

## **Impact of Coaching Tenure**

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## *Abstract*

This research examines how tenure of a head coach and offensive and defensive coordinators impact team performance in the National Football League (NFL). Present in this paper was a very distinctive offensive coordinator story, but head coach and defensive coordinator did not correspond with my stated hypothesis. I find that increased tenure of the offensive coordinator with their current team is associated with better team performance measures in yards per offensive play and first downs. Head coaches' tenure was found to have no impact on a team's overall performance. A defensive coordinator's tenure in the NFL and their current team was shown to have little to no impact on team performance. Additionally, teams whose offensive coordinator was an external hire tended to have lower offensive performance measures, such as yards per offensive play, points scored in a season, as well as first downs in a season, relative to those that hired their offensive coordinator internally.

## *Introduction*

A study done in 2016 by *Business Insider* shows that even though there are a lot of coaching changes in the NFL, there were five NFL coaches that have been with their current team for at least ten seasons (Business Insider, 2016). The NBA, MLB, NHL, and English Premier League have five coaches combined. Since the NFL has the most tenured coaches, that should mean they have a track record of success or have been successful for much of their tenure with their current team. Currently the average tenure of an NFL head coach is 3.4 years. So, one question I ask is, do these higher tenured coaches have any real impact on their team's performance?

This paper examines just that, what is the correlation between tenure and overall team performance on offense and defense. Using the tenures of the head coach, offense coordinator and defensive coordinator, we will see if just one more year benefits a team or negatively impacts a team. I hypothesis that an increase in a coach's tenure will positively impact team performance measures. While looking at specific statistical measures for the offense, such as yards per offensive play, points scored and first downs, and for the defense, yards per offensive play given up, interceptions and turn over percentage, I find an interesting story. It shows that the head coach has no significant impact on both the offense and defensive side of the ball. While the offensive coordinator has a substantial impact with an increased tenure on their current team. It is also found that an external hire of an offensive coordinator will negatively impact team performance. Finally, I also found that the defensive coordinator has no substantial impact on defensive performance.

## *Literature Review*

Many researchers have investigated the importance of Chief Executive Officers (CEO) and their impact on worker and firm productivity. Research has indicated that CEOs do impact worker and firm productivity in the non-sports labor market (Bennedsen et al., 2006; Lazear et al., 2012). Similar studies in the sports labor market have produced mixed results on the impact of coaches/managers on team performance. Goff (2013) finds very little evidence that managers in Major League Baseball have a significant impact on the performances of their team and players. On the other hand, Kahn (1993) found that higher quality managers in Major League Baseball led to higher winning percentages and player quality. In the National Basketball Association, Berri et al. (2009) showed that coaches do not significantly impact player performance. Likewise in the National Football League, Goff (2013) concluded that coaches do not have an impact on team performance. Pitts and Evans (2020) did find that elite and very poor defensive coordinators have a meaningful impact on team productivity. Previously, Pitts and Evans (2018) also found that offensive coordinators have significant impacts on a quarterback's performance. Offensive coordinators work very closely with the quarterbacks in the process of preparation and execution. They find that there is no comparable position on the defense. Additionally, Goff (2013) concludes that the Moneyball era (MLB) and a new importance of passing offense in the late 1970s (NFL) suggest an increased value to managers and coaches in their respective leagues.

Managerial and coaching changes are very common in many sports leagues around the world. Over the past decade NFL teams have made 68 hires at the head coaching level (Schalter, 2020). In all four North American professional sports leagues, over a 20-year interval from 1999 to 2019, the NBA's average coaching tenure was 2.4 years, NHL's 2.6 years, MLB's 3.1 years,

and NFL's leading the way at 3.4 years (Kennedy, 2019). This shows that as a coach, you do not have very long to succeed in these leagues before you are replaced.

