Predicting the Winner of Tied NFL Games: Do the Details Matter?

Jared Quenzel
Bates College

Paul Shea*
Bates College

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Abstract

We construct a dataset of all 429 tied at the half regular season NFL games between 1994 and 2012. We then examine whether or not the path taken to reach the tie (*e.g.* rushing yards, turnovers, etc.) has any ability to predict the eventual winner. Our main finding is that only the point spread is significantly predictive, although there is weak evidence to suggest that allowing more sacks reduces the chances of winning. Surprisingly, we find that the team receiving the first possession of the second half does not enjoy a statistically significant advantage. Teams should thus simply try to maximize their first half lead without expecting that first half strategies such as "establishing the run," will pay dividends in the second half.

Keywords: football, sports strategy, forecasting.

*Corresponding Author: pshea@bates.edu. We thank an anonymous referee and the editor, Leo Kahane, for helpful suggestions.

1 Introduction

Suppose that at halftime, two (American) football teams are tied. Does the path of the game that led to the tie matter, or is that path irrelevant to predicting the eventual outcome of the game? The answer is not obvious. Commentators, coaches and players have long suggested that some strategies - running the ball effectively, hitting the opposing quarterback, possessing the football - are likely to improve a team's relative performance late in the game. Such beliefs may affects teams' strategies. For example, it has long been believed that running the football, as opposed to passing it, becomes increasingly successful as the game wears on, possibly tiring opposing defenses, and thus making a team more likely to win a close game. As a result, coaches often emphasize the need to "establish the run," even though running plays are, on average, significantly less successful than passing plays.[1] If correct, then the team that has run the ball more (or more successfully) at halftime should be more likely to win a tied game. We find, however, that this is not true. Teams should thus run the football in the first half only if doing so is the best way to maximize their halftime lead.

Whether the path matters has a pair of interesting implications. If it does, then it may be optimal for coaches not to try to maximize their halftime lead. Rather, they may wish to pursue a strategy that sacrifices first half performance in exchange for improved performance later in the game. If it it does not matter, then they should simply try to maximize their halftime lead. Sportsbooks also post new gambling lines at halftime of NFL games. The results that we present illustrate how to optimally set these lines.[2]

To examine this question, we collect statistical data for all 429 regular season National Football League (NFL) games that were tied at halftime between 1994 to 2012. We then use a straightforward logit and linear probability analysis to estimate how the path of the game affects the likelihood of winning. We find, unsurprisingly, that the perceived quality of the teams (as measured by gambling lines) robustly matters, the favorite going into the game is more likely to win. No other variable is statistically significant at even the 90% confidence level. Only sacking the opposing team's quarterback enjoys weak, but consistent, evidence at meaningfully increasing the odds of winning. We also find that some factors that one might expect to matter do not actually seem to have any predictive power. In addition to the previously discussed example of running the football, we also find that the team that receives possession after

[1] Alamar (2006) documents this "passing premium puzzle." He shows that running plays yield a much smaller expected return than passing plays.

[2] Because our dependent variable is whether the home team wins, our results are most applicable to "money lines," where bettors wager only on who wins as opposed to point spreads where they bet on a team winning by at least a certain amount.

halftime is not significantly more likely to win.

We interpret most of our regressors (passing, running, etc.) as unexpected deviations in these statistics. We interpret expected differences in these variables as being captured by the point spread, our measure of team quality.[3] By omitting the point spread, we estimate the effects of either expected or unexpected differences in game statistics. These latter results show that passing success is now predictive of winning the game. This suggests that expected passing success is predictive only because it is closely related to which team is better. Unexpected passing success in the first half, however, does not pay dividends later in the game and, conditional on being tied at halftime, it does not make a team more likely to win.

The paper is organized as follows Section 2 presents a brief theoretical model and discusses factors that might be expected to influence the outcome of a tied game. Section 3 then presents our econometric results. Finally, Section 4 concludes.

2 Model

Denote team i as the road team and team j as the home team.[4] Define ρ_{ij} as some measure of team i's performance such that higher values make team i more likely to win:

$$\rho_{ij} = \alpha + \alpha_{ij} + \eta_1 + \eta_2 \tag{1}$$

The constant α includes the away team's inherent disadvantage.[5] The term α_{ij} reflects the relative quality of each team. This is itself a function of each team's attributes. If team i, for example, is far superior at passing the football than team j, then we expect this to influence α_{ij} in team i's favor. The term η_1 is a vector of unexpected events, in the first half of the game, that increase team i's chances of winning. This may include unexpected success running/passing, sacking the opposing quarterback, etc. Notably, expected success in these areas is incorporated in α_{ij}.

