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NFL Overtime-Is an Onside Kick Worth It?

It's the NFC championship and the 49ers are facing the Seahawks. The game has just gone into overtime and the Seahawks win the coin toss. The Seahawks choose to receive and immediately the odds slide in their favor. As we estimated in class, the receiving team has a 55% chance of winning under the new NFL overtime rules. So, should the 49ers just accept this or is there a way the 49ers can react to increase their chances of wining? For my project, I will look into strategies that the kicking team could pursue in order to increase their probability of winning. Particularly, I will test whether going for an onside kick to start overtime is a good idea for the kicking team.

An onside kick is a kickoff intentionally hit short. In an onside kick, the kicking team kicks short in hopes of regaining possession of the ball before the receiving team can control it. When an onside kick is attempted, the ball must travel at least 10 yards before a member of the kicking team can touch it, unless a member of the receiving team touches the ball first. An onside kick is usually used in the 4th quarter of a game when a team is losing by an amount from which it cannot recover in the time remaining and therefore has no choice but to attempt an onside kick. As a result, it is often called a "desperation tactic." Coaches tend to stay away from onside kicks in other situations because they do not want to risk giving up good field position. In addition, onside kicks are looked down on because they are rarely successful. In fact, using Pro-Football-Reference.com, I found that in the past fourteen seasons, only 17.7%(145 out of 819) onside kicks were successfully recovered.

If onside kicks only work about 18% of the time, then how could starting

overtime with an onside kick possibly increase the kicking team's chance of winning? In order to answer this question, it is important to carefully look at the NFL overtime rules. According to the new rules, if the receiving team scores a touchdown, they win the game. Otherwise, they kick-off and the kicking team can win by outscoring the receiving team on their possession. If the game is tied after both teams each get a possession, the old sudden death rules apply. A key part of the NFL overtime rules that is often ignored (mainly because it hasn't been relevant yet) is that a kickoff is an opportunity to possess for the receiving team. Therefore, if the kicking team recovers the kick, the receiving team is considered to have had its opportunity and so all the kicking team needs is a field goal to win the game. Essentially, the game reverts to the old sudden death format with the kicking team getting the first possession. The price of failure, however, isn't nearly as high. If the kicking team does not recover the kick, they can still match or beat an opponent's field goal. In this case, the only benefit for the receiving team is that it gets good field position.

Another factor that needs to be considered when looking at an onside kick and its effect is field position. As I mentioned earlier, the main reason coaches do not attempt onside kicks when the game is close is because they do not want to risk giving up good field position and this is definitely a legitimate reason. However, what if often overlooked is that the kicking team gets solid field position if it recovers the onside kick. This became especially true when the NFL moved kickoffs from the 30-yard line to 35-yard line before the start of the 2012 season. The kicking team kicks off from its own 35-yard line and the rules state the ball must travel ten yards before the kicking team can touch the ball. As a result, if the kicking team does not recover, the receiving team will get the

ball at about their opponent's 45-yard line (on average), which is indeed very good field position. Using the same logic, the kicking team, if they recover, would get the ball at the same place as the receiving team would, about their own 45-yard line. The difference in field position quality is only 10 yards, equivalent of a first down. Before the 2012 season, when kickoffs took place from the 30 yard-line, the difference in field position quality was slightly higher at 20 yards and so an onside kick was less effective. When considering field position, it is important to remember that the cost of an onside kick is not much greater than the benefit of the onside kick, especially with the new rule.

Lastly, an onside kick may be a smart way to start overtime for the kicking team because it would be extremely surprising. No team has ever tried an onside kick to open overtime and the fact that an onside kick is so unlikely means it just might work. For example, in Super Bowl XLIV, the New Orleans Saints shocked both the Colts and the entire football world when they started the second half with an onside kick. This was the first time in Super Bowl history that a team attempted an onside kick before the 4th quarter. The Saints successfully recovered the ball, converted the possession into a touchdown, and ultimately went on to win the Super Bowl thanks to this play. Not only were the Colts completely caught off guard, but they also didn't have their "hands team" of players skilled at catching or securing the ball in the game. When I calculated the success rate of an onside kick initially, a large portion of the sample size included desperation onside kicks in the 4th that the receiving teams expected. Obviously, the likelihood of a surprising and unexpected onside kick is higher, but is it high enough?