Front office decisions on hiring and firing are very important to the health and outlook of an organization. Typically, by changing the coach, the organization hopes to improve overall team performance. Adler et al. (2013) found in college football (NCAAF) that poor performing teams who fire their coach mid-season, show little improvement in team performance with their new coach. Teams who had average records, whose entry conditions for a new coach were favorable, resulted in worse performance. Roach (2013) found that firing a coach lowers a team's expected performance for the next season and their average over the next two. Audus et al. (2001) studied the results of firing mid-season in the English football association, which showed that a change of management during a crisis is unlikely to improve performance by more than might have been expected, had the previous manager remained in position. Balduck et al. (2010) did find that there is a positive team performance effect on in season firing in Belgian male soccer league. Lastly, Audas et al. (2002) found that one of the biggest factors in in-season hiring is that the incoming coach alters the team's tactics. The empirical results suggest in English football leagues it takes up to 16 matches or 3 months after a change in the coach for the team to adapt and perform to the new standards of the coach.

After the decision to fire the coach, the organization has either the option for hiring someone internally or externally. In the non-sports labor markets, there have been studies such as Chan (1996) who looked at the effects of internal versus external hiring in Fortune 100 companies. They found that opening the competition for a position to external candidates reduces the chance for promotion among existing workers, which causes their incentive to work to decrease. On the other hand, Lazear and Oyer (2004) and Bidwell and Mollick (2015) found that

firms prefer internal promotion compared to external promotion. This would then incentivize workers to work harder to work their way up in a corporation.

There is little research on internal versus external hires for sports teams but, Fee et al. (2006) found that an individual's performance of a position coach, is significantly related to the likelihood that, the coach could be in line for a promotion from the outside labor market. They also find that when an internal promotion occurs, an individual's performance measure is unlikely the reason for hire, especially for a prestigious position such as a head coach, offensive or defensive coordinator. Roach (2013) finds individual performance enhances your external labor market options and not so much an internal promotion where you are currently coaching. Pitts and Evans (2018) do find evidence that offensive coordinators who are internally promoted may be associated with a positive impact on their quarterback's performance as opposed to offensive coordinators who are external hires. Mielke (2007) makes the case that the common progression to head coach/manager is from service as a major assistant.

During the hiring process, one characteristic many organizations look at is prior coaching success. Roach (2016) finds that prior head coaching experience in the NFL has a significant negative effect on team performance. Meaning that success in the past with another team does not guarantee success in the future with your new team. Hall and Pedace (2016) also find that past performance in a non-managerial position does not necessarily predict success as a manager in the MLB. Roach (2016) then finds that NFL coaches have less successful teams on average in the coaching spells following their initial head coaching job. This paper then suggests that organizations should not be willing to pay huge premiums for head coaching experience because past success seems to not translate into future success.

As stated above, coaches do not get very much time to have success because before they know it, they could be replaced. So, gaining tenure and success early is very important for longevity as a coach. Pitts and Evans (2020) find that a team's defensive performance is shown to improve with increased defensive coordinator tenure. Mielke (2007) found that the tenure of a coach is based on the success of the coach. Academic research reveals mixed results on the coach's impact on team performance with most of the research saying that coaches have little impact.

## *Data and Methodology*

The question I will be researching is, what impact does tenure of coaches in the National Football League (NFL) have on team performance? My hypothesis is that, in the National Football League (NFL), coaches with increased tenure, such as the head coach, offensive coordinator and defensive coordinators will increase team performance measures.

My sample includes regular season stats from all 32 NFL teams from both the National Football Conference (NFC) and the American Football Conference (AFC) from 2010 to 2019 regular seasons. Playoffs were excluded because not every team makes playoffs each year. The NFC and AFC are both conferences in the NFL that make up all 32 teams. There are 16 teams in each of them, and in each conference, there are four divisions with four teams in each. Typically, each division has all the teams geographically located around the same area in the United States. The sample includes the head coach, offensive coordinator, and defensive coordinator for each of the 32 NFL teams from 2010 to 2019. Coaches are not included in the sample if there were two coaches in the same position or a coach got fired during the season. In

special cases there are co-coordinators, where there would be two coaches in one position sharing the duties, again in those cases they were not included in the dataset.

