Senior Project

Department of Economics

From Touchbacks to Touchdowns: Analyzing the Impact of the NFL's New Kickoff Rule Changes

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Abstract

The NFL changed its kickoff rules in 2024 to a new NFL kickoff format that the NFL called “the Dynamic Kickoff”. The NFL changed its kickoff rules to make the game more exciting and to increase the number of kickoff returns per game. The NFL also changed the kickoff rules to decrease the violence and impact of collisions and, therefore, reduce injuries, particularly concussions. (Holzman-Escareno, 2024) This research paper analyzes whether the NFL was successful in making the NFL kickoff more exciting by increasing the average number of yards per kickoff return, touchdowns per return, the number of returns per game, the longest kickoff return for a team in a given season, and the number of yards per return. Using a two-way fixed effects difference-in-difference model, this research paper finds that the NFL accomplished its goals of more kickoff returns and greater offensive output per kickoff return. Other research suggests a marked decline in the overall number of injuries, even with more kickoff returns. Therefore, the NFL achieved the two desired outcomes of the new dynamic kickoff rule changes. However, the average NFL fans find violent collisions exciting (Dubreuil, C., Dion, D. & Borraz, S., 2023), so there could be a tradeoff between injuries and pleasure due to the violent impact. This paper recommends that the NFL make similar changes to plays that are high in injuries and low in success rate, like the onside kick. Future research should include more post-rule change seasons.

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I. Introduction

The NFL changed its kickoff rules in 2024 from a kickoff anywhere in the field of play to a kickoff into a landing zone between the endzone and the twenty-yard line. The kicker still lines up at his own thirty-five-yard line. The kicking team used to line up on their own thirty-five-yard line, but under the new kickoff format, they line up at the opponent's forty-yard line, twenty-five yards ahead of where they used to line up under the old kickoff format. The receiving team lines up at least nine players in what is being called the "setup zone". Two potential returners from the receiving team line up between the zero and the twenty-yard lines, in what is being called the "landing zone." Players must remain stationary until the ball is touched in the landing zone or hits the ground, unlike in the previous kickoff format where players could begin moving as soon as ball was in the air. If the kicker kicks the ball and it lands in the landing zone, it must be returned. If the kicker kicks the ball into the endzone, the ball is placed at the thirty-yard line, whereas touchbacks used to come out to the twenty-five-yard line. If the kicker kicks the ball out of bounds or short of the landing zone, the ball is placed at the forty-yard line. These changes incentivize returners to return the kickoff rather than signal for a fair catch.

The NFL changed the kickoff rule in 2024 "to address the lowest kickoff return rate in NFL history during the 2023 season" and to "address an unacceptable injury rate on kickoffs," which could be viewed as a public health concern. (Irving, 2024)

This research paper analyzes whether the NFL was successful in making NFL kickoff returns more exciting while increasing the kickoff return rate. To do this, this research paper uses a two-way fixed effects Difference-in-Differences model to analyze the causal effect of the rule changes on the average number of kickoff yards per return (Avg), the number of touchdowns per return (TPR), the number of kickoff returns per game (NRPG), the longest kickoff return per team per season (Lng), and the number of yards per return. The research analyzes the relationship between these outcome variables and economic variables like revenue and profit.

This research paper uses two different data sources to collect data from 2014-2024 on the five outcome variables listed above. The first data source, the Football Database, has data for these five outcome variables for the control group, which is the FBS (Football Bowl Subdivision) Division I Collegiate Football teams. The second data source, NFL.com, has data for these five outcome variables for the treatment group, which is NFL football teams. This paper also utilizes a parallel trend test to test the comparability of the treatment and control groups with respect to the five outcome variables of interest.

The analysis finds that on average, the NFL rule changes increase the average number of yards per kickoff return by 24.71% more than it would have been with no rule changes. The rule changes also increase the number of kickoff returns per game by 18.94%, on average, and the longest kickoff return per team per season increases by 20.71%, on average. These results are statistically significant at the 1% significance level. The coefficient for touchdowns per return is not statistically significant. However, using a confidence interval interpretation, the analysis finds the NFL kickoff rules changes did not have a significant impact on the number of touchdowns per return.

Research is essential for NFL policymakers to make informed decisions regarding future rule changes that could be made to NFL plays, such as the onside kick or the addition of an eighteenth NFL game. Since the research shows that the NFL has accomplished part of its goals regarding the dynamic kickoff rule changes, NFL policymakers have an example for future rule changes. The research is also essential for economists because exciting kickoff returns lead to greater fan interest, leading to more NFL revenue. Further, this research paper uses these results to analyze the trade-offs players have in their decision-making and the impact of player decision-making on the outcome of rule changes in general.

The rest of this paper is organized as follows: Section II discusses the existing literature regarding sports rule changes and their effects on outcomes; Section III describes the data used in the analysis; Section IV analyzes the existing theories regarding rule changes and their impact on outcomes; Section V defines the methodology; Section VI provides and analyzes the results; and Section VII is the conclusion.

II. Literature Review

Profit maximization is one of the primary considerations for rule changes in sports. In his book *Much More Than a Game: Players, Owners, and American Baseball since 1921*, Burk (2003) discusses how MLB owners changed the rules to favor offenses to increase attendance and revenues. He shows that owners were reluctant to make the rule changes because, with greater offensive output, the players would demand higher salaries. Owners were trying to pay players less for their Marginal Revenue Product to gain economic rent.

Increasing the pace of play is another way teams can try to make games more exciting and increase attendance. In their research on the Clock Rule Change and Kickoff Rule Change in NCAA football from 2006-2007, Linna, Paul, Moore, and Weinbach (2014) examine the impact of these rule changes on actual and EP (Expected Scoring). Their research finds that the Clock Rule Change led to an overall decrease in scoring; and, therefore, the clock rule change was revoked later in 2007. They also find that the Kickoff Rule Changes in 2007, combined with repealing the Clock Rule Change, led to better starting field position for the offense and greater scoring compared to pre-2006 offensive field position and scoring. Paul & Weinbach (2020) find that rule changes in the MLB increase the pace of play. They also find that shortening the duration of games increases fan attendance. Keenan (2024) also finds that baseball rule changes, including speeding up the pitch clock, increase average MLB attendance by 8.4% at the 10% significance level. He recommends that the MLB continue to test new rule changes at the minor league level.

Predicting player responses and the change in offensive/defensive strategy is an essential determinant of whether to make sports rule changes. In their research on the behavior analysis of sports rule changes, Chan, Savage, and Torgler (2019) examine player responses to the NBA moving the three-point line closer to the basket between 1994 and 1997 and back to its pre-1994 position in 1997. They find that players tend to adjust instantaneously to rule changes. They also find that better offensive and younger players respond better to the rule changes than older players. In a related study, Salter (2014) examines the Mikan Rule in NBA basketball and its effectiveness in curbing the offensive potency of taller players scoring near the basket. He finds that although the rule makes it more difficult for taller offensive players to score, there are strategic defensive behavioral responses to the rule change that led to the Mikan rule not achieving its intended effect. In another study, Santos (2024) developed mathematical models to examine the effects of sports rule changes on team offensive/defensive strategy in the context of the NHL. The study finds that removing the overtime period or increasing the rewards for a win would lead to more offensive strategies for both teams. The study also shows that offensive strategies align with higher fan interest and more significant team revenue. Houghtaling (2022) finds that changing baseball rules at the minor league level was successful in increasing the number of bases stolen and the success rate on base steals. (Keenan 2024)

In a research study about the Away Goals Rule, Jost (2021) finds that the Away Goals Rule can lead to greater competitive balance introduced by the home-field advantage in the quarter and semifinals in the knockout rounds of the Champions League. In a similar research study on competitive balance and the NFL vs the NCAA, Eckard, E. W. (2019) finds that there is no significant difference in the competitive balance in the NFL and the Power-5 Conferences. Therefore, he goes on to conclude that the NCAA does not have a legitimate case when arguing for college athletes to be paid far less than their NFL counterparts.

Injuries are an inevitable part of any sport, but there are certain decisions leagues, players, and coaches must make that can increase or decrease the risk of injury. Cisyk & Courty (2024) assert that sports injuries are due to uncontrollable risks (accidents) and controllable risks involving player decisions. In their research, they compare injury policies made by sports organizers according to whether the policies maximize welfare, fail to account for behavioral risks, or were made by the athletes themselves. They argue that policies that escalate risk, like mandating protective equipment, are over-adopted by policymakers and athletes, and that policies that de-escalate risk, like return to play rules, are under-adopted.

III. Preview of the Data

This research paper utilizes data from two primary sources. All the data collected is at the team level for a given FBS/NFL football season. Data specific to the FBS, including the number of kickoff returns, total kickoff return yards, average number of yards per kickoff return, the longest kickoff return, and the number of touchdowns, is collected from the Football Database. The Football Database is a database whose primary purpose is to collect both NFL and NCAA

(National Collegiate Athletic Association) football data and statistics (*2024 FBS Kickoff Statistics | the Football Database*, 2024)

Data specific to the NFL is collected from NFL.com, and includes the variables listed above. NFL.com is the official website of the National Football League. (*NFL.com | Official Site of the National Football League*, 2024)

To obtain the outcome variables YPR and TPR used later in the analysis, the number of touchdowns was divided by the number of kickoff returns for a given team in a given year. The variable NRPG was obtained by dividing the number of returns by the number of games played in each season for a given team. This data is collected for the years 2014-2024; with 2014-2023 being the pre-treatment period; and 2024 the treatment year.

It is worth noting that a few FBS teams did not participate in 2020, or were not include in the FBS during the treatment year or a sufficient number of the pre-treatment years. These teams were dropped from the dataset. It is also worth noting that in 2023, the NFL purposely succeeded in significantly reducing the kickoff return rate to reduce injuries and prepare a new kickoff format that would lower injuries while making the play exciting again. Since this year is an outlier, this analysis is justified in dropping it from the final regression models and parallel trend tests. Lastly, there may have been a slight effect of the pandemic on NFL kickoff returns in 2020 because in general, fans were not permitted to be in the NFL stadiums. This could have made it easier for return teams to operate and make decisions with less outside noise, leading to longer and more frequent returns, and potentially affecting the variables in this study.

Table 1 contains the summary statistics for all quantitative variables for NFL teams. Note that there is a large sample size (N) for each of the five outcome variables of interest. The means for TPR and NRPG are lower than the others because there are generally only a few kickoffs returned per game, and touchdowns on kickoff returns are rare. The standard deviation of YPG and long is higher relative to the other outcome variable, but this can be explained by chance. Clearly the maximum and minimum are farther apart for the variables long and YPG; but again, this is due to chance.

Table 1. NFL Summary Statistics

Variable	N	Mean	St. Dev	Minimum	Maximum
Avg	352	23.01	3.05	14.60	38.00
TPR	352	0.01	0.01	0.00	0.09
NRPG	703	0.97	1.90	0.00	44.06
Lng	352	57.40	24.22	0.00	108.00
YPR	352	22.91	3.19	0.00	32.09

Source: NFL.com (2024).

Table 2 contains the summary statistics for all quantitative variables for all FBS teams. Note again that there are fewer observations given for FBS teams relative to NFL teams, but this can be explained by a shorter league year in College Football Relative to the NFL. All other summary statistics are comparable to those in the NFL model, which is a good initial indication that the treatment and control groups are similar.

Table 2. FBS Summary Statistics

Variable	N	Mean	St. Dev.	Minimum	Maximum
Avg	1299	20.73	3.13	9.36	33.67
TPR	1299	0.01	0.02	0.00	0.19
NRPG	1299	2.46	0.93	0.15	6.25
Lng	1299	59.67	25.73	16.00	100.00
YPR	1299	20.73	3.13	9.36	33.67

Source: The Football Database (2024).

IV. Theoretical Framework

Policymakers should consider tradeoffs when determining rule changes in FBS and NFL football. How to hit an opposing player or whether to return a kickoff football are critical decisions players must make in split seconds. In the previous kickoff format, split-second decisions were made while players were moving at higher rates of speed and momentum. Under the new NFL kickoff rules, players are given more time to make decisions than in the old kickoff format because players must remain stationary while the ball is in the air. Furthermore, in the new kickoff format players begin closer to one another, making it harder for them to build up speed and momentum before a collision.

On any given play, players must take risks to try and maximize the potential offensive/defensive output versus the risk of injury. Giving players more time to make decisions can help them make better utility-maximizing decisions. (Katsikopoulos and Gigerenzer, 2022) (Hinz, Lehmann, and Musculus, 2022). Simple heuristics are one of the most common frameworks for modeling decision making under time and other pressures. (Raab, 2012). These models explore situations in which athletes have limited time and resources and are presented with two or more options. (Raab, 2017) Two key factors that determine athlete choices in time-pressured situations with limited resources are their initial preparation and their commitment to the action. These types of embodied-choice paradigms have been shown to accurately depict fast and accurate responses in real-world situations and in general. (Ratcliff 2016).

In a research study by Hinz, Lehmann, and Musculus (2022), amateur and elite handball players underwent a sport-specific embodied choice test. Thirty-two different attack sequences were shown to players. Players had to choose between four sport-specific motor responses in each attack sequence. The research study then uses math models that analyze the specific choices of players and how many times they made the best choice, factoring in the amount of decision time and confidence of each player. The study finds that elite players make the best choice more often than amateur players. Elite players were also found to have slower decision times than amateur players, while elite and amateur players' confidence levels were rated equally highly. Therefore, the study concludes that better, more elite players make better decisions more slowly than amateur players who make worse decisions faster. The study postulates that this is due to specific sensorimotor responses and more elite players favoring accuracy in the tradeoff between accuracy and speed of decision making.

The research conclusions of Hinz, Lehmann, and Musculus were contrary to some of the other models that found that more elite players made decisions faster at the expense of accuracy. A research study by Vaeyens (2007) examines decision time by executing movement-based responses in different offensive patterns. Vaeyens divided the players into groups to execute the different offensive patterns. Vaeyens finds that individuals who were successful decision makers made better decisions in a faster period relative to individuals who were unsuccessful decision makers.

