To Go for Two or Not to Go for Two? A Statistical Analysis of the Biggest Prisoner's Dilemma in the National Football League

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Abstract

In the National Football League, after a team scores a touchdown, they can kick an extra point or attempt a two-point conversion. Historically, teams have opted for the former, as it was associated with a seemingly guaranteed success. In 2015, however, the NFL instituted a rule to move the extra point distance back 13 yards, making it a more difficult kick. This paper will analyze the effect of this rule on the extra point rate, breaking down the game theory behind both strategies and offering recommendations to both NFL teams and the league itself.

Introduction

In the National Football League (NFL), the ultimate goal of every offensive possession is to score a touchdown. Upon this result, a team is awarded six points and is faced with a decision: attempt a one-point extra point kick or go for a two-point conversion from the two-yard line (Goodell, 2023). Historically, teams often opted for the extra point kick unless they urgently required the additional two points because the extra point attempt was more likely to succeed. Before the 2015 season, however, the NFL decided to move the extra point distance back 13 yards from a 20-yard attempt to a 33-yard attempt (Patra, 2015). Despite this decision, it seems like teams are still favoring the one-point strategy. Is this the correct choice? The motivation behind this study is to analyze the impact of this rule change on the league. However, with the rule change making extra point attempts more difficult, it is essential to reevaluate the value of both options.

This study has several objectives. First, the paper examines the extra point and two-point conversion rates from before and after the rule change. Next, the acquired probabilities form an outcome matrix to analyze the effectiveness of both strategies. Theoretically, the expected payoff for kicking an extra point and going for two should be equal. In other words, both strategies should form a Nash equilibrium pair with each other (Jin et al. 2012). Did the rule change make the expected payoff of both strategies equal? Or did it increase the disparity? With the help of Monte Carlo simulations, this paper will determine the proper extra point distance that results in a balance between the two strategies. Lastly, by looking at kicking and two-point conversion data, it is possible to determine the potential points a team could have scored by simply attempting the two-point conversion in each instance. This information can allow the calculation of the number of potential points a team could have scored by only opting for the two-point conversion.

The ultimate goal of this paper is to use empirics and statistical analysis to present the NFL with a challenging decision. Should the league maintain the current extra point distance or consider further adjustments to ensure that kicking the extra point becomes a more difficult decision?

Materials and Methods

To address the above question, we conducted two separate studies—one focused on analyzing two-point conversions, while the other examined extra points. We utilized NFL play-by-play data from the R package nflfastR that spanned from 2006 to 2023, dividing it into two distinct periods: before and after the change in extra point distance regulations (Carl & Baldwin, 2024). The pre-change dataset covers the years 2006 to 2014, while the post-change dataset spans from 2015 to 2023.

First, we filtered the data to isolate instances of two-point conversions and extra points. For extra points, we subsetted the data to 20 yards (standard extra point distance pre-2015) and 33 yards (standard extra point distance post-2015) for the corresponding dataset. Subsequently, we determined the success or failure of each two-point conversion and extra point attempt, assigning a binary outcome for each attempt within both timeframes. Following this, we calculated the average success and failure rates for both types of attempts across all data points. Additionally, we examined the total number of two-point conversion attempts in each timeframe to assess whether the change in distance influenced teams' decision-making regarding conversion attempts. With the data cleaned and filtered, we assessed the significance of our findings from both periods using a t-test. This statistical test will determine whether there is a notable difference in conversion rates for extra points and two-point conversions between the two timeframes.

Utilizing the ratios from the previous calculations, we created two outcome matrices. The first matrix compares the success rate of extra point attempts and two-point conversions before the rule change. The second matrix examines the same thing, except in the timeframe after the rule change. Using these matrices, determining each strategy's expected payoff is possible. If one specific strategy has a higher expected payoff, it would be considered the dominant strategy.

Next, we needed to figure out how to find the ideal extra point distance: where the payoff of an extra point and two-point conversion were equal. Using the above proportions as well as their standard deviation, a random sample following a normal distribution was generated for each distance (20 and 33 yards) to find a hypothetical extra point rate for a random situation. The two generated proportions were used to create a linear model, with the slope representing the change in extra point percentage with a one-yard increase in distance. Using this model, we were able to approximate the probability of making an extra point at every distance. This was repeated 10,000 times through a Monte Carlo simulation and averaged to account for uncertainty. We then compared the expected payout at all distances with the expected payout of the two-point conversion. If the expected payouts were the same, this would indicate that the two strategies would be a Nash equilibrium pair.