Now that I have outlined some of the reasons why attempting an onside kick may increase a kicking team's chance of winning overtime, it is time to look at the numbers.

For my analysis, I will organize all my information into a two-stage probability tree. The first stage will be whether the kicking team recovers the onside kick. The second stage, which contains the conditional probabilities, will be whether the kicking team wins the game. I will add the probability that the kicking teams recovers the kick and wins the game to the probability that the kicking team does not recover and wins the game in order to get the final probability that the kicking team wins overtime (given it attempted an onside kick to start overtime). If this probability is greater than 45%, I can conclude that attempting a kick to start overtime is a good play for the kicking team.

The first task in my analysis is to estimate the likelihood that a "surprising" onside kick is recovered. Since all the expected onside kicks occur in the 4th quarter when teams have no choice but to go for it, I defined a surprise onside sick as any onside kick that is not attempted in the 4th quarter. Using Pro-Football-Reference.com, I looked at all the onside kicks attempted in the first, second, or third quarter in the past 14 seasons. Out of 159 onside kicks attempted, the kicking team successfully recovered 72, which is about 45.3%. This tells me that the kicking team has about a 45.3% chance of recovering an onside kick in overtime.

Next, I need to estimate the conditional probabilities in the second stage of my probability tree. What is the probability that the kicking team wins the game given that it recovers the onside kick and given that it does not recover? Unlike the first stage, it is tough to use past data to estimate these probabilities, since these probabilities rely on fairly specific scenarios. However, I can use the NFL overtime analysis we did in class and basic football logic to make an approximate guess for these probabilities. In the scenario in which the kicking team recovers the onside kick, the kicking team gets the

ball at about its own 45-yard line and the game becomes sudden death. In class, we estimated that the team with the first possession (which has become the kicking team in our case) has a 60% chance of winning under the old NFL sudden death rules. Since the kicking team starts at about their own 45-yard line, which is solid field position, I assume that their probability of winning is slightly higher than that, around 67%. In the scenario in which the kicking team does not recover the ball, the receiving team gets the ball at their opponent's 45-yard line and the new NFL overtime rules are still in play. In class, we estimated that under the new NFL overtime rules, the receiving team has a 55% chance of winning. However, field position must be again taken into account and in this case, has a larger impact. The receiving team gets very good field position and so I assume their probability of winning is about 65%. Thus, the kicking team has a 35% chance of winning the game if they do not recover the onside kick.

.67

.453

.33

.35

.547

.65

P (Kicking Teams Wins)= .304 + .191= 49.5%

Above is the completed probability tree. The probability that the kicking team recovers the onside kick and wins the game is 30.4%. The probability that the kicking team does not recover and wins the game is 19.1%. Adding those two probabilities up tells us that kicking team has a **49.5%** chance of winning if they start overtime with an onside kick. This is larger than the 45% chance of winning they would have had if they started overtime with a regular kickoff. As a result, it seems that starting overtime with an onside kick is a smart play that increases a kicking team's change of winning. The kicking team goes from being at a slight disadvantage to having almost a 50-50 shot at winning.

An onside kick to start overtime increased the kicking team's chance of winning in my analysis. This was mainly because an onside kick in overtime would be very surprising and would catch the receiving team off guard. Therefore, the onside kick in overtime may work the first time it is tried, but after it is attempted once, it won't be as surprising any more. As a result, I calculated the break-even success rate for an onside kick, which ended up being 31.25%. I did this by solving for x in the equation below:

$.67(x) + .35(1-x) = .45 \geq .32x = .1 \geq$ **x=.3125**

This tells us that a team will increase its probability of winning the game by attempting an onside kick as long as its chance of recovering the kick is 31.25% or greater. In other words, the kicking team should go for an onside kick only if they believe they have at least a 31.25% chance of recovering it.

After completing my analysis, I decided to compare my work to other methods that tested the same concept. In early 2011, Brian Burke, the founder of the Advanced

NFL Stats website, did a similar analysis (posted on slate.com) that looked at whether starting overtime with an onside kick makes strategic sense. His analysis had two key differences from mine. Firstly, his breakeven success rate for an onside kick was 40%. The fact that his break-even rate was higher than mine makes perfect sense. Burke performed his analysis right before the NFL moved kickoffs from the 30-yard to 35-yard line. As discussed earlier, an onside kick is less effective when the kicking team has to kickoff from the 30 rather than the 35. If the kicking team recovers, it gets the ball 5 yards further from the their opponent's end zone and if the kicking team does not recover, the receiving team gets the ball 5 yards closer to the opponents end zone. As a result, Burke conditional probabilities for the kicking team winning the game would be lower than mine, resulting in a higher break-even rate.