Like tradeoffs, incentives are an essential way policymakers can help players make better split-second decisions in the tradeoffs they face. More specifically, rule changes can incentivize players to change their decision-making towards achieving the desired outcomes. In his research paper, Howell (2011) explores how changes in policy create incentive-like situations within the sport and recreation industries. The analysis finds that implementing the Wild Card playoff structure in Major League Baseball incentivized teams to spend more money in the offseason to have a better postseason. Furthermore, the creation of additional playoff spots was sufficient to incentivize MLB teams to add to their payroll, suggesting that the rule change increased competitive balance. This research indicates that changing incentives (rule changes) can impact desired outcomes. The NFL hopes to incentivize kickers to kick a returnable ball by increasing the starting field position from the twenty-five-yard line to the thirty-yard line on kickoffs that go through the endzone. Furthermore, at the time of writing, the NFL owners voted to move the touchbacks from the thirty-yard line to the thirty-five-yard line, further incentivizing kickoff returns. (*NFL Owners Vote to Adjust Ball Spot on Touchbacks to 35-Yard Line on Dynamic Kickoffs*, 2024)

Decreasing the number, rate, and severity of injuries on kickoff returns was one of the NFL's most important considerations for adopting new kickoff return rules. According to the NFL's new kickoff rule changes in 2024, the return and kicking teams' line up twenty-five yards closer to one another on the initial kickoff. The kicking unit is not allowed to move until the returner receives the ball in the landing zone, whereas in the past, the kickoff unit would be sprinting full speed down the field while the football was in the air. Therefore, these rule changes are expected to decrease the frequency and impact of high-speed collisions that lead to catastrophic injuries, most notably concussions, on what has been known as a disproportionately dangerous play (NBC Sports, 2022; Hall, 2024).

Therefore, the existing literature differs regarding decision-making given limited time and resources; however, the literature is clear that incentives are successful in influencing player decision-making and behavior towards desired outcomes. This research study hypothesizes that increasing the amount of time to process decisions and incentivizing kickers to kick off into the field of play will lead to greater offensive output on kickoff returns, while increasing the kickoff rate.

V. Methodology

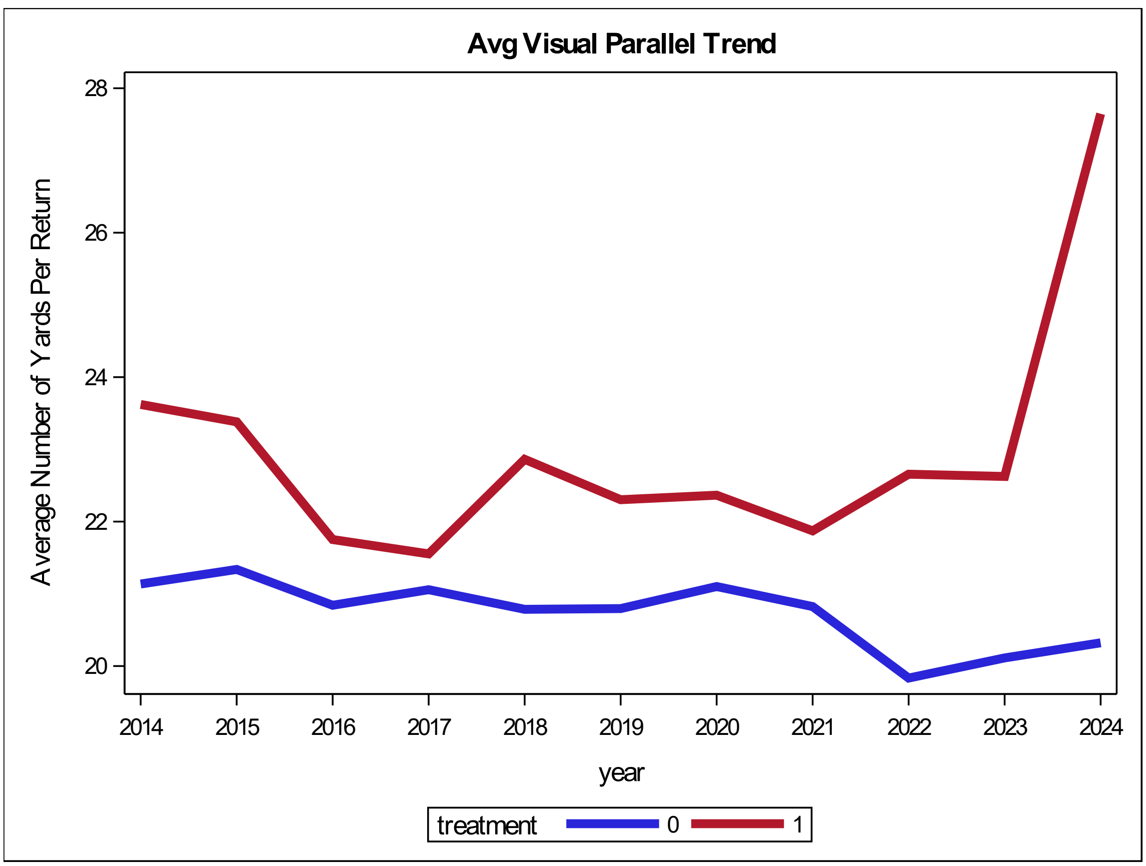
The analysis presented in this research study utilizes a two-way fixed effects Difference-in-Differences Model to evaluate the impact of the NFL kickoff rule changes on five different outcome variables. The equation is the following:

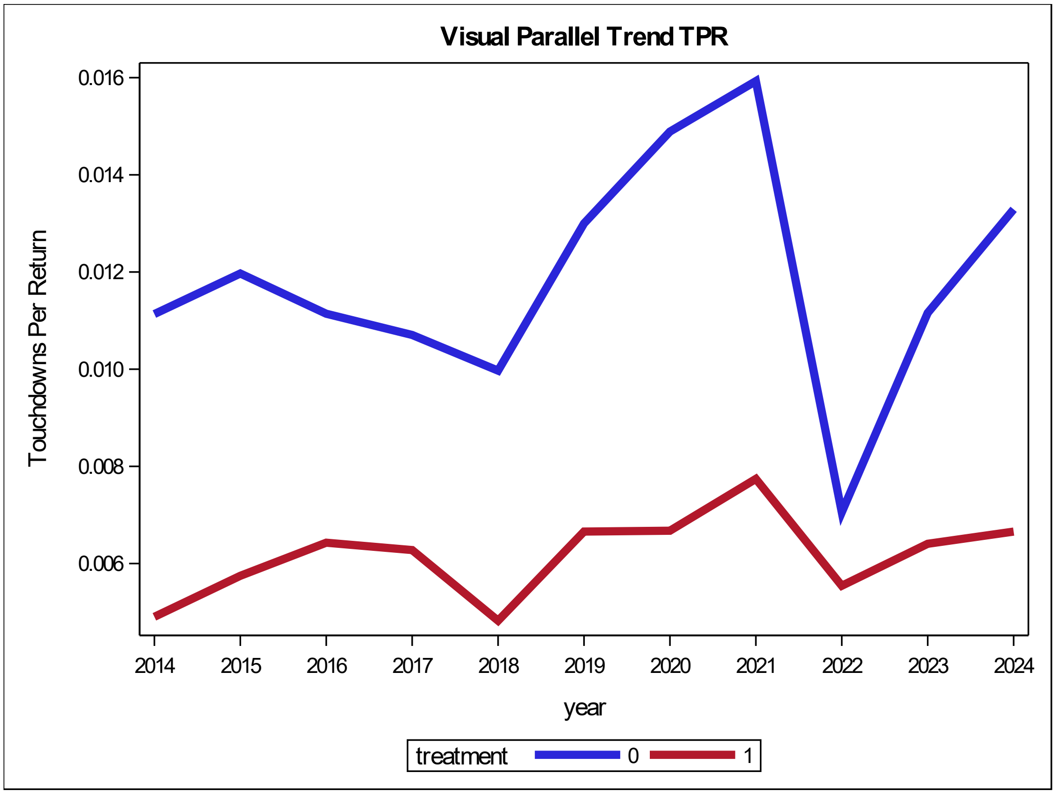
$$Y_{s,t} = B_0 + B_1 RuleChange + Team_s + Year_t + \varepsilon_{s,t} \quad (1)$$

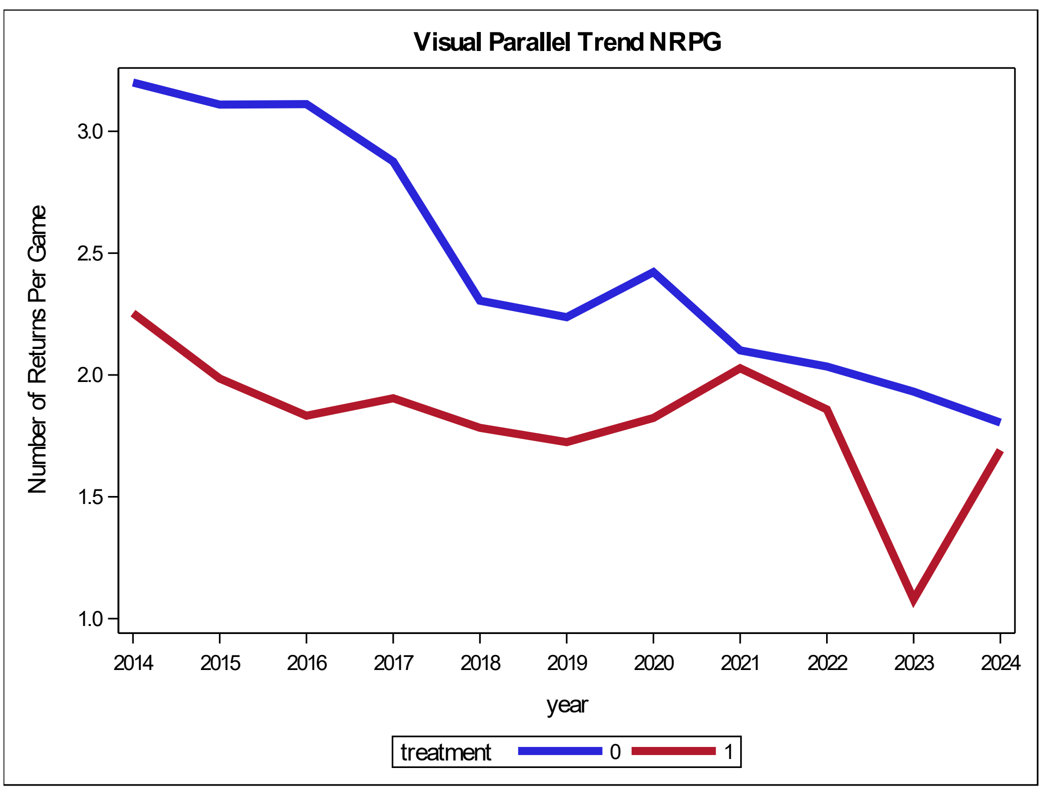
where Y is an outcome variable that represents one of the following for a team s in year t: the average number of yards per return, the number of touchdowns per return, the number of returns per game, the longest return, or the number of yards per return. *RuleChange* is an indicator variable equal to 0 for all FBS collegiate football teams, as they belong to the control group. *RuleChange* is equal to 1 for NFL teams playing in 2024 when the NFL kickoff rule changes came into effect, and zero otherwise. and Year represent team and year fixed effects, respectively. Lastly, ε is the white noise.

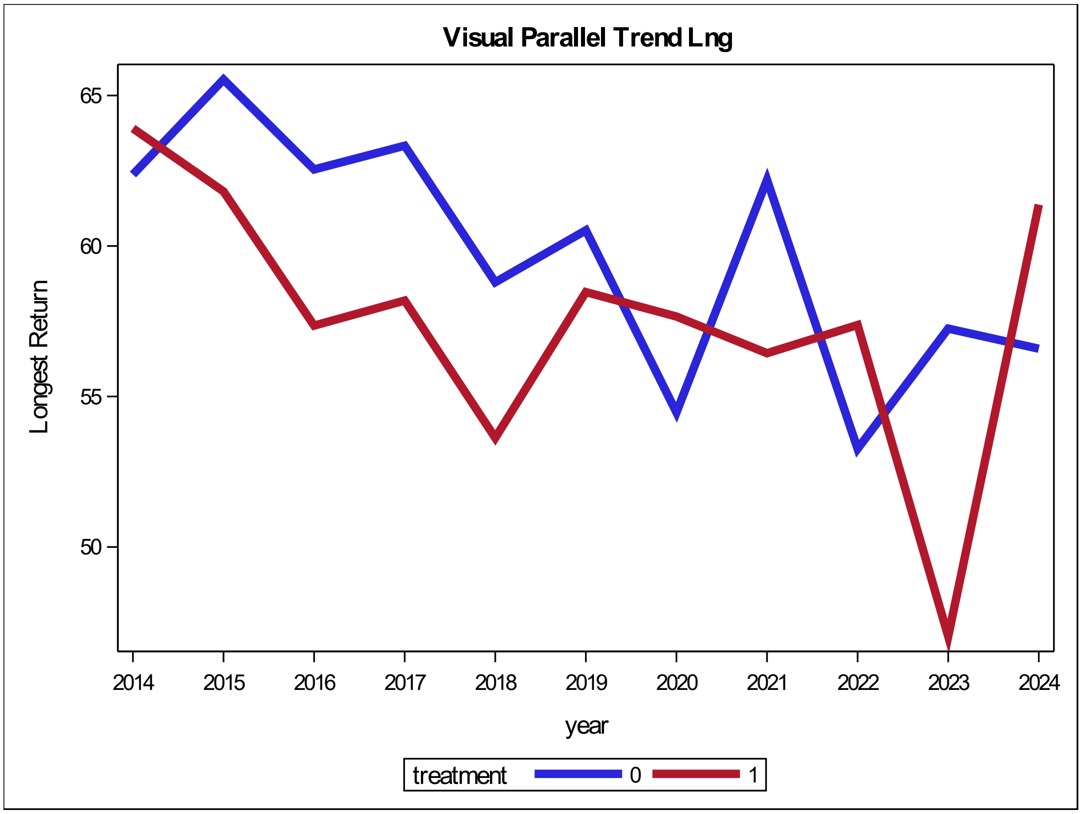
This research paper uses a parallel trend test to test whether the NFL and FBS were comparable in the pre-treatment period (2014-2023). To test this, the parallel trend model uses relative year and treatment. Relative year is defined as the year 2024 subtracted from the given year. Treatment is equal to 1 if the team is an NFL team, and zero otherwise. The interaction terms between relative year and treatment show whether treatment and control groups are comparable in each year for NFL and FBS football teams. For both the regular and hyperbolic sine models, Avg, TPR, and YPR, the interaction terms were not significant at either of the 1%, 5%, or 10% significance levels. This suggests a parallel trend exists between the NFL and FBS for these outcome variables. However, the interaction terms *Relative Year^2*Treatment* and *Relative Year^3*Treatment* for the outcome variable yards per kickoff return are statistically significant at the 10% and 5% significance levels, respectively. This suggests that treatment and control groups may not be as comparable for this outcome variable, which could introduce bias into the results. Lastly, the interaction terms *Relative Year^2* and *Relative Year^3* are statistically significant at 5% and 1% significance levels, respectively. This also indicates that the treatment and control groups are not as comparable for the outcome variable, number of returns per game, which could later introduce bias into the results.