How could these findings be applied to a specific NFL team? Kicker skill and offensive prowess might influence how teams view the after-touchdown strategies. To prevent a broad generalization of the results, we decided to see if individual teams would benefit from going for two points with every opportunity. To calculate this, we found the total points a team scored off of extra points and two-point conversions from 2015 to 2023. In order to get the expected points a team would have scored if they only went for two point conversions, we had to perform a couple calculations. First, we multiplied the number of extra point and two-point conversion attempts by two. This value would give us the total points a team scored if they successfully converted a two-point conversion 100 percent of the time. We then multiplied the value by the team's two-point success rate, giving us the team's expected points. To compare the result of each team only attempting two-point conversions, we subtracted the team's actual total score from the score we computed.

Results

The results of our study provide valuable insights into figuring out if the NFL made the correct decision. Through rigorous analysis of two-point and extra point data, we have uncovered several noteworthy findings that shed light on teams potentially missing points by opting to kick. Figure 1 compares the extra point success rate before and after the rule change. Before 2015, 11,356 extra points were attempted, with over 99 percent of these kicks resulting in a conversion. After the thirteen-yard

pushback, while extra point attempts remained relatively constant at 11,447, the success rate decreased by five percentage points. According to Figure 1, the difference in success rates was statistically significant. In other words, the rule change caused a statistically significant decrease in extra point conversion rates.

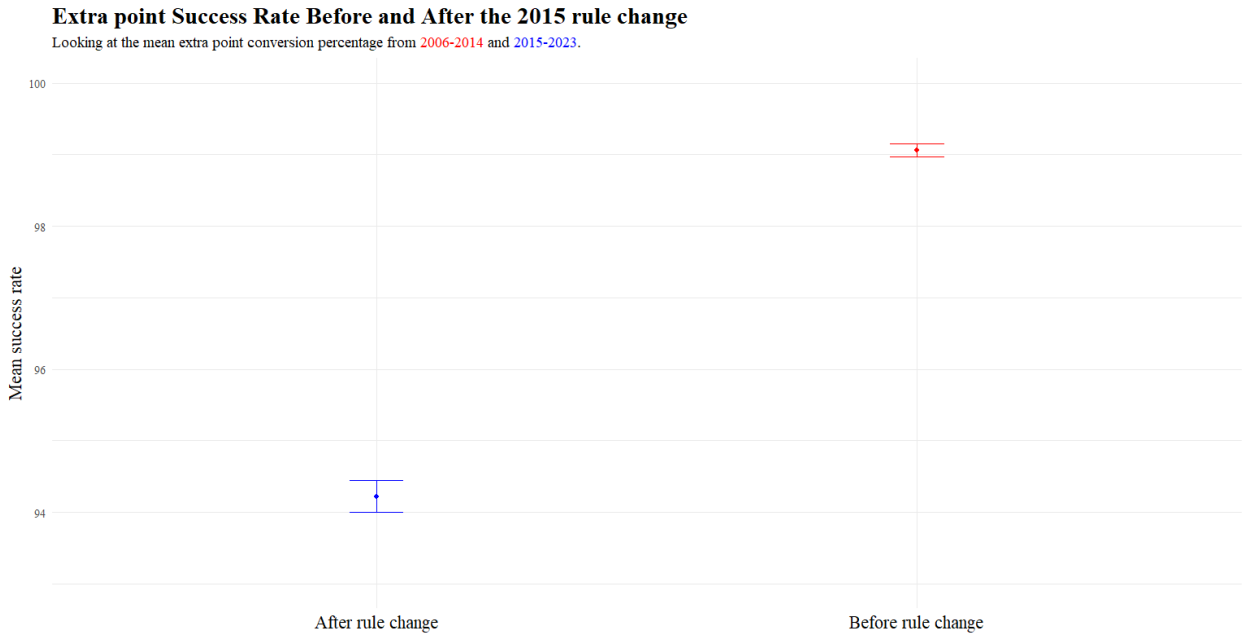

Figure 1: *Extra point success rates before and after the 2015 rule change*

The NFL certainly got the results they wanted, but they may have made two-point conversions much more valuable in exchange. Before the rule change, 529 two-point conversions were attempted from 2006 to 2014. In the same timeframe after the rule change, the league has seen the attempts more than double to a total of 1,126 tries. Despite this increase in attempts, Figure 2 highlights no significant difference in two-point conversion rates, as both proportions were around 49 percent. The observations make sense, as two-point conversions have a smaller sample size, hence accounting for variation, and the extra point rule did not structurally change the process of two-point attempts.