My variables include, team, coaching, offensive and defensive statistics. Starting with the offensive side of the ball, my dependent variables include yards per offensive play, points scored in a season, and first downs in a season. Yards per offensive play, is the average yards each team gained per play in a season. That means your team is really moving the ball efficiently down the field when this is higher and not so much when it is lower. Next is points scored in a season, and this is the total amount of points the team scored in a whole season from touchdowns, field goals, extra points, safeties and two-point conversions. Lastly is first downs gained in a season, which is the total amount of times the offense got a first down and got four new downs. In the NFL you get four downs which is an attempt, to go ten yards to get a first down. If you pass the first down marker you are awarded with a first down, and you get four more tries to get another, unless you score. Again, the more first downs you have the better your offense is at moving the ball.

I ran three regressions using defensive statistics those were yards per offensive play given up, interceptions in a season and turn over percentage on defense. Yards per offensive play given up is the average yards the offense gained on the defense each play over a season. Interceptions is the amount of passes the defense caught off the offense over a whole season. This statistic typically shows how good your secondary really is. The secondary is the cornerbacks and the safeties who guard the opponent receivers. Any player on the defense can catch a pass from the opponent, but typically it is the corners and safeties. Finally turn over percentage is the percentage of time the defense causes a turnover against the offense, giving



their team the ball on offense. Having a higher turnover percentage lead to more opportunities for your offense to possess the ball.

My main variables of interest are the coaching statistics. These independent variables will include the head coach, and both offensive and defensive coordinator characteristics. Starting with the head coach, I recorded the tenure in the NFL as a head coach, tenure as head coach on their current team, and if the coach was hired externally. For the offensive and defensive coordinators, the tenure in the NFL as a coach, tenure on their current team, and if the coach was externally hired, was recorded. I will also be including strength of schedule, all-pro players on a team, bye week, and draft capital percentage. Strength of schedule is the is a unit of measurement to determine the difficulty or ease of an opponent. Higher strength of schedule indicates a tougher schedule, lower indicates easier. All-pro players on a given team, indicates the number of players on the team that were named to all pro lineups. This is an after-season award that the NFL hands out to the best players at each position. Bye week is the week during a given season, where the NFL says they do not have to play a game. In the dataset the week the bye week occurred was entered. This was put into this dataset because I believe depending on when you have your bye week could either really help your team, hurt your team, or have no impact at all. Injuries start to pile up later in the season, so a week off to get everyone rested later. Draft capital percentage is the percentage of draft picks the team had in the draft leading up to the season. The higher percentage, the more players you drafted, and the lower percentage the less players you selected in the draft. This was included because with more draft picks you have a better chance at more of them being significant players on their

teams. Lastly for my variables, I controlled for each year 2010 to 2019, so every year has its own independent variable. The omitted year was 2010.

To test my hypothesis, there will be six linear regressions performed with all the independent variables. Those were, yards per offensive play, points scored and first downs for the offense, and yards per offensive play given up, interceptions and turn over percentage on defense. Three regressions for the offense and three for the defense. The defensive coaching statistics will not be included in the offensive regressions, and the offensive coaching statistics will not be included in the defensive regressions. What will be included in the offensive regression will be all the independent variables, strength of schedule, all-pros, bye week, draft capital percentage as well as all the control years minus 2010, as well as two defensive variables, which were yards per offensive play given up and turn over percentage for the defense. This was included in the regression, to see if there is any correlation between the defense and the offense. Likewise for the defensive regressions which included all the independent variables, strength of schedule, all-pros, bye week and draft capital percentage, two offensive variables were used which were, yards per offensive play and turn over percentage for the offense.