Figures 1-5. Visual Parallel Trend Test.




Visual Parallel Trend TPR
Touchdowns Per Return
0.016
0.014
0.012
0.010
0.008
0.006
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment
0
1


Visual Parallel Trend NRPG
Number of Returns Per Game
3.0
2.5
2.0
1.5
1.0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment
0
1


Visual Parallel Trend Lng
Longest Return
65
60
55
50
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment
0
1

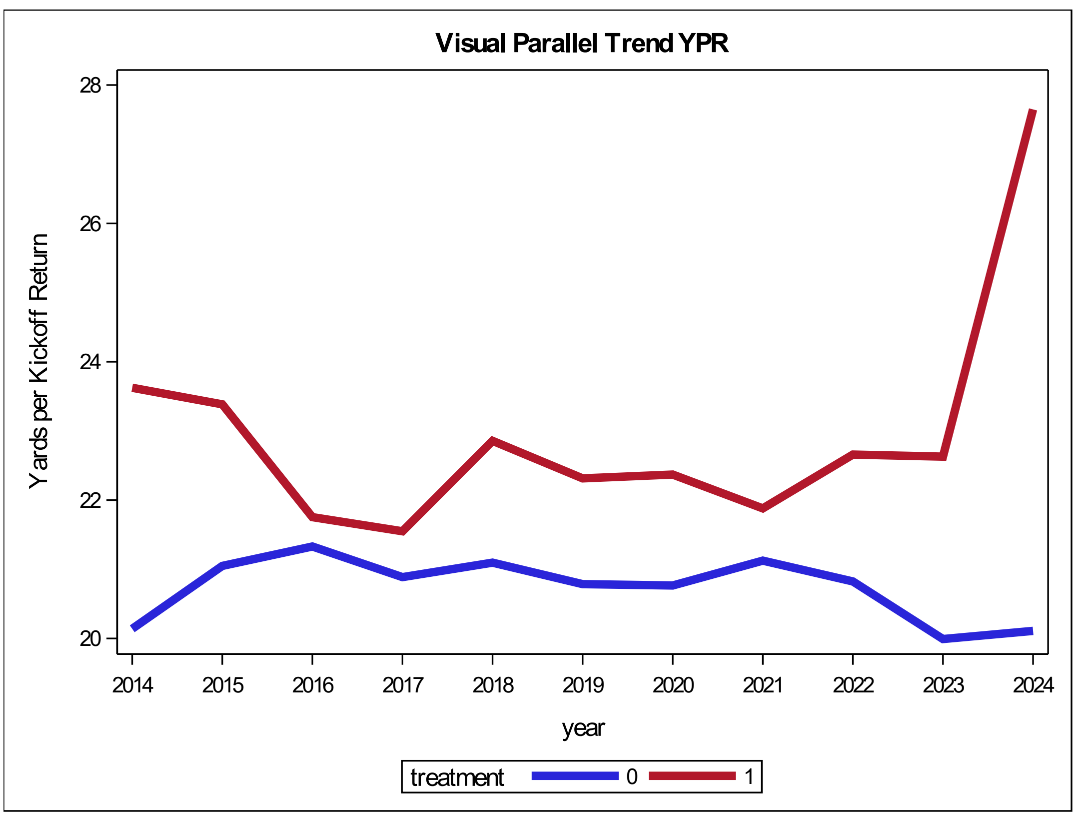

Visual Parallel Trend YPR
Yards per Kickoff Return
28
26
24
22
20
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment
0
1

Table 3. Parallel Trend Statistical Test Regular Model.

Regressors	Avg	TPR	NRPG	Lng	YPR
Treatment	3.8686*	0.0145	-0.7089	0.6470	-0.8759
	(2.2156)	(0.0132)	(0.4501)	(20.5760)	(2.3166)
Relative Year	-1.6443**	-0.0138**	0.3578*	-0.2203	1.0959
	(0.7511)	(0.0055)	(0.2038)	(6.0850)	(0.8191)
Relative Year^2	-0.2598*	-0.0025**	0.0894**	0.2791	0.2331
	(0.1355)	(0.0010)	(0.0371)	(1.1096)	(0.1474)
Relative Year^3	-0.0132*	-0.0001**	0.0046**	0.0207	0.0144*
	(0.0073)	(0.0001)	(0.0020)	(0.0612)	(0.0081)
Relative Year*Treatment	0.8591	0.0126	-0.5004*	-2.1056	-1.8941
	(1.3929)	(0.0084)	(0.2891)	(12.7892)	(1.4317)
Relative Year^2*Treatment	0.0566	0.0022	-0.1334**	-0.9190	-0.4390*
	(0.2540)	(0.0015)	(0.0534)	(2.3335)	(0.2608)
Relative Year^3*Treatment	-0.0015	0.0001	-0.0081***	-0.0711	-0.0293**
	(0.0140)	(0.0001)	(0.0030)	(0.1290)	(0.0144)
Intercept	17.6392***	-0.0100	2.4822***	54.0668***	22.3708***
	(1.1783)	(0.0083)	(0.3194)	(9.7213)	(1.3574)
Number of Observations	1,335	1,335	1,336	1,335	1,335
Adjusted R-Square	0.06492	0.01738	0.2791	0.01341	0.05014
Overall Significance	16.36***	4.59***	103.80***	2.63**	13.62***

Notes: Robust standard errors are in parentheses. *, **, and * indicate 10%, 5%, 1% significance levels, respectively.**

Table 4. Parallel Trend Statistical Test Inverse Hyperbolic Sine Model.

Regressors	AS(Avg)	AS(TPR)	AS(NRPG)	AS(Lng)	AS(YPR)
Treatment	0.1707*	0.0145	-0.2631	-0.0179	-0.0398
	(0.1031)	(0.0132)	(0.2030)	(0.3396)	(0.1077)
Relative Year	-0.0634*	-0.0138**	0.1692**	0.0400	0.0606
	(0.0370)	(0.0055)	(0.0811)	(0.1035)	(0.0401)
Relative Year^2	-0.0094	-0.0025**	0.0407***	0.0141	0.0136*
	(0.0066)	(0.0010)	(0.0144)	(0.0187)	(0.0072)
Relative Year^3	-0.0005	-0.0001**	0.0021***	0.0009	0.0009**
	(0.0004)	(0.0001)	(0.0008)	(0.0010)	(0.0004)
Relative Year*Treatment	0.0274	0.0126	-0.2101	-0.0753	-0.0972
	(0.0645)	(0.0084)	(0.1298)	(0.2105)	(0.0664)
Relative Year^2*Treatment	0.0001	0.0022	-0.0567**	-0.0244	-0.0230*
	(0.0117)	(0.0015)	(0.0238)	(0.0383)	(0.0121)
Relative Year^3*Treatment	-0.0002	0.0001	-0.0035***	-0.0017	-0.0015**
	(0.0006)	(0.0001)	(0.0013)	(0.0021)	(0.0007)
Intercept	3.5844***	-0.0100	1.6262***	4.6400***	3.7944***
	(0.0594)	(0.0083)	(0.1309)	(0.1669)	(0.0670)
Number of Observations	1,335	1,335	1,336	1,335	1,335
Adjusted R-Square	0.06856	0.01738	0.2634	0.02037	0.05516
Overall Significance	17.68***	4.58***	105.36***	3.97***	15.63***

Source: Data collected from the Football Database (2024) and NFL.com (2024).

Notes: Robust standard errors are in parentheses. *, **, and * indicate 10%, 5%, 1% significance levels, respectively. AS(Argument) is the inverse hyperbolic sine function applied to the outcome variable.**

VI. Results

The NFL analysis in the Table finds that the 2024 rules changes, in general, significantly impacted the outcome variables of interest. The analysis finds that, on average, the rule changes increase the average number of yards per kickoff return by 5.78 yards per return more than if there had been no rule changes. This result is statistically significant at the 1% significance level.

The interpretations of the coefficient for yards per kickoff return is similar to the interpretation of the average number of yards per kickoff return. The number of touchdowns per return is not statistically significant at either the 1%, 5%, or 10% significance levels. However, using a confidence interval interpretation, there is a 95% chance that the number of touchdowns per return increases or decreases between -0.008236 and 0.007836 touchdowns per return more or less than it would have had there been no rule changes. Therefore, this analysis is 95% confident that the NFL kickoff rule changes did not significantly impact the number of touchdowns per return. This is an unexpected and unintended result of the analysis. However, since players line up closer to one another under the new rule and must wait to move until the ball is in the air, the defense has more time to align and prevent explosive returns for touchdowns.

On average, the rule changes increase the number of kickoff returns per game by 0.56 more returns per game than it would have had there been no rule changes. This result is also statistically significant at the 1% significance level.

On average, the rule changes increase the longest kickoff return per team per season by 7.55 more kickoff return yards than it would have been had there been no rule changes. This result is statistically significant at the 1% significance level. Interestingly, the longest kickoff return per team per season increases on average for the 2024 season, while the number of touchdowns per return remains the same. Longer kickoff returns are more exciting for fans, showing the kickoff rules are trending in the right direction.

The interpretations and coefficients for yards per kickoff return are similar to the interpretation of the average number of kickoff returns.

Table 5. Regular Model Results.

Regressors	Avg	TPR	NRPG	Lng	YPR
DID	5.7829***	-0.0002	0.5589***	7.5507	5.7631***
	(0.5456)	(0.0041)	(0.1135)	(5.1135)	(0.5221)
Intercept	23.4872***	0.0176***	0.1527**	63.9841***	22.3600***
	(0.2037)	(0.0016)	(0.0758)	(1.9627)	(0.2978)
Team and Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes
Number of Observations	1,493	1,493	1,494	1,493	1,493
Adjusted R-Square	0.2988	0.1579	0.5354	0.1627	0.1753
Overall Significance	3.26E21***	2.44E23***	4.89E16***	3.4E24***	6.22E22***

Source: Data collected from the Football Database (2024) and NFL.com (2024).
Notes: Robust standard errors are in parentheses and clustered at the team level. *, **, and * indicate 10%, 5%, 1% significance levels, respectively.**

The hyperbolic sine model finds that on average, the rule changes increase the average number of yards per return by 24.71% more than it would have been had there been no rule changes. The model finds that the average number of yards per kickoff return increased by 20.58%, and that the longest return by game increased by 18.94%. These results are statistically significant at the 1% significance level.

The number of touchdowns per return was not statistically significant at either of the 10%, 5%, or 1% significance levels. However, using a confidence level interpretation yields similar results to the one in the model above. The completed results can be found in the table above. The result that the NFL rule changes had no statistically significant impact on touchdowns is expected due to the low sample size and the added reaction time for the kicking team to align the defense.

Table 6. Inverse Hyperbolic Sine Model Results.

Regressors	AS(Avg)	AS(TPR)	AS(NRPG)	AS(Lng)	AS(YPR)
DID	0.2471***	-0.0002	0.2058***	0.1894**	0.2398***
	(0.0241)	(0.0041)	(0.0563)	(0.0830)	(0.0221)
Intercept	3.8477***	0.0176***	0.0617**	4.7769***	3.7837***
	(0.0095)	(0.0016)	(0.0244)	(0.0315)	(0.0151)
Team and Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes
Number of Observations	1,493	1,493	1,494	1,493	1,493
Adjusted R-Square	0.2959	0.1579	0.5341	0.1760	0.1660
Overall Significance	1.15E21***	6.93E23***	1.08E16***	1.78E19***	5.33E21***

Source: Data collected from the Football Database (2024) and NFL.com (2024).

Notes: Robust standard errors are in parentheses and clustered at the team level. *, **, and * indicate 10%, 5%, 1% significance levels, respectively. AS(Argument) is the inverse hyperbolic sine function applied to the outcome variable.**

VII. Conclusions

This analysis aims to see if the NFL successfully increases the number of kickoff returns and makes kickoffs more exciting by increasing offensive output. The model shows that the NFL successfully increases the number of kickoff returns and offensive production. Preliminary auxiliary research suggests that the kickoff successfully reduced the number of injuries, even with a greater volume of kickoff returns. Therefore, it is inferred that increasing a player's reaction time positively affects the efficacy of split-second player decision making.

This analysis suggests that these results could be generalized to other types of NFL plays. The NFL has had a long-standing problem with the onside kick. There have historically been too many injuries and far too few successful onside kicks for the game to be as exciting and relevant as possible. (Jones, 2024) Changing the onside kick format has long been discussed by the NFL, and the results of this analysis suggest that a similar structure of rule changes that increase reaction time could decrease injuries and increase the success rate.