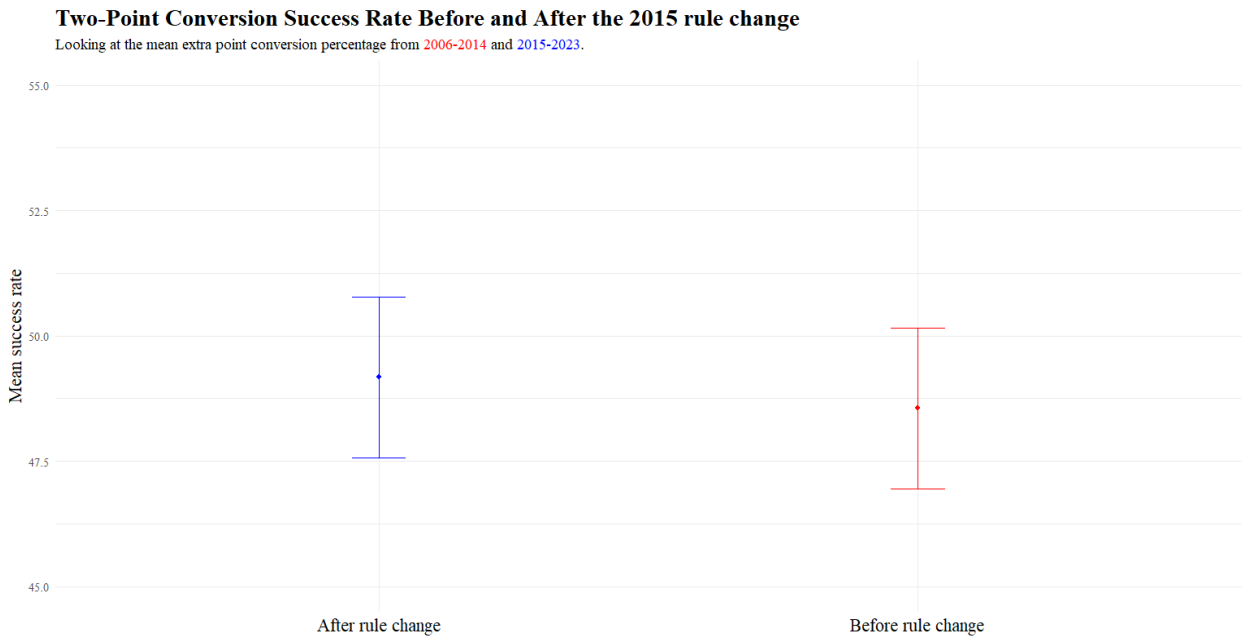

Figure 2: *Two-point conversion success rates before and after the 2015 rule change*

The proportions from **Figure 1** and **Figure 2** are represented in an outcome matrix. When analyzing the matrices, it is worth noting that extra point conversion rates were multiplied by one, and the two-point conversion rates were multiplied by two to get the expected payout of each strategy. **Figure 3** details the outcome matrix of extra points and two-point conversions before the rule change. Due to the high extra point success rate, extra points had a higher expected payout than two-point conversions. On average, if a team kicked only extra points, they would score more points in the long run. **Figure 4** details the outcome matrix of the two strategies after the rule change. The lower success rate of extra points resulted in the two-point conversion having the higher payout and being the dominant strategy. On average, if a team only went for two points, they would score more points in the long run. Through a game theory lens, moving the extra point distance has made the two-point conversion the dominant strategy, making it a preferable option.