However, the second difference was a bit more alarming. Burke estimated that the kicking team has a 60% chance of recovering an onside kick in overtime, which is significantly higher than my estimate of 45.3%. There are two possible reasons why our estimates differed. Firstly, since Burke performed his analysis in 2011, he used data from the 2001 to 2010 seasons while my data included those years and the last three seasons. This suggests that in recent years teams may have become more prepared for surprise onside kicks. Secondly, Burke defined a surprise onside kick as an onside kick attempted when the kicking team, based on win probability statistics, has a better than 20 percent chance of winning at the time of the kick. Unlike my analysis, his sample size of surprise onside kicks did not include onside kicks that were attempted in the first three quarters when the kicking team had a very low shot at winning and included surprise onside kicks attempted in the 4th quarter. This really made me wonder whether my definition of a

surprise onside kick (an onside kick that is not attempted in the 4ᵗʰ quarter) underestimated the probability that the kicking team recovers an onside kick in overtime. In reality, when a team is down by a large margin before the 4ᵗʰ quarter, the other team understands that their opponent may attempt an onside kick and so they are more ready for it. As a result, onside kicks attempted in these situations are not really that surprising and therefore are likely not recovered by the kicking team. Additionally but less likely, a surprise onside kick attempted in the 4ᵗʰ quarter may have a greater chance of being recovered by the kicking team due to high pressure on the receiving team to control the ball in a close game.

How can I test whether I underestimated the likelihood that a surprising onside kick is recovered? Is my estimate different than Burke's estimate simply because my analysis includes more recent data or is there a flaw in the way I defined a surprise onside kick? **I can answer these questions by looking at the percentage of surprise onside kicks between the 2001 and 2010 seasons that were successfully recovered by the kicking team, using my definition of a surprise onside kick**. If this percentage is fairly close to 60%, I can conclude that teams have just become more prepared for the possibility of a surprise onside kick. On the other hand, if the percentage is significantly less than 60%, I can conclude that I underestimated the success rate of a surprise onside kick. Looking at the data, I found that this percentage is equal to about 50%. By including "desperate" onside kicks attempted in the first three quarters in my sample size of surprise onside kicks, I underestimated the probability that the kicking team recovers the surprise onside kick by about 10%. Accounting for this in my probability tree, I now get that the kicking team has a 52.6% chance of winning if they start overtime with an

onside kick (as shown below)

.67

.55

.33

.35

.45

.65
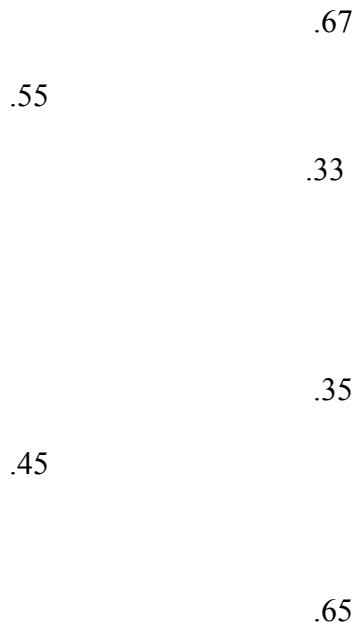
P (Kicking Teams Wins)= .369 + .157= 52.6%

In a big game with playoff or even Super Bowl implications, coaches want to be aware of all possible strategies that may increase their team's chance of winning. Starting overtime with an onside kick is definitely one of those strategies that coaches should be aware of. Not a single team has ever tried an onside kick in overtime and what makes an onside kick effective is its element of surprise. By attempting an onside kick to start overtime rather than doing a regular kick-off, the kicking teams probability of winning goes from 45% to about 50%. When I was able to more accurately estimate a success rate for a surprise onside kick (thanks to the help of Brian Burke), the kicking team's likelihood of winning increased to about 52.6%. As a result, if I am a coach and my team

is kicking off in overtime, I am definitely going for an onside kick. However, it is definitely a risky play and I just hope a coach has the guts to try it one day.