Since the analysis shows no significant increase or decrease in the touchdown return rate on kickoffs, it recommends that the NFL change its kickoff return structure to encourage longer, more exciting kickoff returns per touchdown. Under the old kickoff rule format, it was not uncommon for a returner to line up in his endzone and return the ball for an explosive one-hundred-yard kickoff return touchdown. Since, under the new rule changes, the returners line up between the zero and twenty-yard lines, and both teams must remain stationary while the ball is in the air, it disincentivizes long, explosive kickoff returns as in the past.

At the time of writing, the NFL is considering minor tweaks to the new NFL kickoff rules, including moving the starting field position from the thirty-yard line for kickoffs that land in the endzone. According to the NFL, this incentives teams further to return kickoffs. This analysis recommends that the NFL make this kickoff rule change and predicts that the rule change will increase the average number of returns per kickoff.

Future research should look specifically into the rate of injuries under the new kickoff format. An analysis a few years from now with a greater sample size of data should analyze if the NFL successfully reduced the number of injuries and concussions on kickoff returns, even with a future higher expected kickoff return rate than at the time of authoring this paper. Furthermore, it would be expedient to analyze the post-treatment and pre-treatment data. As the NFL is committed to player health and safety, and more high school and collegiate football leagues are adopting increasingly safe rules led by the NFL, it is more important than ever for injury research to promote public health and safety.