	Success	Failure	Expected payout
Extra-point attempt	0.991	0.009	0.991
Two-point attempt	0.486	0.514	0.972

Figure 3: *Outcome matrix before the 2015 rule change*

	Success	Failure	Expected payout
Extra-point attempt	0.942	0.058	0.942
Two-point attempt	0.492	0.508	0.984

Figure 4: *Outcome matrix after the 2015 rule change*

Figure 5 displays the results of the Monte Carlo simulation for every extra point distance, from 18 yards to 35 yards. The bar plots represent the difference between the expected payout of kicking an extra point at that distance and the expected payout of the two-point conversion. Since the two-point conversion success rate did not change significantly before and after the extra point rule change, the same expected payout for two-point conversions from **Figure 4** was used for every distance. To achieve the goal of both strategies having an equal payout, the distance corresponding to the bar closest to zero would

be the ideal distance. According to the graph, a 22-yard extra point had the most similar expected payout to a two-point conversion. All extra points over 22 yards received lower payouts than the two-point conversion. Extra points shorter than 22 yards received higher payouts than the two-point conversion.

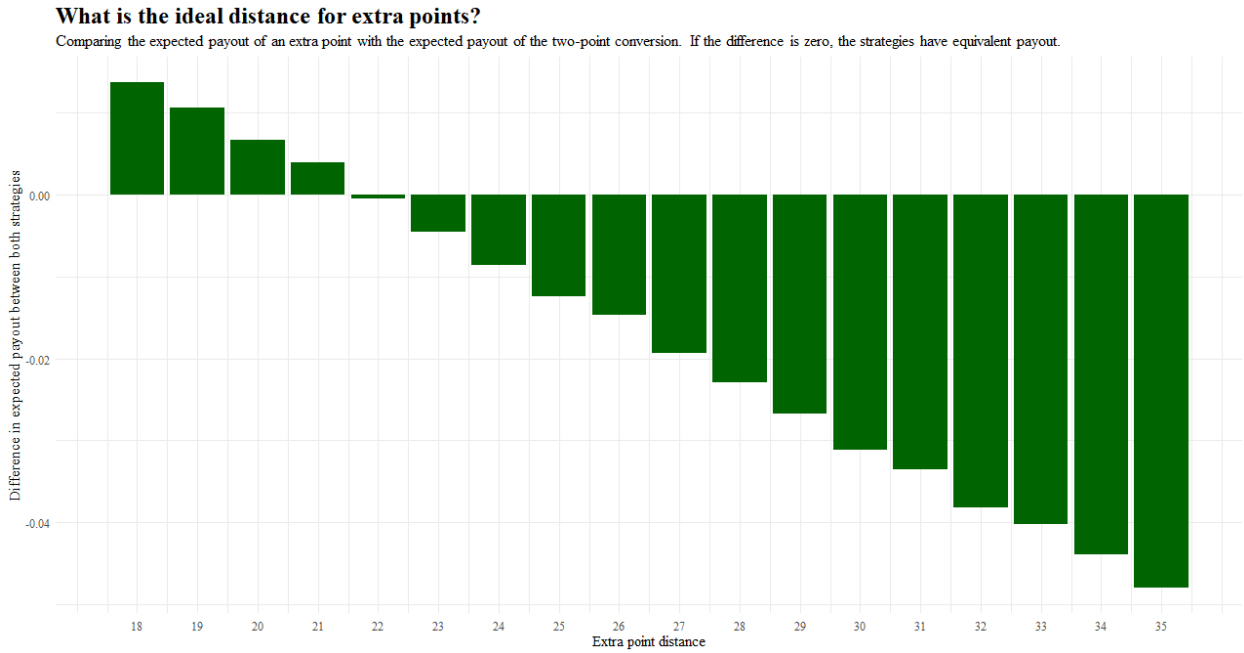

Figure 5: *Finding the extra point distance that achieves equilibrium between the two choices*

Two-point conversions seem to be the better strategy. But is this true for every team? **Figure 6** displays a team-specific analysis using their extra point and two-point success rates. Shockingly enough, 19 of the 32 NFL teams would have scored more points between 2015 and 2023 if they had only gone for two instead of settling for the extra point. The Kansas City Chiefs would have benefited the most, scoring 177 more points, if they simply attempted a two-point conversion after every touchdown. These findings truly show that two-point conversions have become the dominant strategy in the NFL, and teams should be taking advantage.