This paper considers the possibility that η_1 may itself affect the team's second half performance. Formally:

[3] Levitt (2004) shows that sportsbooks do not set lines just to match the expected outcome of the game. They instead attempt to exploit the biases of gamblers. The deviations of point spreads from the expected outcome are, however, so small that when factoring in commissions, gamblers cannot bet profitably. We thus maintain that the point spread is a very good measure of relative team strength.

[4] Neutral site games are rare in the NFL. They include the Super Bowl (League Championship) and occasional games played outside the United States. In the latter case, however, one team is still designated the home team despite enjoying a reduced advantage.

[5] Point spreads typically reflect about a three point home field advantage.

$$\eta_2 = f\eta_1 + g_2 \tag{2}$$

Here g_2 is a factor of unexpected events (similar to η_1) that occur in the second half. The vector f is a channel by which random events of the first half effect affect the game's outcome by affecting the events of the second half.

Team i's probability of winning is then a function of ρ_{ij}. The simplest representation is a linear probability model where:

$$p = \beta\rho_{ij} \tag{3}$$

Linear probability models offer straightforward interpretation. They also, however, suffer from several technical issues, most notably including the potential for probabilities greater than one or less than zero. We can instead impose a logit specification to fix these issues:

$$p = \frac{1}{1 + e^{-\beta\rho_{ij}}} \tag{4}$$

This paper tests between a pair of hypotheses:

Case 1: $f = 0$

In this case, the events of each half are independent. The optimal first half strategy for each team is simply to try to lead by as much as possible at halftime. It does not matter how they attain a particular lead.

Case 2: $f \neq 0$

In this case, unexpected events in the first half may continue to influence the game in the second half. It is difficult to watch an NFL game without hearing this argument. Suppose, for illustration, that the notion of "establishing the run," is valid. That is running plays (as opposed to passing plays) wear down the opposing defense and lead to greater success later in the game. In this example, not all 3 point leads are created the same. A team leading by three points is more likely to win if it attained this lead through an unusually high number of running plays as opposed to doing so through other means.

A team's optimal strategy is thus more complicated than in Case 1. Suppose that an additional running play contributes a lower value of η_1, which all else equal makes winning less likely. If the associated element of f is negative, however, then this strategy may contribute to a higher value of η_2. If the latter effect dominates, it may then be optimal to not simply maximize the halftime lead, but instead attempt to set up second half success, even if doing so might result in a worse halftime score.

We now discuss factors that may appear on the right hand side of (1).

#1: The Point Spread:

In football, most gambling is done through a point spread. A bet on the favorite for example, wins if and only if that team wins by more than the amount of the point spread.[6] The point spread is thus a measure of which team is stronger and we use it to capture α_{ij}. Levitt (2004) shows that that point spreads, while not entirely efficient, are a reliable predictor of the game's outcome. We expect, and do consistently find, that the favored team is more likely to win a tied game at halftime.

#2: Initial Second Half Possession:

In football, the team that starts on defense in the first half is almost always the first to go on offense in the second half. Because the vast majority of points are scored on offense, we expected this to be an advantage. We find, however, that it is not. Most likely, this is because the team starting on offense does so after receiving a kickoff, a play that usually results in relatively weak field position.

#3: Running the Football:

In football, the team on offense must choose between running and passing the football. Several papers have noted that if these types of plays are compared on the basis of yards gained per play and turnover risk (where the team on offense loses possession through a serious mishap), passing appears to be the clearly superior option. Alomar (2006) refers to this as the "passing premium puzzle." Kovash and Levitt (2009) provide a more detailed analysis and reach a similar conclusion; teams pass too little and run too much.[7] One possible explanation is that the costs and benefits of running versus passes are not fully captured by simply comparing yards per play and turnover risk. Another is that teams are not maximizing their chances of winning the game, due either to irrationality or choosing to maximize something else (*e.g.* minimizing criticism). Romer (2006) finds evidence of the latter explanation in a different setting; teams are too cautious by not going for it enough on fourth down.[8]

[6] For a more detailed discussion of point spreads, including how they are optimally set, see Sandford and Shea (2013).

