. While the outcome of a coin flip to determine first possession is ex ante fair, immediately after the toss it is no longer fair because the winning team has a significant chance of scoring on its first possession. NFL Commissioner Paul Tagliabue has said that "There has been a trend in the last seven or eight seasons that the team winning the toss in overtime wins the game. That advantage of receiving the ball first is becoming unbalanced." (New York Times, 2003a).[2]

Suggested reform often includes guaranteeing both teams at least one possession (New York Times, 2003a, 2003c). Unfortunately, this conflicts with the efficiency of using sudden death. It also only postpones the fairness issue. If the teams remain tied after their initial overtime possession, the original problem reappears. Thus, both teams must be be guaranteed an equal number of possession indefinitely, as in the college overtime system. Economic theory with its focus on the fair and efficient allocation of scarce resources suggests a natural solution.

We propose a system that is fair even after the initial possession is awarded and maintains the the efficiency of sudden death. To begin overtime, the teams bid on the starting yard line of the first possession. The team that bids closest to its own goal line gets possession and starts at its bid. Then sudden death commences with the team scoring first winning. This system is more ex post fair because even after the first possession is decided, teams are indifferent to whether or not they start with the ball. Below we construct a simple model to examine the equilibrium properties of our auction.

2 Equilibrium of the auction game and its properties

Suppose teams 1 and 2 tie in regulation, turning the game into an overtime. The continuation outcome at the beginning of overtime is characterized by the probability that team 1 would win. Let $f(x)$ and $g(y)$ denote team 1's probability of winning when it begins offense at x and when team 2 begins its offense at y, respectively, where yardage is measured from one's own end zone. Obviously, $1-g(y)$ and $1-f(x)$ will then represent team 2's probability of winning when it begins

[1] When a college football game goes to overtime, each team is given one possession from its opponent's twenty-five yard line. The leader after those possessions, if there is one, is declared the winner. If the teams remain tied, this continues, switching the order of possessions for each overtime, until one team leads the other at the end of the overtime. To prevent too many overtimes/possessions, extra points do not count from the 3rd overtime on, making it necessary for teams scoring touchdowns to attempt a two-point conversion.

[2] Of the first 355 Nation Football League overtime games 100 were decided by the team winning the coin toss and then winning the game on its first possession (New York Times, 2003c). In 2002 of 25 overtime games, 10 were decided on the first possession (New York Times, 2003b) with 17 games eventually won by the team winning the coin flip.

offense at y and when team 1 begins its offense at x, respectively.[3] These probabilities are assumed to be a common knowledge for the coaches. A coach representing its team is assumed to maximize the probability of his team winning. We look for a Nash equilibrium of this game. It is reasonable to assume the following properties for $f(\cdot)$ and $g(\cdot)$:

- Monotonicity *$f(\cdot)$ is nondecreasing and $g(\cdot)$ is nonincreasing.*
- Continuity: *$f(\cdot)$ and $g(\cdot)$ are continuous.*
- Interiority: *$f(0) \leq g(0)$ and $f(100) \geq g(100)$.*

Figure 1 portrays $f(\cdot)$ and $g(\cdot)$ satisfying these properties.

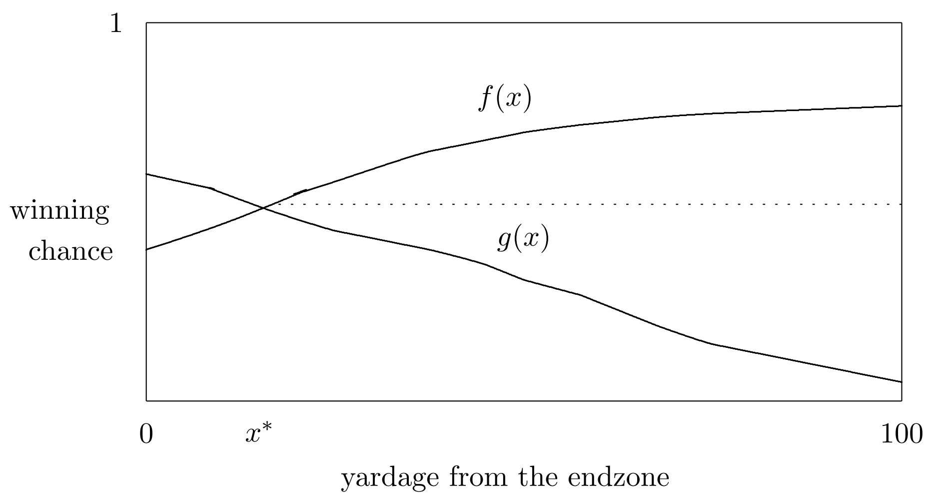

Figure 1

Monotonicity means that the further away from its end zone a team begins its offense, the higher is its chance to win. Continuity is self explanatory. Interiority means these $f(\cdot)$ and $g(\cdot)$ crosses at some $x \in [0, 1]$, as illustrated in the figure: A team would rather defend at the opponent team's end zone than begin offense at its own end zone. All three conditions are quite reasonable. Given these three conditions, the equilibrium of this bidding game occurs at the crossing of $f(\cdot)$ and $g(\cdot)$, as will be shown in the next proposition.[4]

Proposition 1 *Given the three conditions, it is an equilibrium for each team to bid x^* such that $f(x^*) = g(x^*)$. Team 1 wins with probability $f(x^*)$ in any equilibrium.*

Proof. Given the three conditions, there exists x^* such that $f(x^*) = g(x^*)$. If coach 1 picks x

[3] To analyze the case where one team kicks off to the other, x and y can be where the teams kick off from and $f(x)$ and $g(y)$ the associated expected probabilities of winning. The current NFL rule is that the kick off is from the 30 yard line. An similar mechanism can be constructed where the kick off position could be auctioned off rather than starting field position.