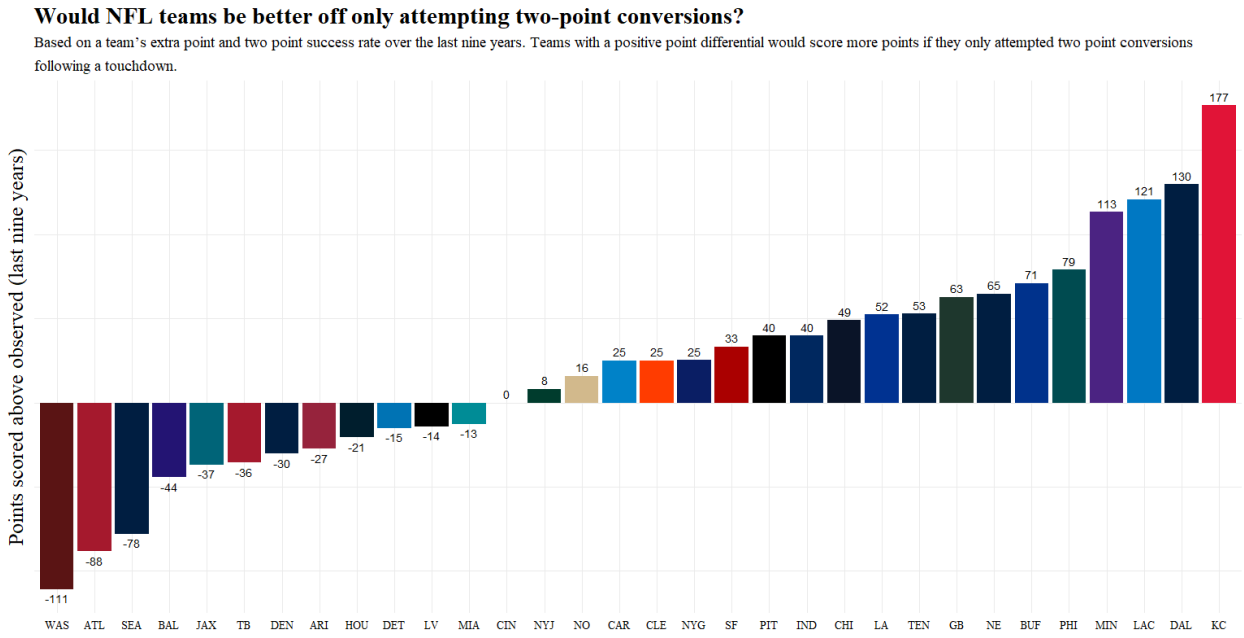

Figure 6: *Team-specific analysis based on team extra point and two-point conversion rates*

Discussion

The NFL's rule change has undoubtedly impacted the success of extra points, allowing the two-point conversion to become a viable strategy. Based on our analysis, NFL teams should consider going for two points more often as they may be leaving points on the table. Being elite at two-point conversions can provide an advantage that could differentiate between a win and a loss.

While there are some shocking discoveries in our study, some limitations must be addressed. One of these is the numerous confounding variables in the study. The drop in conversion rate on extra points could be due to other factors such as kicker skill level or an abnormal increase in wind. It would make sense to kick the extra point in some situations. If the scores are level and the team only needs one point to win the game, it makes sense to kick the extra point since it is still the more probable event. There are also simply not enough two-point conversion attempts to conclude that it is the optimal strategy. We would need a larger sample of two-point conversions to do so. Finalizing conclusions when two-point conversion attempts are still a rarity is simply not plausible.

This study has future applications. If two-point conversion attempts continue to rise, it would be interesting to see if our conclusions still hold true. Under the current NFL rules, we foresee an increase in offensive points scored as teams become more comfortable with two-point conversions in non-crisis scenarios.

Conclusion

While there has been a noticeable increase in two-point conversion attempts across the league since the extra point distance rule change, teams still opt to go for the extra point over 99 percent of the time.

However, our thorough analysis has revealed that this option might not be as safe as previously thought. Was the rule change a good idea? The analytics say yes. Moving the extra point distance has revitalized the two-point strategy. Going for two points has historically been classified as an end-of-game tactic when teams are desperate. The results of this study prove that the strategy needs to be more utilized, and teams would be, on average, better off going for two points more often. Does this mean that teams should go for two points every play? Probably not. However, teams should reconsider how they view the role of the two-point conversion in today's NFL.

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