There were three regressions for both offense and defense, starting with the first regression, which examines the relationship between yards per offensive plays and the independent variables.

$$\text{Yards per offensive play}_i = \beta_0 + \beta_1 \text{HC Tenure on team}_i + \beta_2 \text{HC Tenure in NFL}_i + \beta_3 \text{HC External}_i + \beta_4 \text{OC Tenure on Team}_i + \beta_5 \text{OC Tenure in NFL}_i + \beta_6 \text{OC External}_i + \beta_7 \text{Strength of Schedule}_i + \beta_8 \text{All Pros}_i + \beta_9 \text{Bye Week}_i + \beta_{10} \text{Draft Capital Percentage}_i + \beta_{11} \text{Yards per offensive}$$

play given up<sub>i</sub> +  $\beta_{12}$  Turn Over Percentage Defense<sub>i</sub> +  $\beta_{13}$  2011<sub>i</sub> +  $\beta_{14}$  2012<sub>i</sub> +  $\beta_{15}$  2013<sub>i</sub> +  $\beta_{16}$  2014<sub>i</sub> +  $\beta_{17}$  2015<sub>i</sub> +  $\beta_{18}$  2016<sub>i</sub> +  $\beta_{19}$  2017<sub>i</sub> +  $\beta_{20}$  2018<sub>i</sub> +  $\beta_{21}$  2019<sub>i</sub> +  $\epsilon_i$

My second regression on offense examines the relationship between points scored and the independent variables.

Points Scored<sub>i</sub> =  $\beta_0$  +  $\beta_1$ HC Tenure on team<sub>i</sub> +  $\beta_2$ HC Tenure in NFL<sub>i</sub> +  $\beta_3$ HC External<sub>i</sub> +  $\beta_4$  OC Tenure on Team<sub>i</sub> +  $\beta_5$  OC Tenure in NFL<sub>i</sub> +  $\beta_6$  OC External<sub>i</sub> +  $\beta_7$  Strength of Schedule<sub>i</sub> +  $\beta_8$  All Pros<sub>i</sub> +  $\beta_9$  Bye Week<sub>i</sub> +  $\beta_{10}$  Draft Capital Percentage<sub>i</sub> +  $\beta_{11}$  Yards per offensive play given up<sub>i</sub> +  $\beta_{12}$  Turn Over Percentage Defense<sub>i</sub> +  $\beta_{13}$  2011<sub>i</sub> +  $\beta_{14}$  2012<sub>i</sub> +  $\beta_{15}$  2013<sub>i</sub> +  $\beta_{16}$  2014<sub>i</sub> +  $\beta_{17}$  2015<sub>i</sub> +  $\beta_{18}$  2016<sub>i</sub> +  $\beta_{19}$  2017<sub>i</sub> +  $\beta_{20}$  2018<sub>i</sub> +  $\beta_{21}$  2019<sub>i</sub> +  $\epsilon_i$

My third regression on offense examines the relationship between first downs and the independent variables.

First downs<sub>i</sub> =  $\beta_0$  +  $\beta_1$ HC Tenure on team<sub>i</sub> +  $\beta_2$ HC Tenure in NFL<sub>i</sub> +  $\beta_3$ HC External<sub>i</sub> +  $\beta_4$  OC Tenure on Team<sub>i</sub> +  $\beta_5$  OC Tenure in NFL<sub>i</sub> +  $\beta_6$  OC External<sub>i</sub> +  $\beta_7$  Strength of Schedule<sub>i</sub> +  $\beta_8$  All Pros<sub>i</sub> +  $\beta_9$  Bye Week<sub>i</sub> +  $\beta_{10}$  Draft Capital Percentage<sub>i</sub> +  $\beta_{11}$  Yards per offensive play given up<sub>i</sub> +  $\beta_{12}$  Turn Over Percentage Defense<sub>i</sub> +  $\beta_{13}$  2011<sub>i</sub> +  $\beta_{14}$  2012<sub>i</sub> +  $\beta_{15}$  2013<sub>i</sub> +  $\beta_{16}$  2014<sub>i</sub> +  $\beta_{17}$  2015<sub>i</sub> +  $\beta_{18}$  2016<sub>i</sub> +  $\beta_{19}$  2017<sub>i</sub> +  $\beta_{20}$  2018<sub>i</sub> +  $\beta_{21}$  2019<sub>i</sub> +  $\epsilon_i$

My first regression on the defense examines yards per offensive play given up in relationship to the independent variables.