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Appendix 1. Sas Codes

```
/*ods excel file="/home/u63018936/mysasfolder/Parelleltrendtest.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder
proc print data=Table_Wide_Sorted_withstat;
run;*/
proc import datafile="/home/u63018936/mysasfolder/NCAADatabase4.xlsx"
        out=work.NCAADatabase4
        dbms=xlsx
        replace;
sheet="datasorted2";
getnames=yes;
run;

proc import datafile="/home/u63018936/mysasfolder/NFLFootballDataBase4.xlsx"
        out=work.NFLDatabase4
        dbms=xlsx
        replace;
sheet="NFLDatabase";
getnames=yes;
run;

Proc sort data=NCAADatabase4;
by year;
run;

Proc sort data=NFLDatabase4;
by year;
run;
```

```
ods excel file="/home/u63018936/mysasfolder/SUMNFL.xlsx";
PROC MEANS DATA=NFLDatabase4 nolabels /*mean StdDev Min Max */ maxdec=2;
	var avg TPR NRPG lng YPR;

RUN;

quit;
ods excel close;

ods excel file="/home/u63018936/mysasfolder/SUMFBS.xlsx";
PROC MEANS DATA=NCAADatabase4 nolabels maxdec=2;
	var avg TPR NRPG lng YPR;

RUN;

quit;

ods excel close;



*Proc Freq Data=NCAADatabase;
*tables Gms Yds Avg Lg TD year;
*run;



data NFLDatabase3;
	set NFLDatabase4;
	if year=2024 then DID=1;
	else DID=0;
	if year=2024 then DID1=1;
	else DID1=0;
	if year=2024 then DID2=1;
	else DID2=0;
	if year=2024 then DID3=1;
	else DID3=0;
	if year=2024 then DID4=1;
	else DID4=0;
	treatment=1;

	*where team ne "";
	*test=lag(Avg);
	Avg=lag(Avg);
	TD=lag(TD);
```

```
            Ret=lag(Ret);
            Yds=lag(Yds);
            Lng=lag(Lng);
            TPR=lag(TPR);
            NRPG=lag(NRPG);
            YPG=lag(YPG);
            YPR=lag(YPR);
            if team ne "" then output;
            run;

            data combined;
            set NCAADatabase4 NFLDatabase3;
            if treatment=. then treatment=0;
            if DID=. then DID=0;
            y2=year*year;
            y3=year*year*year;
            ry=year-2024;
            ry2=ry*ry;
            ry3=ry*ry*ry;
            *keep Team DID AVG Treatment Year y2 y3 ry ry2 ry3;
ln_NRPG=arsinh(NRPG);
ln_YPR=arsinh(YPR);
ln_TPR=arsinh(TPR);
ln_Lng=arsinh(Lng);
ln_Avg=arsinh(avg);

            run;

            /*PROC MEANS DATA=NFLDatabase1;
            var avg td ret lng yds;
RUN;

PROC MEANS DATA=NCAADatabase2;
            var avg td ret lng yds;
RUN;
*/

ods output summary=pt1;
PROC MEANS DATA=combined maxdec=2;
            var Avg TPR NRPG lng YPR;
            by treatment year;
RUN;


data pt2;
set pt1;
            keep treatment year Avg_Mean TPR_Mean NRPG_Mean lng_Mean YPR_Mean;
```

```
run;

ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend5.rtf";


            proc sgplot data=pt2;

    series x=year y=Avg_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
 title "Avg Visual Parallel Trend";
  yaxis label="Average Number of Yards Per Return";
run;
             ods rtf close;

ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend6.rtf";


            proc sgplot data=pt2;

    series x=year y=TPR_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
   title "Visual Parallel Trend TPR";
    yaxis label="Touchdowns Per Return";

run;
             ods rtf close;

             ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend7.rtf";


            proc sgplot data=pt2;

    series x=year y=NRPG_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend NRPG";
  Yaxis label="Number of Returns Per Game";
run;


             ods rtf close;

             ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend8.rtf";


            proc sgplot data=pt2;

    series x=year y=Lng_mean / group=treatment lineattrs=(pattern=solid thickness=5);
```

```
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend Lng";
  Yaxis label="Longest Return";
run;
            ods rtf close;

             ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend9.rtf";

            proc sgplot data=pt2;

    series x=year y=YPR_mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend YPR";
  Yaxis label="Yards per Kickoff Return";
run;
            ods rtf close;




ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
                                FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
Proc SurveyReg Data=combined plots=none;
           Class Team Year/Ref=first;
           cluster Team;
           where year ne 2023;
           Model AVG = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
                                FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
Proc SurveyReg Data=combined plots=none;
           Class Team Year/Ref=first;
           cluster Team;
           where year ne 2023;
           Model TPR= DID Team Year/Solution AdjRsq;
Run;



ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
                                FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
Proc SurveyReg Data=combined plots=none;
           Class Team Year/Ref=first;
           cluster Team;
           where year ne 2023;
           Model NRPG = DID Team Year/Solution AdjRsq;
```

```
Run;

ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
                              FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
Proc SurveyReg Data=combined plots=none;
          Class Team Year/Ref=first;
          cluster Team;
          where year ne 2023;
          Model Lng = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
                              FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
Proc SurveyReg Data=combined plots=none;
          Class Team Year/Ref=first;
          cluster Team;
          where year ne 2023;
          Model YPR = DID Team Year/Solution AdjRsq;
Run;



Data Table_Long;
          length Model $10; /* Makes sure the variable Model has the right length and its values are not
truncated */
          length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are
not truncated */
          set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of
databases use in the "set" statement */

          ThisIsM=M;
          Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
                              and (substr(Parameter,1,4) ne "year");
          length Star $3;
          if Probt le 0.01 then Star="***";
                    else if Probt le 0.05 then Star="**";
                    else if Probt le 0.1 then Star="*";
                    else Star="";



          if        M="WORK.PEFORMODEL1" then Model="Model1";
          else if M="WORK.PEFORMODEL2" then Model="Model2";
          else if M="WORK.PEFORMODEL3" then Model="Model3";
          else if M="WORK.PEFORMODEL4" then Model="Model4";
          else if M="WORK.PEFORMODEL5" then model="Model5";
```

```
        Results=Estimate;
        EditedResults=Cats(put(Results,comma16.4),Star);
        output;

        Results=StdErr;
        EditedResults=Cats("(",put(Results,comma16.4),")");
        output;


        keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
        by Model Parameter;
run;


/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
        set Table_Long_Sorted;
        if Model="Model1" then output Model1Results;
        else if Model="Model2" then output Model2Results;
        else if Model="Model3" then output Model3Results;
        else if Model="Model4" then output Model4Results;
        else if Model="Model5" then output Model5Results;
        drop Model;
run;


/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
        merge Model1Results Model2Results Model3Results Model4Results Model5Results;
        by Parameter;
        length Order 3;
        if Parameter="DID" then order=1;
```

```
	else order=2;


	if mod(_n_,2)=1 then Regressors=Parameter;


run;

/* Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
	by Order;
run;

/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
	merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
	ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
	ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
	ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
	ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);


	Where Label1="Number of Observations";
	Model1=Put(NVModel1,comma16.);
	Model2=Put(NVModel2,comma16.);
	Model3=Put(NVModel3,comma16.);
	Model4=Put(NVModel4,comma16.);
	Model5=Put(NVModel5,comma16.);

	keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
Data AdjRsq;
	merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
	merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
	merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
	merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
	merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

	where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
    OSM2(rename=(EditedFvalue=Model2))
```

```
    OSM3(rename=(EditedFvalue=Model3))
    OSM4(rename=(EditedFvalue=Model4))
    OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
        where Effect="Model";
        ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;


        Keep Label1 EditedFvalue;
Run;


data OSM1(rename=(EditedFvalue=Model1))
         OSM2(rename=(EditedFvalue=Model2))
         OSM3(rename=(EditedFvalue=Model3))
         OSM4(rename=(EditedFvalue=Model4))
         OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 indsname=M;
        where Effect="Model";
        *ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);
```

```
	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
		else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
		else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
		else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
		else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

	Keep Label1 EditedFvalue;
Run;

Data OverallSig;
	merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
	set NumofObs AdjRsq OverallSig;
	rename Label1=Regressors;
Run;

Data OtherInfo;
	Length Label1 Model1 Model2 Model3 Model4 Model5 $30;
	Regressors="Team and Year Fixed Effects?";
	Model1="Yes";
	Model2="Yes";
	Model3="Yes";
	Model4="Yes";
	Model5="Yes";
	Output;


Run;

/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;

	Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;
```

```
	/* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/results2.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "NFL Kickoff Rule Change Results";
footnote1 justify=left "Source: Data collected from the Football Database (2024) and NFL.com (2024). ";
footnote2 justify=left "Notes: Robust standard errors are in parentheses and clustered at the team level. *,
**, and *** indicate 10%, 5%, 1% significance levels, respectively.";
proc print data=Table_wide_sorted_withstat noobs;
	var Regressors;
	var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
	format Regressors $VariableName.;
run;

ods excel close;
/* Balance of Regressors Test
Proc TTest Data = combined;
Where Year <2024;
Var Avg Td Lng Ret Yds;
Class Treatment;
run; */

	Ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
			FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2023;
	Model Avg= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
			FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2023;
	Model TPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
			FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
```

```
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2023;
	Model NRPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
			FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2023;
	Model Lng= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
			FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2023;
	Model YPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

/*Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
			FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model ln_YPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;*/


Data Table_Long;
	length Model $10; /* Makes sure the variable Model has the right length and its values are not
truncated */
	length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are
not truncated */
	set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of
databases use in the "set" statement */

	ThisIsM=M;
```

```
	Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
			and (substr(Parameter,1,4) ne "year");
	length Star $3;
	if Probt le 0.01 then Star="***";
		else if Probt le 0.05 then Star="**";
		else if Probt le 0.1 then Star="*";
		else Star="";



	if	M="WORK.PEFORMODEL1" then Model="Model1";
	else if M="WORK.PEFORMODEL2" then Model="Model2";
	else if M="WORK.PEFORMODEL3" then Model="Model3";
	else if M="WORK.PEFORMODEL4" then Model="Model4";
	else if M="WORK.PEFORMODEL5" then model="Model5";





	Results=Estimate;
	EditedResults=Cats(put(Results,comma16.4),Star);
	output;

	Results=StdErr;
	EditedResults=Cats("(",put(Results,comma16.4),")");
	output;


	keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
	by Model Parameter;
run;


/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
	set Table_Long_Sorted;
```

```
	if Model="Model1" then output Model1Results;
	else if Model="Model2" then output Model2Results;
	else if Model="Model3" then output Model3Results;
	else if Model="Model4" then output Model4Results;
	else if Model="Model5" then output Model5Results;
	drop Model;
run;


/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
	merge Model1Results Model2Results Model3Results Model4Results Model5Results;
	by Parameter;
	length Order 3;
	if Parameter="treatment" then order=1;
	else if Parameter="ry" then order=2;
	else if Parameter="ry2" then order=3;
	else if Parameter="ry3" then order=4;
	else if Parameter="ry*treatment" then order=5;
	else if Parameter="ry2*treatment" then order=6;
	else if Parameter="ry3*treatment" then order=7;
	else if Parameter="Intercept" then order=8;


	if mod(_n_,2)=1 then Regressors=Parameter;


run;

 /*Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
	by Order;
run;


/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
	merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
	ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
	ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
	ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
	ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);


	Where Label1="Number of Observations";
	Model1=Put(NVModel1,comma16.);
```

```
        Model2=Put(NVModel2,comma16.);
        Model3=Put(NVModel3,comma16.);
        Model4=Put(NVModel4,comma16.);
        Model5=Put(NVModel5,comma16.);

        keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
Data AdjRsq;
        merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
        merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
        merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
        merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
        merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

        where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
    OSM2(rename=(EditedFvalue=Model2))
    OSM3(rename=(EditedFvalue=Model3))
    OSM4(rename=(EditedFvalue=Model4))
    OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
        where Effect="Model";
        ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;


        Keep Label1 EditedFvalue;
```

```
Run;


data OSM1(rename=(EditedFvalue=Model1))
     OSM2(rename=(EditedFvalue=Model2))
     OSM3(rename=(EditedFvalue=Model3))
     OSM4(rename=(EditedFvalue=Model4))
     OSM5(rename=(EditedFvalue=Model5));
    Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 indsname=M;
    where Effect="Model";
    *ThisIsM=M;

    length Star $3;
    if ProbF le 0.01 then Star="***";
        else if ProbF le 0.05 then Star="**";
        else if ProbF le 0.1 then Star="*";
        else Star="";

    Label1="Overall Significance";
    EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

    if M="WORK.OVERALLSIGMODEL1" then output OSM1;
        else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
        else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
        else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
        else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

    Keep Label1 EditedFvalue;
Run;

Data OverallSig;
    merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
    set NumofObs AdjRsq OverallSig;
    rename Label1=Regressors;
Run;



/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;
```

```
	Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;


/* create new name for variables in the regression results table through defining a new format*/





/*ods excel file="/home/u63018936/mysasfolder/procmeansNCAA.xlsx"
options(Embedded_Titles="ON" Embedded_Footnotes="ON");
proc print data=NCAADatabase5;
run; */

/*ods excel close;
ods excel file="/home/u63018936/mysasfolder/procmeansNFL.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON");
proc print data=NFLDatabase5;
run; */


 /* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/parelleltrendtest1.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "Parellel Trend Test";
proc print data=Table_wide_sorted_withstat noobs;
	var Regressors;
	var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
	format Regressors $VariableName.;
run;

ods excel close;

/*ods excel file="/home/u63018936/mysasfolder/Parelleltrendtest.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder
proc print data=Table_Wide_Sorted_withstat;
run;*/




*Proc Freq Data=NCAADatabase;
*tables Gms Yds Avg Lg TD year;
```

```
*run;



/*PROC MEANS DATA=NFLDatabase1;
	var avg td ret lng yds;
RUN;

PROC MEANS DATA=NCAADatabase2;
	var avg td ret lng yds;
RUN;
*/
ods output summary=pt1;
PROC MEANS DATA=combined;
	var ln_avg ln_YPR ln_TPR ln_NRPG ln_lng;
	by treatment year;
RUN;



data pt2;
set pt1;
	keep treatment year Ln_Avg_Mean ln_TPR_Mean ln_NRPG_Mean ln_lng_Mean
ln_YPR_mean;
run;

ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend10.rtf";
proc sgplot data=pt2;

   series x=year y=ln_Avg_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend AS(Avg)";
  Yaxis label="AS(Avg)";
run;

ods rtf close;


ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend11.rtf";
proc sgplot data=pt2;

   series x=year y=ln_TPR_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend AS(TPR)";
  Yaxis label="AS(TPR)";
run;
	ods rtf close;
```

```
ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend12.rtf";

            proc sgplot data=pt2;

    series x=year y=ln_NRPG_mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend AS(NRPG)";
  Yaxis label="AS(NRPG)";
run;
            ods rtf close;

           ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend13.rtf";
           proc sgplot data=pt2;

    series x=year y=ln_Lng_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
   title "Visual Parallel Trend AS(Lng)";
    yaxis label="AS(Lng)";

run;
            ods rtf close;

            ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend14.rtf";


           proc sgplot data=pt2;

    series x=year y=ln_YPR_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
 title "Visual Parallel Trend AS(YPR)";
  yaxis label="AS(YPR)";
run;
            ods rtf close;
/*         proc sgplot data=pt2;

    series x=year y=ln_Avg_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
            ods pdf close;

ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


           proc sgplot data=pt2;
```

```
   series x=year y=ln_NRPG_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
        ods pdf close;

        ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


       proc sgplot data=pt2;

   series x=year y=ln_YPR_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;


        ods pdf close;

        ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


       proc sgplot data=pt2;

   series x=year y=ln_Lng_mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
        ods pdf close;

        ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


       proc sgplot data=pt2;

   series x=year y=ln_NRPG_mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
        ods pdf close;

       /*


ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
```

```
                              FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
Proc SurveyReg Data=combined plots=none;
          Class Team Year/Ref=first;
          cluster Team;
          where year ne 2023;
          Model ln_AVG = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
                              FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
Proc SurveyReg Data=combined plots=none;
          Class Team Year/Ref=first;
          cluster Team;
          where year ne 2023;
          Model ln_TPR= DID Team Year/Solution AdjRsq;
Run;


ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
                              FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
Proc SurveyReg Data=combined plots=none;
          Class Team Year/Ref=first;
          cluster Team;
          where year ne 2023;
          Model ln_NRPG = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
                              FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
Proc SurveyReg Data=combined plots=none;
          Class Team Year/Ref=first;
          cluster Team;
          where year ne 2023;
          Model ln_Lng = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
                              FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
Proc SurveyReg Data=combined plots=none;
          Class Team Year/Ref=first;
          cluster Team;
          where year ne 2023;
          Model ln_YPR = DID Team Year/Solution AdjRsq;
Run;
```

```
Data Table_Long;
	length Model $10; /* Makes sure the variable Model has the right length and its values are not truncated */
	length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are not truncated */
	set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of databases use in the "set" statement */

	ThisIsM=M;
	Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
			and (substr(Parameter,1,4) ne "year");
	length Star $3;
	if Probt le 0.01 then Star="***";
		else if Probt le 0.05 then Star="**";
		else if Probt le 0.1 then Star="*";
		else Star="";



	if	M="WORK.PEFORMODEL1" then Model="Model1";
	else if M="WORK.PEFORMODEL2" then Model="Model2";
	else if M="WORK.PEFORMODEL3" then Model="Model3";
	else if M="WORK.PEFORMODEL4" then Model="Model4";
	else if M="WORK.PEFORMODEL5" then model="Model5";





	Results=Estimate;
	EditedResults=Cats(put(Results,comma16.4),Star);
	output;

	Results=StdErr;
	EditedResults=Cats("(",put(Results,comma16.4),")");
	output;


	keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
	by Model Parameter;
run;
```

```
/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
	set Table_Long_Sorted;
	if Model="Model1" then output Model1Results;
	else if Model="Model2" then output Model2Results;
	else if Model="Model3" then output Model3Results;
	else if Model="Model4" then output Model4Results;
	else if Model="Model5" then output Model5Results;
	drop Model;
run;


/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
	merge Model1Results Model2Results Model3Results Model4Results Model5Results;
	by Parameter;
	length Order 3;
	if Parameter="DID" then order=1;
	else order=2;


	if mod(_n_,2)=1 then Regressors=Parameter;


run;

/* Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
	by Order;
run;

/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
	merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
	ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
	ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
	ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
	ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);
```

```
	Where Label1="Number of Observations";
	Model1=Put(NVModel1,comma16.);
	Model2=Put(NVModel2,comma16.);
	Model3=Put(NVModel3,comma16.);
	Model4=Put(NVModel4,comma16.);
	Model5=Put(NVModel5,comma16.);

	keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
Data AdjRsq;
	merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
	merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
	merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
	merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
	merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

	where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
    OSM2(rename=(EditedFvalue=Model2))
    OSM3(rename=(EditedFvalue=Model3))
    OSM4(rename=(EditedFvalue=Model4))
    OSM5(rename=(EditedFvalue=Model5));
	Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
	where Effect="Model";
	ThisIsM=M;

	length Star $3;
	if ProbF le 0.01 then Star="***";
		else if ProbF le 0.05 then Star="**";
		else if ProbF le 0.1 then Star="*";
		else Star="";

	Label1="Overall Significance";
	EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;
```

```
        Keep Label1 EditedFvalue;
Run;


data OSM1(rename=(EditedFvalue=Model1))
         OSM2(rename=(EditedFvalue=Model2))
         OSM3(rename=(EditedFvalue=Model3))
         OSM4(rename=(EditedFvalue=Model4))
         OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 indsname=M;
        where Effect="Model";
        *ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
                else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
                else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
                else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
                else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

        Keep Label1 EditedFvalue;
Run;

Data OverallSig;
        merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
        set NumofObs AdjRsq OverallSig;
        rename Label1=Regressors;
Run;

/*Data OtherInfo;
```

```
            Length Label1 Model1 Model2 Model3 Model4 Model5 $30;
            Regressors="Team and Year Fixed Effects?";
            Model1="Yes";
            Model2="Yes";
            Model3="Yes";
            Model4="Yes";
            Model5="Yes";
            Output;


Run; /*

/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;

            Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;


            /* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/results3.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "NFL Kickoff Rule Change Results";
footnote1 justify=left "Source: Data collected from the Football Database (2024) and NFL.com (2024). ";
footnote2 justify=left "Notes: Robust standard errors are in parentheses and clustered at the team level. *,
**, and *** indicate 10%, 5%, 1% significance levels, respectively.";
proc print data=Table_wide_sorted_withstat noobs;
            var Regressors;
            var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
            format Regressors $VariableName.;
run;

ods excel close;
/* Balance of Regressors Test
Proc TTest Data = combined;
Where Year <2024;
Var Avg Td Lng Ret Yds;
Class Treatment;
run; */
```

```
    Ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
                FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
    Proc SurveyReg Data=combined plots=none;
    *Class Year/Ref=first;
    *Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
    where year<2023;
    Model ln_Avg= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
                FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
    Proc SurveyReg Data=combined plots=none;
    *Class Year/Ref=first;
    *Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
    where year<2023;
    Model ln_TPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
                FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
    Proc SurveyReg Data=combined plots=none;
    *Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
    where year<2023;
    Model ln_NRPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution
adjrsq;

Run;

Ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
                FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
    Proc SurveyReg Data=combined plots=none;
    *Class Year/Ref=first;
    *Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
    where year<2023;
    Model ln_Lng= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
                FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
    Proc SurveyReg Data=combined plots=none;
    *Class Year/Ref=first;
    *Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
    where year<2023;
```

```
	Model ln_YPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

/*Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
				FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model ln_YPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;*/


Data Table_Long;
	length Model $10; /* Makes sure the variable Model has the right length and its values are not
truncated */
	length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are
not truncated */
	set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of
databases use in the "set" statement */

	ThisIsM=M;
	Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
				and (substr(Parameter,1,4) ne "year");
	length Star $3;
	if Probt le 0.01 then Star="***";
		else if Probt le 0.05 then Star="**";
		else if Probt le 0.1 then Star="*";
		else Star="";



	if	M="WORK.PEFORMODEL1" then Model="Model1";
	else if M="WORK.PEFORMODEL2" then Model="Model2";
	else if M="WORK.PEFORMODEL3" then Model="Model3";
	else if M="WORK.PEFORMODEL4" then Model="Model4";
	else if M="WORK.PEFORMODEL5" then model="Model5";





	Results=Estimate;
	EditedResults=Cats(put(Results,comma16.4),Star);
```

```
        output;

        Results=StdErr;
        EditedResults=Cats("(",put(Results,comma16.4),")");
        output;


        keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
        by Model Parameter;
run;


/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
        set Table_Long_Sorted;
        if Model="Model1" then output Model1Results;
        else if Model="Model2" then output Model2Results;
        else if Model="Model3" then output Model3Results;
        else if Model="Model4" then output Model4Results;
        else if Model="Model5" then output Model5Results;
        drop Model;
run;


/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
        merge Model1Results Model2Results Model3Results Model4Results Model5Results;
        by Parameter;
        length Order 3;
        if Parameter="treatment" then order=1;
        else if Parameter="ry" then order=2;
        else if Parameter="ry2" then order=3;
        else if Parameter="ry3" then order=4;
        else if Parameter="ry*treatment" then order=5;
        else if Parameter="ry2*treatment" then order=6;
        else if Parameter="ry3*treatment" then order=7;
        else if Parameter="Intercept" then order=8;
```

```
        if mod(_n_,2)=1 then Regressors=Parameter;


run;

 /*Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
        by Order;
run;


/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
        merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
        ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
        ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
        ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
        ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);


        Where Label1="Number of Observations";
        Model1=Put(NVModel1,comma16.);
        Model2=Put(NVModel2,comma16.);
        Model3=Put(NVModel3,comma16.);
        Model4=Put(NVModel4,comma16.);
        Model5=Put(NVModel5,comma16.);

        keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
Data AdjRsq;
        merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
        merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
        merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
        merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
        merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

        where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
    OSM2(rename=(EditedFvalue=Model2))
```

```
    OSM3(rename=(EditedFvalue=Model3))
    OSM4(rename=(EditedFvalue=Model4))
    OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
        where Effect="Model";
        ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;


        Keep Label1 EditedFvalue;
Run;


data OSM1(rename=(EditedFvalue=Model1))
         OSM2(rename=(EditedFvalue=Model2))
         OSM3(rename=(EditedFvalue=Model3))
         OSM4(rename=(EditedFvalue=Model4))
         OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 indsname=M;
        where Effect="Model";
        *ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);
```

```
	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
		else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
		else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
		else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
		else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

	Keep Label1 EditedFvalue;
Run;

Data OverallSig;
	merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
	set NumofObs AdjRsq OverallSig;
	rename Label1=Regressors;
Run;



/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;

	Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;

ods excel close;
/* create new name for variables in the regression results table through defining a new format*/










/*ods excel file="/home/u63018936/mysasfolder/procmeansNCAA.xlsx"
options(Embedded_Titles="ON" Embedded_Footnotes="ON");
proc print data=NCAADatabase5;
run; */

/*ods excel close;
```

```
ods excel file="/home/u63018936/mysasfolder/procmeansNFL.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON");
proc print data=NFLDatabase5;
run; */


 /* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/parelleltrendtest3.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "Parellel Trend Test";
proc print data=Table_wide_sorted_withstat noobs;
	var Regressors;
	var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
	format Regressors $VariableName.;
run;
```