[7] They also find a negative serial correlation in play-calling, suggesting that teams are inefficiently predictable.

[8] Other papers that examine optimal play-calling include Alomar (2010), and Rockerbie (2008).

An observer does not have to wait long for coaches, announcers, and reporters to extol the virtues of running the football. The frequency of these comments could easily convince a fan that running the football is a moral issue. We present, as anecdotes, two such representative quotes.

> Running wins football games...It's not always the fanciest way, but it can win games.
>
> —Bill Parcells, 1991[9]

> When you run the ball effectively, you wear down an opposing defense, chew the game clock and keep the other team's offense off of the field."
>
> —Anthony Cosenza, 2012[10]

Suppose that running the football does tire out opposing defenses. In our model, this is represented as a case where one element of f does not equal zero. From (2), this shifts the mean of η_2. In other words, running the football unexpectedly well in first half makes unexpected (at the start of the game) beneficial events like successfully passing, running, etc. in the second half more likely.[11]

Our estimation allows us to test against two competing explanations for the passing premium puzzle. First, that there is some deeper benefit to running that makes NFL play-calling win-maximizing. Second, that running less would result in fewer wins. We suspect, and find evidence for, the latter. We believe that the best explanation is that running and winning are correlated and that NFL teams mistake this relationship as causation.[12]

To examine this issue, we consider measures that include both rushing attempts and rushing success. We consistently find that running is insignificant.

#4: Sacking the Opposing Quarterback:

Quarterback is unquestionably the most important position on a football team. When a quarterback is sacked, he typically experiences significant physical contact with an opposing player. It is plausible that such trauma could reduce his effectiveness, thus inducing inferior quarterback play in the second half. Sacks may also cause injury to the opposing quarterback,

[9]See Palmer, K. *Game of My Life: New York Giants: Memorable Stories of Giants Football.* Champaign, IL: Sports Pub., 2007. In fairness to Parcells, his quote dates from prior to a series of rule changes that have reduced the effectiveness of running plays relative to passing plays.

[10]Cosenza, A. 2012. "Key to Bengals Victory: Establish the Run Versus the Steelers." *Cincyjungle.com*

[11]Another possibility, not formally included in our model, is that running the football affects the variance of η_2. If correct, then an underdog might benefit from running the football because doing so helps negate their inherent disadvantage.

[12]Schatz (2003) explains this point in great detail. When teams possess leads, they often choose to run the ball as an effective means of running out the clock, creating this correlation.

possibly requiring that a typically inferior backup take his place in the second half. While we are unaware of any rigorous statistical efforts to answer this question, we do offer the following quote from Super Bowl winning quarterback Jim Plunkett for illustration:

> When you don't have confidence in the pocket, you either throw the ball too soon or bail out and try to run out of trouble. When you do that, bad things happen. Even when the protection is good, you can't count on it consistently, and that gets you in trouble.
>
> —Jim Plunkett, 2010[13]

Our results show some support for this notion. We typically find that the team with more sacks is more likely to win, with p-values ranging between 0.1 and 0.3, and that each additional sack allowed reduces the chances of winning by about 1.7%.

#5: Fewer Non-Offensive Scores:

Although most points in football come through offense, teams occasionally score while on defense or special teams. One explanation of these scores is that they are largely random events. Clearly, such scores make it more likely that a team will win the game.

Conditional on the game being tied at halftime, however, it is possible that a team having scored in this manner is lucky to have done so. If correct, they may be unlikely to benefit from a non-offensive score in the second half and may thus be likely to lose the game. We do not, however, find evidence in support of this hypothesis.

#6: Fewer Turnovers:

Turnovers, which include fumbles and interceptions, are among the most significant plays in a football game. We thus posit that if a team benefits from an unusually high number of them, they are unlikely to experience the same benefit in the second half and are thus more likely to lose. Our reasoning is similar to #5. We also do not, however, find evidence in support of this hypothesis.

#7 Number of Offensive Plays:

It is plausible that either offenses or defenses are more prone to becoming ineffective through tiredness. We thus include measures of the number of offensive plays run or the time spent on offense. We do not find statistical significance.

[13] See Hayes, N. 2010"Former NFL Sack-magnets Feel Cutler's Pain." *Chicago Sun-Times*, 11/2/2010.