Yards per offensive play given up<sub>i</sub> =  $\beta_0$  +  $\beta_1$ HC Tenure on team<sub>i</sub> +  $\beta_2$ HC Tenure in NFL<sub>i</sub> +  $\beta_3$ HC External<sub>i</sub> +  $\beta_4$  DC Tenure on Team<sub>i</sub> +  $\beta_5$  DC Tenure in NFL<sub>i</sub> +  $\beta_6$  DC External<sub>i</sub> +  $\beta_7$  Strength of Schedule<sub>i</sub> +  $\beta_8$  All Pros<sub>i</sub> +  $\beta_9$  Bye Week<sub>i</sub> +  $\beta_{10}$  Draft Capital Percentage<sub>i</sub> +  $\beta_{11}$  Yards per offensive play<sub>i</sub> +  $\beta_{12}$  Turn Over Percentage Offense<sub>i</sub> +  $\beta_{13}$  2011<sub>i</sub> +  $\beta_{14}$  2012<sub>i</sub> +  $\beta_{15}$  2013<sub>i</sub> +  $\beta_{16}$  2014<sub>i</sub> +  $\beta_{17}$  2015<sub>i</sub> +  $\beta_{18}$  2016<sub>i</sub> +  $\beta_{19}$  2017<sub>i</sub> +  $\beta_{20}$  2018<sub>i</sub> +  $\beta_{21}$  2019<sub>i</sub> +  $\epsilon_i$

My second regression for the defense examines interceptions in relationship to the independent variables.

$$\begin{aligned} \text{Interceptions}_i = & \beta_0 + \beta_1 \text{HC Tenure on team}_i + \beta_2 \text{HC Tenure in NFL}_i + \beta_3 \text{HC External}_i + \beta_4 \\ & \text{DC Tenure on Team}_i + \beta_5 \text{DC Tenure in NFL}_i + \beta_6 \text{DC External}_i + \beta_7 \text{Strength of Schedule}_i + \beta_8 \\ & \text{All Pros}_i + \beta_9 \text{Bye Week}_i + \beta_{10} \text{Draft Capital Percentage}_i + \beta_{11} \text{Yards per offensive play}_i + \beta_{12} \\ & \text{Turn Over Percentage Offense}_i + \beta_{13} 2011_i + \beta_{14} 2012_i + \beta_{15} 2013_i + \beta_{16} 2014_i + \beta_{17} 2015_i + \beta_{18} \\ & 2016_i + \beta_{19} 2017_i + \beta_{20} 2018_i + \beta_{21} 2019_i + \epsilon_i \end{aligned}$$

My third and final regression for the defense examines turn over percentage of the defense in relationship with the independent variables.

$$\begin{aligned} \text{Turn Over Percentage Defense}_i = & \beta_0 + \beta_1 \text{HC Tenure on team}_i + \beta_2 \text{HC Tenure in NFL}_i + \\ & \beta_3 \text{HC External}_i + \beta_4 \text{DC Tenure on Team}_i + \beta_5 \text{DC Tenure in NFL}_i + \beta_6 \text{DC External}_i + \beta_7 \\ & \text{Strength of Schedule}_i + \beta_8 \text{All Pros}_i + \beta_9 \text{Bye Week}_i + \beta_{10} \text{Draft Capital Percentage}_i + \beta_{11} \text{Yards} \\ & \text{per offensive play}_i + \beta_{12} \text{Turn Over Percentage Offense}_i + \beta_{13} 2011_i + \beta_{14} 2012_i + \beta_{15} 2013_i + \beta_{16} \\ & 2014_i + \beta_{17} 2015_i + \beta_{18} 2016_i + \beta_{19} 2017_i + \beta_{20} 2018_i + \beta_{21} 2019_i + \epsilon_i \end{aligned}$$

## Results

As was discussed in the data and methodology sections there were three regressions ran. Heteroskedasticity was not present among any of the regressions. Another test that was ran was a correlation matrix to test for multicollinearity. When looking at the correlation matrix, multicollinearity was found to be no concern. Below is the table which shows the results for all three offensive regressions.