/* Sas Codes for Models Including 2023 */

```
/*ods excel file="/home/u63018936/mysasfolder/Parelleltrendtest.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder
proc print data=Table_Wide_Sorted_withstat;
run;*/
proc import datafile="/home/u63018936/mysasfolder/NCAADatabase4.xlsx"
	out=work.NCAADatabase4
	dbms=xlsx
	replace;
sheet="datasorted2";
getnames=yes;
run;

proc import datafile="/home/u63018936/mysasfolder/NFLFootballDataBase4.xlsx"
	out=work.NFLDatabase4
	dbms=xlsx
	replace;
sheet="NFLDatabase";
getnames=yes;
run;

Proc sort data=NCAADatabase4;
by year;
```

```
run;

Proc sort data=NFLDatabase4;
by year;
run;


ods excel file="/home/u63018936/mysasfolder/SUMNFL.xlsx";
PROC MEANS DATA=NFLDatabase4 nolabels /*mean StdDev Min Max */ maxdec=2;
	var avg TPR NRPG lng YPR;

RUN;

quit;
ods excel close;

ods excel file="/home/u63018936/mysasfolder/SUMFBS.xlsx";
PROC MEANS DATA=NCAADatabase4 nolabels maxdec=2;
	var avg TPR NRPG lng YPR;

RUN;


*Proc Freq Data=NCAADatabase;
*tables Gms Yds Avg Lg TD year;
*run;



data NFLDatabase3;
	set NFLDatabase4;
	if year=2024 then DID=1;
	else DID=0;
	if year=2024 then DID1=1;
	else DID1=0;
	if year=2024 then DID2=1;
	else DID2=0;
	if year=2024 then DID3=1;
	else DID3=0;
	if year=2024 then DID4=1;
	else DID4=0;
	treatment=1;

	*where team ne "";
	*test=lag(Avg);
	Avg=lag(Avg);
	TD=lag(TD);
```

```
	Ret=lag(Ret);
	Yds=lag(Yds);
	Lng=lag(Lng);
	TPR=lag(TPR);
	NRPG=lag(NRPG);
	YPG=lag(YPG);
	YPR=lag(YPR);
	if team ne "" then output;
	run;

	data combined;
	set NCAADatabase4 NFLDatabase3;
	if treatment=. then treatment=0;
	if DID=. then DID=0;
	y2=year*year;
	y3=year*year*year;
	ry=year-2024;
	ry2=ry*ry;
	ry3=ry*ry*ry;
	*keep Team DID AVG Treatment Year y2 y3 ry ry2 ry3;
ln_NRPG=log(NRPG);
ln_YPR=log(YPR);
ln_TPR=log(TPR);
ln_Lng=log(Lng);
ln_Avg=log(avg);

	run;

	/*PROC MEANS DATA=NFLDatabase1;
	var avg td ret lng yds;
RUN;

PROC MEANS DATA=NCAADatabase2;
	var avg td ret lng yds;
RUN;
*/
ods output summary=pt1;
PROC MEANS DATA=combined;
	var Avg YPR TPR NRPG lng;
	by treatment year;
RUN;


data pt2;
set pt1;
	keep treatment year Avg_Mean TPR_Mean NRPG_Mean lng_Mean YPR_Mean;
run;
```

```
ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend1.rtf";


            proc sgplot data=pt2;

    series x=year y=Avg_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
 title "Visual Parallel Trend Avg";
  yaxis label="Average Number of Yards Per Return";

run;
             ods rtf close;

ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend.rtf";


            proc sgplot data=pt2;

    series x=year y=TPR_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);
   title "Visual Parallel Trend TPR";
    yaxis label="Touchdowns Per Return";

run;
             ods rtf close;

             ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


            proc sgplot data=pt2;

    series x=year y=YPR_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;


             ods pdf close;

             ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


            proc sgplot data=pt2;

    series x=year y=YPR_mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);
```

```
run;
            ods pdf close;

            proc sgplot data=pt2;

   series x=year y=Lng_mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
            ods pdf close;

             proc sgplot data=pt2;

   series x=year y=TPR_mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
            ods pdf close;



ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
                                  FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
Proc SurveyReg Data=combined plots=none;
            Class Team Year/Ref=first;
            cluster Team;
            Model AVG = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
                                  FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
Proc SurveyReg Data=combined plots=none;
            Class Team Year/Ref=first;
            cluster Team;

            Model TPR= DID Team Year/Solution AdjRsq;
Run;



ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
                                  FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
Proc SurveyReg Data=combined plots=none;
            Class Team Year/Ref=first;
            cluster Team;
            Model NRPG = DID Team Year/Solution AdjRsq;
```

```
Run;

ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
                              FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
Proc SurveyReg Data=combined plots=none;
        Class Team Year/Ref=first;
        cluster Team;
        Model Lng = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
                              FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
Proc SurveyReg Data=combined plots=none;
        Class Team Year/Ref=first;
        cluster Team;
        Model YPR = DID Team Year/Solution AdjRsq;
Run;



Data Table_Long;
        length Model $10; /* Makes sure the variable Model has the right length and its values are not
truncated */
        length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are
not truncated */
        set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of
databases use in the "set" statement */

        ThisIsM=M;
        Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
                              and (substr(Parameter,1,4) ne "year");
        length Star $3;
        if Probt le 0.01 then Star="***";
                else if Probt le 0.05 then Star="**";
                else if Probt le 0.1 then Star="*";
                else Star="";



        if      M="WORK.PEFORMODEL1" then Model="Model1";
        else if M="WORK.PEFORMODEL2" then Model="Model2";
        else if M="WORK.PEFORMODEL3" then Model="Model3";
        else if M="WORK.PEFORMODEL4" then Model="Model4";
        else if M="WORK.PEFORMODEL5" then model="Model5";
```

```
	Results=Estimate;
	EditedResults=Cats(put(Results,comma16.3),Star);
	output;

	Results=StdErr;
	EditedResults=Cats("(",put(Results,comma16.3),")");
	output;


	keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
	by Model Parameter;
run;


/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
	set Table_Long_Sorted;
	if Model="Model1" then output Model1Results;
	else if Model="Model2" then output Model2Results;
	else if Model="Model3" then output Model3Results;
	else if Model="Model4" then output Model4Results;
	else if Model="Model5" then output Model5Results;
	drop Model;
run;


/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
	merge Model1Results Model2Results Model3Results Model4Results Model5Results;
	by Parameter;
	length Order 3;
	if Parameter="DID" then order=1;
	else order=2;
```

```
	if mod(_n_,2)=1 then Regressors=Parameter;


run;

/* Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
	by Order;
run;

/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
	merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
	ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
	ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
	ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
	ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);


	Where Label1="Number of Observations";
	Model1=Put(NVModel1,comma16.);
	Model2=Put(NVModel2,comma16.);
	Model3=Put(NVModel3,comma16.);
	Model4=Put(NVModel4,comma16.);
	Model5=Put(NVModel5,comma16.);

	keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
Data AdjRsq;
	merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
	merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
	merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
	merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
	merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

	where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
    OSM2(rename=(EditedFvalue=Model2))
    OSM3(rename=(EditedFvalue=Model3))
    OSM4(rename=(EditedFvalue=Model4))
```

```
    OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
        where Effect="Model";
        ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;


        Keep Label1 EditedFvalue;
Run;


data OSM1(rename=(EditedFvalue=Model1))
         OSM2(rename=(EditedFvalue=Model2))
         OSM3(rename=(EditedFvalue=Model3))
         OSM4(rename=(EditedFvalue=Model4))
         OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 indsname=M;
        where Effect="Model";
        *ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

        if M="WORK.OVERALLSIGMODEL1" then output OSM1;
                else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
```

```
                else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
                else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
                else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

        Keep Label1 EditedFvalue;
Run;

Data OverallSig;
        merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
        set NumofObs AdjRsq OverallSig;
        rename Label1=Regressors;
Run;

Data OtherInfo;
        Length Label1 Model1 Model2 Model3 Model4 Model5 $30;
        Regressors="Team and Year Fixed Effects?";
        Model1="Yes";
        Model2="Yes";
        Model3="Yes";
        Model4="Yes";
        Model5="Yes";
        Output;


Run;

/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;

        Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;

        /* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/results2.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "NFL Kickoff Rule Change Results";
footnote1 justify=left "Source: Data collected from the Football Database (2024) and NFL.com (2024). ";
footnote2 justify=left "Notes: Robust standard errors are in parentheses and clustered at the team level. *,
**, and *** indicate 10%, 5%, 1% significance levels, respectively.";
proc print data=Table_wide_sorted_withstat noobs;
```

```
	var Regressors;
	var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
	format Regressors $VariableName.;
run;

ods excel close;
/* Balance of Regressors Test
Proc TTest Data = combined;
Where Year <2024;
Var Avg Td Lng Ret Yds;
Class Treatment;
run; */

	Ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
			FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model Avg= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
			FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model TPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
			FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2022;
	Model NRPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
			FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
	Proc SurveyReg Data=combined plots=none;
```

```
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model Lng= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
			FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model YPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

/*Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
			FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model ln_YPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;*/


Data Table_Long;
	length Model $10; /* Makes sure the variable Model has the right length and its values are not
truncated */
	length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are
not truncated */
	set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of
databases use in the "set" statement */

	ThisIsM=M;
	Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
			and (substr(Parameter,1,4) ne "year");
	length Star $3;
	if Probt le 0.01 then Star="***";
		else if Probt le 0.05 then Star="**";
		else if Probt le 0.1 then Star="*";
		else Star="";
```

```
	if 	M="WORK.PEFORMODEL1" then Model="Model1";
	else if M="WORK.PEFORMODEL2" then Model="Model2";
	else if M="WORK.PEFORMODEL3" then Model="Model3";
	else if M="WORK.PEFORMODEL4" then Model="Model4";
	else if M="WORK.PEFORMODEL5" then model="Model5";




	Results=Estimate;
	EditedResults=Cats(put(Results,comma16.3),Star);
	output;

	Results=StdErr;
	EditedResults=Cats("(",put(Results,comma16.3),")");
	output;


	keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
	by Model Parameter;
run;


/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
	set Table_Long_Sorted;
	if Model="Model1" then output Model1Results;
	else if Model="Model2" then output Model2Results;
	else if Model="Model3" then output Model3Results;
	else if Model="Model4" then output Model4Results;
	else if Model="Model5" then output Model5Results;
	drop Model;
run;
```

```
/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
	merge Model1Results Model2Results Model3Results Model4Results Model5Results;
	by Parameter;
	length Order 3;
	if Parameter="treatment" then order=1;
	else if Parameter="ry" then order=2;
	else if Parameter="ry2" then order=3;
	else if Parameter="ry3" then order=4;
	else if Parameter="ry*treatment" then order=5;
	else if Parameter="ry2*treatment" then order=6;
	else if Parameter="ry3*treatment" then order=7;
	else if Parameter="Intercept" then order=8;


	if mod(_n_,2)=1 then Regressors=Parameter;


run;

 /*Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
	by Order;
run;


/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
	merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
	ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
	ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
	ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
	ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);


	Where Label1="Number of Observations";
	Model1=Put(NVModel1,comma16.);
	Model2=Put(NVModel2,comma16.);
	Model3=Put(NVModel3,comma16.);
	Model4=Put(NVModel4,comma16.);
	Model5=Put(NVModel5,comma16.);

	keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
```

```
Data AdjRsq;
	merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
	merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
	merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
	merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
	merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

	where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
   OSM2(rename=(EditedFvalue=Model2))
   OSM3(rename=(EditedFvalue=Model3))
   OSM4(rename=(EditedFvalue=Model4))
   OSM5(rename=(EditedFvalue=Model5));
	Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
	where Effect="Model";
	ThisIsM=M;

	length Star $3;
	if ProbF le 0.01 then Star="***";
		else if ProbF le 0.05 then Star="**";
		else if ProbF le 0.1 then Star="*";
		else Star="";

	Label1="Overall Significance";
	EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;


	Keep Label1 EditedFvalue;
Run;


data OSM1(rename=(EditedFvalue=Model1))
	 OSM2(rename=(EditedFvalue=Model2))
	 OSM3(rename=(EditedFvalue=Model3))
	 OSM4(rename=(EditedFvalue=Model4))
	 OSM5(rename=(EditedFvalue=Model5));
	Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
```

```
OverallSigModel5 indsname=M;
	where Effect="Model";
	*ThisIsM=M;

	length Star $3;
	if ProbF le 0.01 then Star="***";
		else if ProbF le 0.05 then Star="**";
		else if ProbF le 0.1 then Star="*";
		else Star="";

	Label1="Overall Significance";
	EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
		else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
		else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
		else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
		else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

	Keep Label1 EditedFvalue;
Run;

Data OverallSig;
	merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
	set NumofObs AdjRsq OverallSig;
	rename Label1=Regressors;
Run;



/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;

	Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;

ods excel close;
/* create new name for variables in the regression results table through defining a new format*/


/*ods excel file="/home/u63018936/mysasfolder/procmeansNCAA.xlsx"
```

```
options(Embedded_Titles="ON" Embedded_Footnotes="ON");
proc print data=NCAADatabase5;
run; */

/*ods excel close;
ods excel file="/home/u63018936/mysasfolder/procmeansNFL.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON");
proc print data=NFLDatabase5;
run; */


 /* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/parelleltrendtest2.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "Parellel Trend Test";
proc print data=Table_wide_sorted_withstat noobs;
	var Regressors;
	var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
	format Regressors $VariableName.;
run;

ods excel close;

/*ods excel file="/home/u63018936/mysasfolder/Parelleltrendtest.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder
proc print data=Table_Wide_Sorted_withstat;
run;*/


*Proc Freq Data=NCAADatabase;
*tables Gms Yds Avg Lg TD year;
*run;


	/*PROC MEANS DATA=NFLDatabase1;
	var avg td ret lng yds;
RUN;

PROC MEANS DATA=NCAADatabase2;
	var avg td ret lng yds;
RUN;
*/
ods output summary=pt1;
PROC MEANS DATA=combined;
	var ln_avg ln_YPR ln_TPR ln_NRPG ln_lng;
```

```
            by treatment year;
RUN;

data pt2;
set pt1;
            keep treatment year Avg_Mean TPR_Mean NRPG_Mean lng_Mean YPR_Mean;
run;

data pt2;
set pt1;
            keep treatment year Ln_Avg_Mean ln_TPR_Mean ln_NRPG_Mean ln_lng_Mean
ln_YPR_mean;
run;

ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend10.rtf";
proc sgplot data=pt2;

    series x=year y=ln_Avg_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend AS(NRPG)";
  Yaxis label="AS(Avg)";
run;

ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend11.rtf";
proc sgplot data=pt2;

    series x=year y=ln_TPR_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend AS(TPR)";
  Yaxis label="AS(TPR)";
run;
             ods rtf close;


ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend12.rtf";

             proc sgplot data=pt2;

    series x=year y=ln_NRPG_mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
  title "Visual Parallel Trend AS(NRPG)";
  Yaxis label="AS(NRPG)";
run;
             ods rtf close;

            ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend13.rtf";
            proc sgplot data=pt2;
```

```
   series x=year y=ln_Lng_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
   title "Visual Parallel Trend AS(Lng)";
    yaxis label="AS(Lng)";

run;
            ods rtf close;

            ods rtf file="/home/u63018936/mysasfolder/visualparelleltrend14.rtf";


           proc sgplot data=pt2;

   series x=year y=ln_YPR_Mean / group=treatment lineattrs=(pattern=solid thickness=5);
  xaxis values= (2014 to 2024 by 1);
 title "Visual Parallel Trend AS(YPR)";
  yaxis label="AS(YPR)";
run;
            ods rtf close;



           /*proc sgplot data=pt2;

   series x=year y=ln_Avg_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
            ods pdf close;

ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


           proc sgplot data=pt2;

   series x=year y=ln_NRPG_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
            ods pdf close;

            ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


           proc sgplot data=pt2;
```

```
   series x=year y=ln_YPR_Mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;


            ods pdf close;

            ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


           proc sgplot data=pt2;

   series x=year y=ln_Lng_mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
            ods pdf close;

            ods pdf file="/home/u63018936/mysasfolder/visualparelleltrend.pdf";


           proc sgplot data=pt2;

   series x=year y=ln_TPR_mean / group=treatment lineattrs=(pattern=solid);
  xaxis values= (2014 to 2024 by 1);

run;
            ods pdf close; */




ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
                              FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
Proc SurveyReg Data=combined plots=none;
           Class Team Year/Ref=first;
           cluster Team;
           Model ln_AVG = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
                              FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
Proc SurveyReg Data=combined plots=none;
           Class Team Year/Ref=first;
           cluster Team;
```

```
	Model ln_TPR= DID Team Year/Solution AdjRsq;
Run;


ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
				FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
Proc SurveyReg Data=combined plots=none;
	Class Team Year/Ref=first;
	cluster Team;
	Model ln_NRPG = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
				FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
Proc SurveyReg Data=combined plots=none;
	Class Team Year/Ref=first;
	cluster Team;
	Model ln_Lng = DID Team Year/Solution AdjRsq;
Run;

ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
				FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
Proc SurveyReg Data=combined plots=none;
	Class Team Year/Ref=first;
	cluster Team;
	Model ln_YPR = DID Team Year/Solution AdjRsq;
Run;



Data Table_Long;
	length Model $10; /* Makes sure the variable Model has the right length and its values are not
truncated */
	length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are
not truncated */
	set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of
databases use in the "set" statement */

	ThisIsM=M;
	Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
				and (substr(Parameter,1,4) ne "year");
	length Star $3;
	if Probt le 0.01 then Star="***";
		else if Probt le 0.05 then Star="**";
		else if Probt le 0.1 then Star="*";
		else Star="";
```

```
	if 	M="WORK.PEFORMODEL1" then Model="Model1";
	else if M="WORK.PEFORMODEL2" then Model="Model2";
	else if M="WORK.PEFORMODEL3" then Model="Model3";
	else if M="WORK.PEFORMODEL4" then Model="Model4";
	else if M="WORK.PEFORMODEL5" then model="Model5";





	Results=Estimate;
	EditedResults=Cats(put(Results,comma16.2),Star);
	output;

	Results=StdErr;
	EditedResults=Cats("(",put(Results,comma16.2),")");
	output;


	keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
	by Model Parameter;
run;


/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
	set Table_Long_Sorted;
	if Model="Model1" then output Model1Results;
	else if Model="Model2" then output Model2Results;
	else if Model="Model3" then output Model3Results;
	else if Model="Model4" then output Model4Results;
	else if Model="Model5" then output Model5Results;
	drop Model;
run;
```

```
/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
	merge Model1Results Model2Results Model3Results Model4Results Model5Results;
	by Parameter;
	length Order 3;
	if Parameter="DID" then order=1;
	else order=2;


	if mod(_n_,2)=1 then Regressors=Parameter;


run;

/* Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
	by Order;
run;

/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
	merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
	ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
	ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
	ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
	ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);


	Where Label1="Number of Observations";
	Model1=Put(NVModel1,comma16.);
	Model2=Put(NVModel2,comma16.);
	Model3=Put(NVModel3,comma16.);
	Model4=Put(NVModel4,comma16.);
	Model5=Put(NVModel5,comma16.);

	keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
Data AdjRsq;
	merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
	merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
	merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
	merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
```

```
            merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

            where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
    OSM2(rename=(EditedFvalue=Model2))
    OSM3(rename=(EditedFvalue=Model3))
    OSM4(rename=(EditedFvalue=Model4))
    OSM5(rename=(EditedFvalue=Model5));
            Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
            where Effect="Model";
            ThisIsM=M;

            length Star $3;
            if ProbF le 0.01 then Star="***";
                        else if ProbF le 0.05 then Star="**";
                        else if ProbF le 0.1 then Star="*";
                        else Star="";

            Label1="Overall Significance";
            EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

            if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;


            Keep Label1 EditedFvalue;
Run;


data OSM1(rename=(EditedFvalue=Model1))
             OSM2(rename=(EditedFvalue=Model2))
             OSM3(rename=(EditedFvalue=Model3))
             OSM4(rename=(EditedFvalue=Model4))
             OSM5(rename=(EditedFvalue=Model5));
            Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 indsname=M;
            where Effect="Model";
            *ThisIsM=M;

            length Star $3;
```

```
	if ProbF le 0.01 then Star="***";
		else if ProbF le 0.05 then Star="**";
		else if ProbF le 0.1 then Star="*";
		else Star="";

	Label1="Overall Significance";
	EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
		else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
		else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
		else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
		else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

	Keep Label1 EditedFvalue;
Run;

Data OverallSig;
	merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
	set NumofObs AdjRsq OverallSig;
	rename Label1=Regressors;
Run;

Data OtherInfo;
	Length Label1 Model1 Model2 Model3 Model4 Model5 $30;
	Regressors="Team and Year Fixed Effects?";
	Model1="Yes";
	Model2="Yes";
	Model3="Yes";
	Model4="Yes";
	Model5="Yes";
	Output;


Run;

/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;

	Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;
```

```
        /* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/results3.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "NFL Kickoff Rule Change Results";
footnote1 justify=left "Source: Data collected from the Football Database (2024) and NFL.com (2024). ";
footnote2 justify=left "Notes: Robust standard errors are in parentheses and clustered at the team level. *,
**, and *** indicate 10%, 5%, 1% significance levels, respectively.";
proc print data=Table_wide_sorted_withstat noobs;
        var Regressors;
        var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
        format Regressors $VariableName.;
run;

ods excel close;
/* Balance of Regressors Test
Proc TTest Data = combined;
Where Year <2024;
Var Avg Td Lng Ret Yds;
Class Treatment;
run; */

        Ods output ParameterEstimates=PEforModel1 DataSummary=ObsModel1
                        FitStatistics=AdjRsqModel1 Effects=OverallSigModel1;
        Proc SurveyReg Data=combined plots=none;
        *Class Year/Ref=first;
        *Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
        where year<2024;
        Model ln_Avg= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel2 DataSummary=ObsModel2
                        FitStatistics=AdjRsqModel2 Effects=OverallSigModel2;
        Proc SurveyReg Data=combined plots=none;
        *Class Year/Ref=first;
        *Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
        where year<2024;
```

```
	Model ln_TPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel3 DataSummary=ObsModel3
				FitStatistics=AdjRsqModel3 Effects=OverallSigModel3;
	Proc SurveyReg Data=combined plots=none;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model ln_NRPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution
adjrsq;

Run;

Ods output ParameterEstimates=PEforModel4 DataSummary=ObsModel4
				FitStatistics=AdjRsqModel4 Effects=OverallSigModel4;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model ln_Lng= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
				FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model ln_YPR= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;

/*Ods output ParameterEstimates=PEforModel5 DataSummary=ObsModel5
				FitStatistics=AdjRsqModel5 Effects=OverallSigModel5;
	Proc SurveyReg Data=combined plots=none;
	*Class Year/Ref=first;
	*Model Avg= year y2 y3 treatment treatment*year treatment*y2 treatment*y3 /solution adjrsq;
	where year<2024;
	Model ln_YPG= ry ry2 ry3 treatment treatment*ry treatment*ry2 treatment*ry3 /solution adjrsq;

Run;*/


Data Table_Long;
	length Model $10; /* Makes sure the variable Model has the right length and its values are not
```

```
truncated */
	length Parameter $30; /* Makes sure the variable Parameter has the right length and its values are
not truncated */
	set PEforModel1 PEforModel2 PEforModel3 PEforModel4 PEforModel5
indsname=M;/*"indsname" creates an indicator variable (here I call it "M") that tracks the name of
databases use in the "set" statement */

	ThisIsM=M;
	Where (Estimate ne 0) and (substr(Parameter,1,4) ne "Team")
			and (substr(Parameter,1,4) ne "year");
	length Star $3;
	if Probt le 0.01 then Star="***";
		else if Probt le 0.05 then Star="**";
		else if Probt le 0.1 then Star="*";
		else Star="";



	if	M="WORK.PEFORMODEL1" then Model="Model1";
	else if M="WORK.PEFORMODEL2" then Model="Model2";
	else if M="WORK.PEFORMODEL3" then Model="Model3";
	else if M="WORK.PEFORMODEL4" then Model="Model4";
	else if M="WORK.PEFORMODEL5" then model="Model5";





	Results=Estimate;
	EditedResults=Cats(put(Results,comma16.2),Star);
	output;

	Results=StdErr;
	EditedResults=Cats("(",put(Results,comma16.2),")");
	output;


	keep Model Parameter EditedResults;

run;

/* We sometimes need this sorting step when we have multiple regression models */
proc sort data=Table_Long out=Table_Long_Sorted;
	by Model Parameter;
run;
```