[4] If interiority does not hold, equilibrium is at zero or 100, as one can clearly see from the logic of the argument used in the proposition.

against coach 2 bidding x^*, the former's payoff is

$$\pi_1(x, x^*) = \begin{cases} f(x) & \text{if } x < x^*, \\ \frac{f(x^*)+g(x^*)}{2} & \text{if } x = x^*, \\ g(x^*) & \text{if } x > x^*. \end{cases}$$

Since $\frac{f(x^*)+g(x^*)}{2} = g(x^*) = f(x^*)$, $\pi_1(x, x^*)$ is nondecreasing for any $x \leq x^*$ and stays constant for $x > x^*$. (In Figure 1, this payoff coincides with $f(x)$ for $x \leq x^*$ and with the dotted line for $x \geq x^*$.) So, the payoff is maximized at $x = x^*$. Hence, there is no profitable deviation for coach 1. A symmetric argument works for coach 2, using the fact that $1 - f(x^*) = 1 - g(x^*)$. The uniqueness in the probability of winning follows from the fact that the game is a two-person zero sum game. ▌

The equilibrium outcome has a couple of desirable properties, compared with the current rule of selecting a team at random to kick off from its 30 yards.

□ *Indifference to the Assignment:* Because the assignment of the offense right is exogenous to the performance of the teams, arguably the particular assignment should not matter for the fortune of each time. The current rule does not guarantee this. Auctioning ensures that the assignment does not matter, for teams are indifferent to it in equilibrium.

□ *Fairness of the Assignment:* It is not easy to delineate the precise requirements of "fairness" in an assignment rule when teams are asymmetric. After all, the entertainment value of a game may be enhanced if a stronger team is handicapped to a certain extent.[5] Even if a stronger team is handicapped, however, it seems desirable for *the handicapping not to be so extreme that a stronger team will more likely lose after the assignment.* This minimal notion of fairness seems not only uncontroversial but it also implies the obvious desideratum: *teams with the equal capabilities must have the equal chance of winning no matter which team is assigned the offense right.*

To describe our fairness notion formally, say team 1 is *more capable* than team 2 if $f(x) \geq 1 - g(x)$ for all x, and strictly so if the inequality holds strictly. This condition simply means that team 1 is more likely to win than team 2, when starting its offense at the same offense yardage or when facing an offense by its opponent team at the same yardage. In the same vein, say two teams are *equally capable* if $f(x) = 1 - g(x)$ for all x.

It is easy to see that the current rule is unlikely to satisfy our fairness notion. For instance, even if team 1 is more capable than team 2, it is possible that, if team 2 is selected (by random coin tossing) to start on offense (i.e., receive a kickoff), team 1 has more than half chance of losing. Two equally capable teams will not have the equal chance of winning after the assignment, except by a mere coincidence. Clearly, the equally capable teams have the same chance of winning *prior to* coin tossing, but what matters is the winning chance *after* the coin tossing, which is not necessarily a half even when the teams are equally capable.

It is easy to see that auctioning the offense right will guarantee the notion of fairness.

[5] While handicapping may increase excitement it is rarely used in the sporting contest itself, presumably for fairness and incentive reasons. Handicapping to increase competitive parity occurs outside of the contests through scheduling, draft rules, salary limits, or revenue sharing.

Corollary 1 *Given the auctioning of the offense right, a (strictly) more capable team is (strictly) more likely to win, and equally capable teams have the equal chance of winning at the start of an overtime play in equilibrium.*

Proof. Let x^* be an equilibrium bid. Without any loss, suppose team 1 is more capable than team 2. Then, $f(x^*) \geq 1 - g(x^*)$. By Proposition 1, $f(x^*) = g(x^*)$. Combining the two facts, we have $f(x^*) \geq \frac{1}{2}$. The inequality is strict if team 1 is strictly more capable than team 2, and becomes an equality if two teams are equally capable. ▌

3 Conclusion

How to break ties arises in all sporting endeavors. Sports like baseball and basketball that have sufficient volatility of scoring relative to how physically draining they are can easily break ties without departing from the normal game process. Football, soccer, hockey, and tennis all eventually adopt some bastardization of themselves to finally determine a winner. Tie breaking rules trade off efficiency (quick ending) against making the tie breaking contest like the game itself.

Because fairness conflicts with efficiency college and professional football have taken divergent approaches to overtime. We propose auctioning off where to begin offense (or kick off) to eliminate fairness issues while ensuring efficiency. This tie breaking system may also increase excitement. A relatively better offensive team would bid aggressively, valuing first possession over better field position. Similarly, a better defensive team would bid less aggressively, valuing the better field position on the second possession if they initially stop their opponents.

When the Wall Street Journal ran an online forum on this issue (Wall Street Journal, 2003), Tom Donahoe, then president and general manager of the Buffalo Bills, wrote "[w]e don't like the current system. It just seems that too much depends on the coin flip – who wins it and who loses it." Donahoe wrote of the auction proposal being "way too revolutionary for the National Football League. It sounds more like a videogame to me. I couldn't see that happening." However, the NFL's steady increase of coaching decisions to enhance fairness, e.g., the challenge rule for instant replay reviews of plays, are similar in spirit.

References

[1] New York Times, 2003a, N.F.L. Ponders Changing How Overtime Is Played, January 25, Section D, page 5.

[2] New York Times, 2003b, N.F.L. Decides Not to Make Changes, for Now, March 27, Section S, page 5.

[3] New York Times, 2003c, Heads or Tails Is No Way To Determine Overtime, November 4, Section D, page 1.

[4] Wall Street Journal Online, 2003, Should the Outcome of a Coin Flip Mean So Much in NFL Overtime?, December 22.