3 Data and Results

Our data consist of statistics from all 429 regular season NFL games that have been tied at halftime from 1994 through 2012.[14] The challenge in estimating how strategies affect the outcome of games is that a game's score also affects strategy. For example, when a team has a lead they are more likely to run than pass because doing so minimizes the number of plays remaining in the game. We view tied games as a natural experiment that allows us to avoid this issue.

Data on the point spread come from Northcoast Sports. All other variables come from the NFL's Game Statistics and Information System. All variables are measured as the value of the home team less that of the visiting team.

Throughout, our dependent variable is a binary variable that equals one if the home team wins the game.[15] Our econometric method is to run a simple logit/linear probability specification that includes the point spread, second half possession, and one variable from each of 5 separate categories. Table 1, details these categories:[16]

Table 1: Variables By Category

Category	**Variables**
Passing	**Passing Yards**, Gross Passing Yards, Passing Attempts, Passing Completions, Completion %, Yards/Pass, Pass Play %
Rushing	**Rushing Yards**, Rushing Attempts, Yards/Rush, Rush Play %
Offensive Efficiency	**Offensive Plays**, First Downs, Third Down Attempts, Third Down Success %,Time of Possession , Yards/Play
Negative Plays	**Sacks Allowed**, Sack Yards, Punts, Penalties, Penalty Yards, Fumbles, Fumbles Lost, Interceptions, Turnovers
Scoring	**Red Zone Attempts**, Red Zone Efficiency, Red Zone Points/Attempt, Points off Turnovers, Non-Offensive Scores

Our baseline specification includes the first, bolded variable in each category. For robustness, we then considered each other variable by substituting it for the baseline variable in its category (*e.g.* replacing passing yards with passing attempts.) Except where discussed hereafter, running alternate specifications does not affect our main conclusions. Likewise, omitting second half possession does not affect our main conclusions.

For interpretation, we focus on the results from the linear probability model. We do so

[14]We discard eight tied playoff games because the teams in those games face different incentives. Losing a playoff game always ends the team's season.

[15]Games ending in a tie are rare in football. None of the games tied at halftime ended in a tie.

[16]The average point spread was the home team being favored by 2.30 points. The home team won 56% of the games.

because the fitted probabilities always range between zero and one and the levels of statistical significance are very similar to the logit specification. For completeness, we also report the odds ratio and level of statistical significance from the logit specification.[17] Table 2 reports the results for the baseline specification:

Table 2: Baseline Results

Variable	Coefficient (LPM)	p-value (LPM)	Odds Ratio (Logit)
Constant	0.524	0.000	NA
Point Spread	0.0229	0.000	1.107***
Possession	-0.0332	0.495	0.858
Passing Yards	0.000491	0.356	1.00220
Rushing Yards	0.000153	0.841	1.000767
Offensive Plays	-0.00103	0.782	1.00438
Sacks Allowed	-0.0172	0.264	0.928
Red Zone Attempts	0.0156	0.499	1.0704

As expected, we find with a high level of confidence that the favored team is more likely to win a tied game. An increase in the point spread of 3 points increases the team's chances of winning a tied game by a little less than 7%. Alternatively, using the logit specification, a one-unit increase in the point spread implies that the team is 1.11 times more likely to win. Surprisingly, we find that the team receiving the first possession of the second half does not have a statistically significant effect on a team's chances of winning. In fact, the estimated magnitude is important in the opposite direction, the team receiving the second half kickoff is about 3% less likely to win. None of our alternate specifications returned a statistically significant coefficient, but many yield the opposite sign. This result occurs because receiving a kickoff results, on average, in poor field position. In 2010, the average field possession after a kickoff was the 26.8 yard line, in 2011, it was the 22.1 yard line.[18]

To formally test the hypothesis that $f = 0$, we run a joint f-test on all of the independent variables except for the point spread. If this hypothesis is valid, then our theoretical model suggests that the two halves of a football game are independent events, and that unexpected events in the first half have no bearing on which team wins the game. We fail to reject this hypothesis, our f-test yields a p-value of only 0.423.

We find no evidence that running the football provides a team with a latent advantage that pays off late in a close game. For this specification, the sign is positive but not at all statistically

[17]For the odds ratio, *** indicates statistically significant at the 99% level, ** at the 85% level, and * at the 90% level.