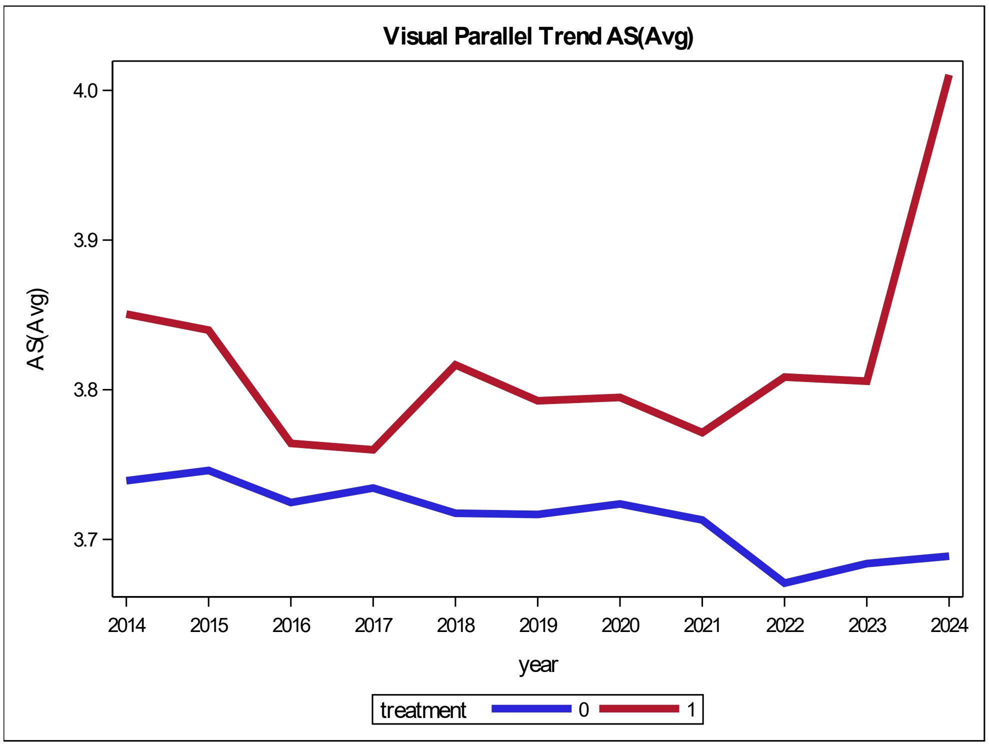
```
/* Step 2: Create separate results columns (in the form of separate databases) corresponding to each
model */
data Model1Results(rename=(EditedResults=Model1))
Model2Results(rename=(EditedResults=Model2))
Model3Results(rename=(EditedResults=Model3))
Model4Results(rename=(EditedResults=Model4))
Model5Results(rename=(EditedResults=Model5));
	set Table_Long_Sorted;
	if Model="Model1" then output Model1Results;
	else if Model="Model2" then output Model2Results;
	else if Model="Model3" then output Model3Results;
	else if Model="Model4" then output Model4Results;
	else if Model="Model5" then output Model5Results;
	drop Model;
run;


/* Step 3: Create the final results table that would include all models side-by-side*/
data Table_Wide;
	merge Model1Results Model2Results Model3Results Model4Results Model5Results;
	by Parameter;
	length Order 3;
	if Parameter="treatment" then order=1;
	else if Parameter="ry" then order=2;
	else if Parameter="ry2" then order=3;
	else if Parameter="ry3" then order=4;
	else if Parameter="ry*treatment" then order=5;
	else if Parameter="ry2*treatment" then order=6;
	else if Parameter="ry3*treatment" then order=7;
	else if Parameter="Intercept" then order=8;


	if mod(_n_,2)=1 then Regressors=Parameter;


run;

 /*Order the variables in the results table */
proc sort data=Table_Wide out=Table_Wide_Sorted(drop=Order Parameter);
	by Order;
run;


/* Step 4: Create the rows for other statistics and info */
/* The row for Number of Obs. */
Data NumofObs;
	merge ObsModel1(rename=(NValue1=NVModel1) drop=CValue1)
```

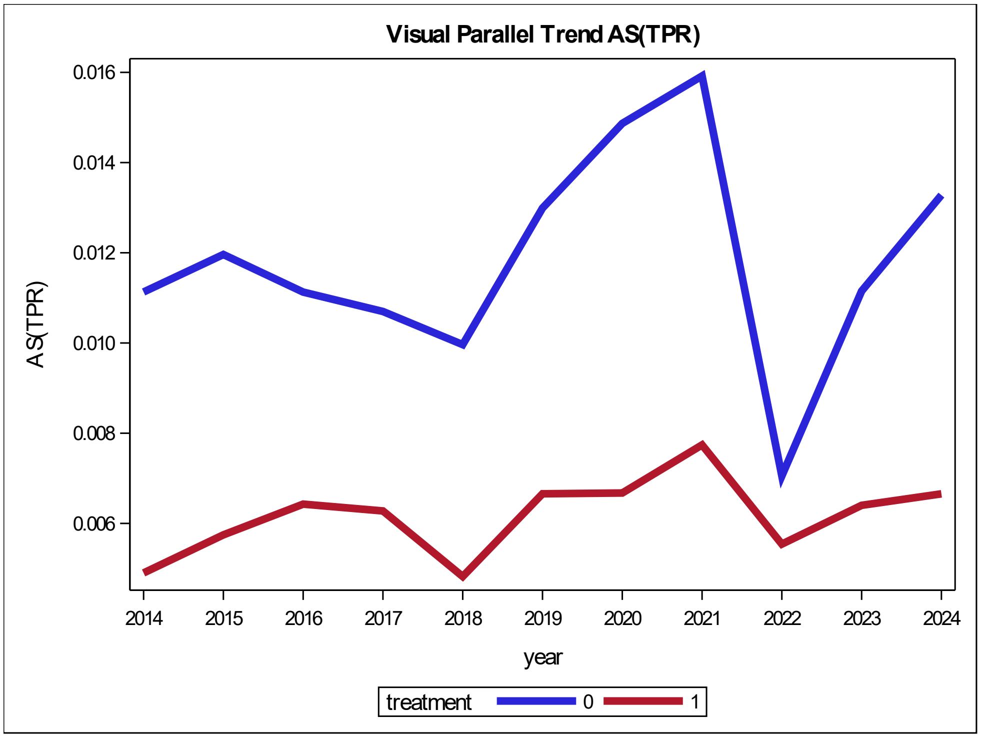
```
        ObsModel2(rename=(NValue1=NVModel2) drop=CValue1)
        ObsModel3(rename=(NValue1=NVModel3) drop=CValue1)
        ObsModel4(rename=(NValue1=NVModel4) drop=CValue1)
        ObsModel5(rename=(NValue1=NVModel5) drop=CValue1);


        Where Label1="Number of Observations";
        Model1=Put(NVModel1,comma16.);
        Model2=Put(NVModel2,comma16.);
        Model3=Put(NVModel3,comma16.);
        Model4=Put(NVModel4,comma16.);
        Model5=Put(NVModel5,comma16.);

        keep Label1 Model1 Model2 Model3 Model4 Model5;
Run;

/* The row for Adjusted R-Squared */
Data AdjRsq;
        merge AdjRsqModel1 (rename=(CValue1=Model1) drop=NValue1);
        merge AdjRsqModel2 (rename=(CValue1=Model2) drop=NValue1);
        merge AdjRsqModel3 (rename=(CValue1=Model3) drop=NValue1);
        merge AdjRsqModel4 (rename=(CValue1=Model4) drop=NValue1);
        merge AdjRsqModel5 (rename=(CValue1=Model5) drop=NValue1);

        where Label1="Adjusted R-Square";
Run;

/* The row for the Overall Significance (F-Test) */
Data OSM1(rename=(EditedFvalue=Model1))
   OSM2(rename=(EditedFvalue=Model2))
   OSM3(rename=(EditedFvalue=Model3))
   OSM4(rename=(EditedFvalue=Model4))
   OSM5(rename=(EditedFvalue=Model5));
        Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 Indsname=M;
        where Effect="Model";
        ThisIsM=M;

        length Star $3;
        if ProbF le 0.01 then Star="***";
                else if ProbF le 0.05 then Star="**";
                else if ProbF le 0.1 then Star="*";
                else Star="";

        Label1="Overall Significance";
        EditedFvalue=Cats(put(Fvalue,comma7.2),Star);
```

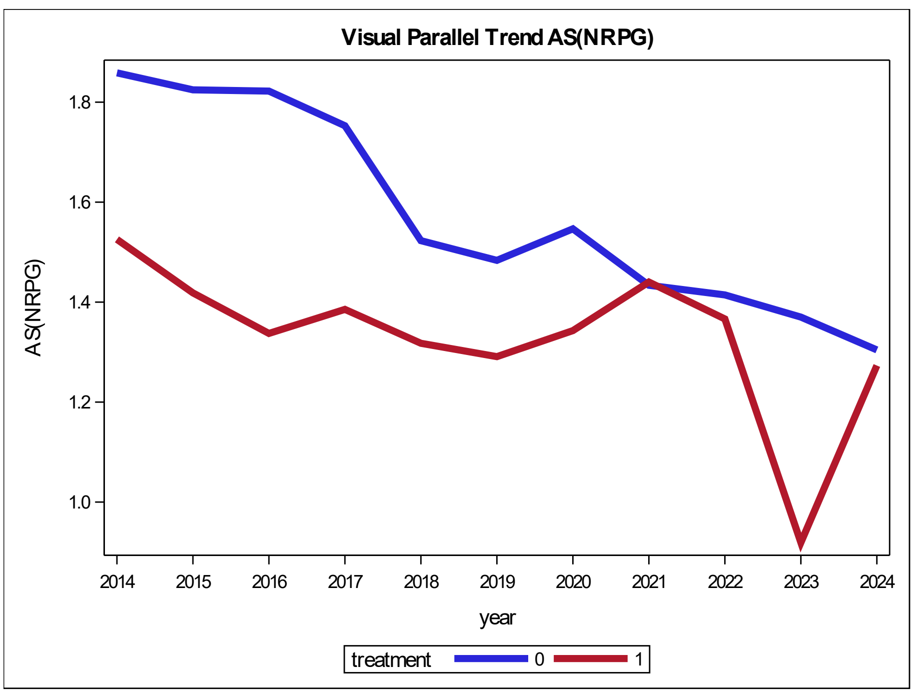
```
	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
else if M="WORK.OVERALLSIGMODEL5" then output OSM5;


	Keep Label1 EditedFvalue;
Run;


data OSM1(rename=(EditedFvalue=Model1))
	 OSM2(rename=(EditedFvalue=Model2))
	 OSM3(rename=(EditedFvalue=Model3))
	 OSM4(rename=(EditedFvalue=Model4))
	 OSM5(rename=(EditedFvalue=Model5));
	Set OverallSigModel1 OverallSigModel2 OverallSigModel3 OverallSigModel4
OverallSigModel5 indsname=M;
	where Effect="Model";
	*ThisIsM=M;

	length Star $3;
	if ProbF le 0.01 then Star="***";
		else if ProbF le 0.05 then Star="**";
		else if ProbF le 0.1 then Star="*";
		else Star="";

	Label1="Overall Significance";
	EditedFvalue=Cats(put(Fvalue,comma7.2),Star);

	if M="WORK.OVERALLSIGMODEL1" then output OSM1;
		else if M="WORK.OVERALLSIGMODEL2" then output OSM2;
		else if M="WORK.OVERALLSIGMODEL3" then output OSM3;
		else if M="WORK.OVERALLSIGMODEL4" then output OSM4;
		else if M="WORK.OVERALLSIGMODEL5" then output OSM5;

	Keep Label1 EditedFvalue;
Run;

Data OverallSig;
	merge OSM1 OSM2 OSM3 OSM4 OSM5;
Run;



/* Combine All rows */
Data OtherStat;
```

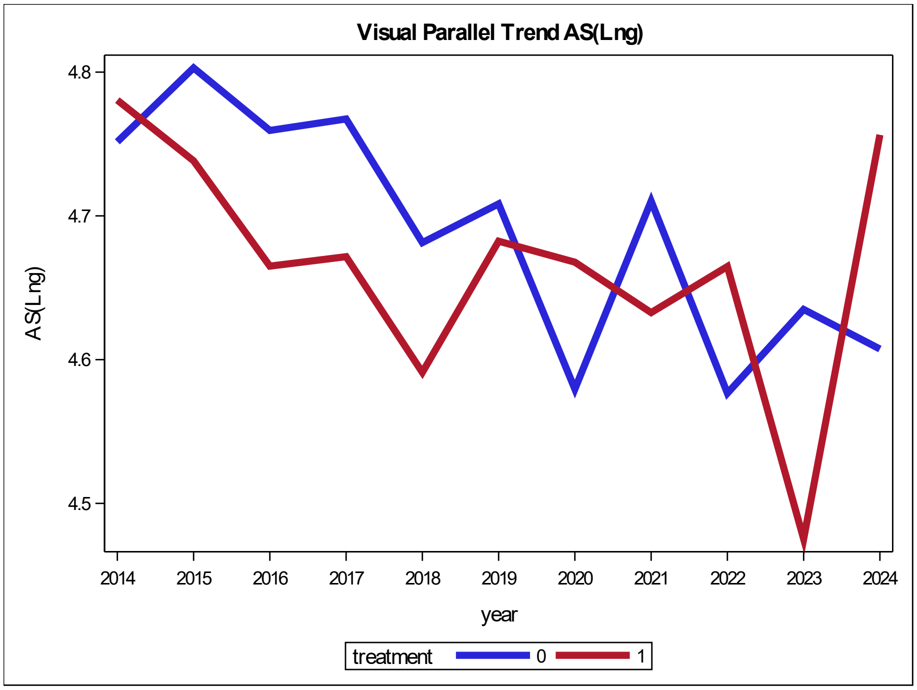
```
            set NumofObs AdjRsq OverallSig;
            rename Label1=Regressors;
Run;



/* Step 5: Add other statistics to the results table */
Data Table_wide_sorted_withstat;

            Set Table_Wide_Sorted  OtherInfo OtherStat;
Run;

ods excel close;
/* create new name for variables in the regression results table through defining a new format*/









/*ods excel file="/home/u63018936/mysasfolder/procmeansNCAA.xlsx"
options(Embedded_Titles="ON" Embedded_Footnotes="ON");
proc print data=NCAADatabase5;
run; */

/*ods excel close;
ods excel file="/home/u63018936/mysasfolder/procmeansNFL.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON");
proc print data=NFLDatabase5;
run; */


 /* Print the clean results table */
ods excel file="/home/u63018936/mysasfolder/parelleltrendtest3.xlsx" options(Embedded_Titles="ON"
Embedded_Footnotes="ON"); /*Use the path to your MySAS folder */

Title "Parellel Trend Test";
proc print data=Table_wide_sorted_withstat noobs;
            var Regressors;
            var Model1-Model5 / style(header)={just=center} style(data)={just=center
tagattr="type:String"};
            format Regressors $VariableName.;
run;
```

Appendix 2. Visual Parallel Trend Hyperbolic Sine Model.

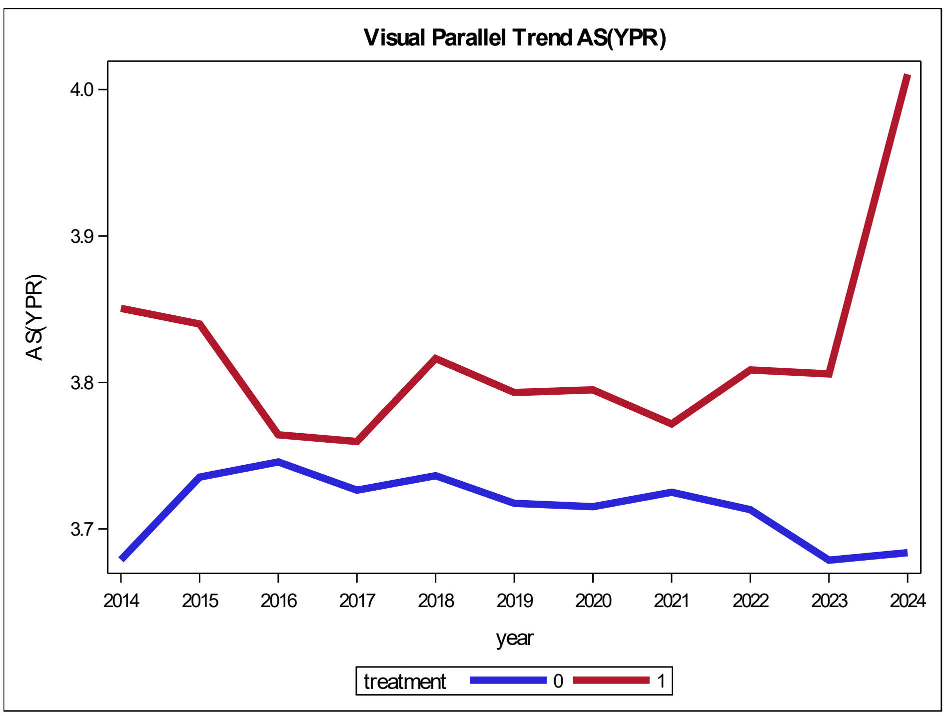



Visual Parallel Trend AS(TPR)
0.016
0.014
0.012
0.010
0.008
0.006
AS(TPR)
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment
0
1


Visual Parallel Trend AS(NRPG)
1.8
1.6
1.4
1.2
1.0
AS(NRPG)
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment
0
1



Visual Parallel Trend AS(Lng)
4.8
4.7
4.6
4.5
AS(Lng)
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment 0 1



Visual Parallel Trend AS(YPR)
4.0
3.9
3.8
3.7
AS(YPR)
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
year
treatment 0 1