[18]See Carr. P. 2012. "Kickoff Rule Change Has a Big Effect on NFL." *ESPN.com* 1/3/12. After 2010, the NFL instituted a rule change that made kickoff returns less successful.

significant. None of our alternate variables in the Rushing category yield statistical significance and many yield a negative coefficient. Our results suggest that if teams choose to run the football, they should thus do so on the basis of the expected yards gained and the risk involved. "Establishing the run" for its own sake does not maximize a team's chances of winning the game.

We do find weak evidence that allowing sacks reduces a team's chances of winning.[19] this coefficient is generally negative with p-values ranging from 0.1 to 0.3. The coefficient estimate suggests that this variable may be important. Allowing an additional sack reduces the chances of winning by 1.7%.[20]

In addition to estimating the model with each alternate variable from Table 1, we also estimate it with just the point spread and only one baseline variable. We do this for each category. Our main results do not change. Only the point spread is statistically significant.[21]

Excluding the Point Spread

We interpret our right hand variables, excluding the point spread, as unexpected shocks to sacks, passing yards, etc. The expected component of these events is nested in the point spread. By omitting the point spread from our specification, we quantify the effect of changes to these variables regardless if they are expected or unexpected:

Table 3: Results Excluding the Point Spread

Variable	Coefficient (LPM)	p-value (LPM)	Odds Ratio (Logit)
Constant	0.573	0.000	NA**
Possession	-0.0291	0.564	0.886
Passing Yards	0.00101	0.064	1.00418*
Rushing Yards	0.000025	0.975	1.0001
Offensive Plays	-0.000681	0.860	0.997
Sacks Allowed	-0.0138	0.386	0.944
Red Zone Attempts	0.0270	0.259	1.112

Notably, the p-value on passing yards falls below 0.1. This suggests that while passing yards are a decent predictor of who wins the game, this is largely because the better team (as reflected in the point spread) tends to have the superior passing game. This result is unsurprising given

[19]Ideally, we would use data on quarterback hits instead of sacks. Unfortunately, these are not available. We also do not have data on quarterback or other key injuries

[20]To put this in perspective, allowing five sacks in a half would be an exceptionally bad performance.

[21]We also tried including interaction terms between the point spread and other variables. This would allow, for example, the number of offensive plays to predict victory only for large underdogs. These were also insignificant.

the importance of the passing game in the NFL. Additional unexpected passing yards, however, as shown in Table (2) have no significant predictive power. This result is further illustrated if we exclude the statistically insignificant variables from Table 3

Table 4: Results Excluding the Point Spread

Variable	Coefficient (LPM)	p-value (LPM)	Odds Ratio (Logit)
Constant	0.554	0.000	NA**
Passing Yards	0.00101	0.009	1.00419***

Passing yards are now statistically significant at the 99% confidence level. 10 addional first half passing yards increase the chances of winning by about 1%. We repeat this exercise for each of the variables in the Passing category from Table 1. The results were very similar for all of them except Yards per Passing Play. Those results were not significant.

The significance of passing yards (when the point spread is excluded) is consistent with other empirical work. Both Alomar (2006), and Kovash and Levitt (2009) find that NFL teams pass too little. Nevertheless, it is difficult to follow the NFL without often hearing statements that emphasize the importance of the run such as "Minnesota is 3-0 when Chester Taylor rushes for 100+ yards." Schatz (2003) shows that the best NFL teams tend to pass early, build a substantial lead, and then run out the clock by predominantly choosing running plays. This yields the frequently referenced positive correlation between winning and running that is often confused as causation. The results from Tables 3 and 4 are consistent with these findings.

4 Conclusion

We examine whether the path taken to a tie football game matters in forecasting the winner of the game. Our most interesting results are negative, that details such as the first second half possession and running (attempts or yards), do not matter. The only variable that seems to matter is the point spread, a measure of which team is stronger.

Our results suggest that the optimal strategy is to try to attain as large a halftime lead as possible. At first glance, this may seem obvious. But it runs contrary to extensive analysis that suggests that certain first half strategies may affect the teams' performance in the second half. Such analysis appears to be over-thinking the game.

Our results focus on unexpected strategies, such as running more than normal. We do not claim that expected strategies are irrelevant. We find that, omitting the point spread, passing success is a good predictor of the final outcome. This result arises because passing success is a good measure of which team is better. The effect thus disappears when we control for the point spread.

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