Table 1: Offense

	Yards Per Offensive Play	Points Scored	First Downs
HC Tenue on Team	-0.014 (0.01)	0.17 (1.34)	0.14 (0.77)
HC Tenue in NFL	0.007 (0.006)	0.42 (0.81)	-0.215 (0.477)
HC External	0.04 (0.07)	13.99 (9.24)	5.25 (5.3)
OC Tenue on Team	0.03** (0.015)	3.28 (2.1)	2.58** (1.2)
OC Tenure in NFL	-0.001 (0.004)	-0.60 (0.55)	-0.2 (0.31)
OC External	-0.147** (0.06)	-16.99** (7.84)	-14.68*** (4.5)
Strength of Schedule (SoS)	-0.32** (0.015)	-7.1*** (2.03)	-3.2*** (1.17)
All Pros	0.07*** (0.012)	11.58*** (1.63)	4.4*** (0.94)
Bye Week	0.01 (0.01)	1.93 (1.48)	0.21 (0.85)
Draft Capital Percentage	-0.002 (0.03)	0.12 (4.1)	-1.28 (2.3)
Yards Per Offensive Play Given up	0.48*** (0.06)	45.23*** (8.37)	27.08*** (4.8)
Turn Over Percentage Defense	0.01 (0.009)	5.22*** (1.23)	0.53 (0.71)
2011	0.14 (0.11)	15.76 (14.89)	7.6 (8.5)
2012	0.12 (0.11)	26.44* (15.59)	17.03** (8.38)
2013	0.04 (0.11)	31.86** (14.47)	16.73** (8.31)
2014	0.05 (0.11)	7.39 (14.71)	11.9 (8.4)
2015	0.11 (0.12)	14.4 (15.33)	8.84 (8.8)
2016	0.17 (0.11)	26.89* (15.24)	19.66** (8.75)
2017	0.04 (0.11)	17.64 (15.15)	6.23 (8.7)
2018	0.2* (0.12)	24.97 (15.11)	17.19* (8.89)
2019	0.14 (0.11)	20.723 (15.11)	20.43** (8.68)
Constant	2.36*** (0.41)	-18.004* (54.1)	143.31*** (31.07)
Number of Observations	280	280	280
F-Stat	5.94***	8.16***	5.19***
R <sup>2</sup>	0.325	0.39	0.29

Note: Robust standard errors for independent variables are show in parentheses.

The symbols \*, \*\*, \*\*\* correspond to a 10%, 5%, and 1% level of significance.

Three offensive regressions were conducted. The dependent variables were yards per offensive play, points scored in a season, and total first downs in a season. The head coach independent variables were not significant at any level in all three regressions for the offense. This raises some questions as to why that is the case. One reason as to why might be that the coordinators make more calls impacting the offense. Whereas the head coach, in most of the cases, is not calling the offensive plays. There are some special cases which were removed from this study, but typically each team has an offensive coordinator who calls the plays.

Next, are the offensive coordinator variables, which resulted in two being significant at the 5% level for offensive coordinator tenure on their current team. They were significant for the yards per offensive play and the first down regression. Every additional year coached on a current team for the offensive coordinator leads to an increase of 0.03 yards per offensive play. Likewise, every additional year coached on their current team leads to about 2.58 more first downs per season. Offensive coordinator tenure in the NFL was not significant in determining any of the offensive stats explored in this study. The last offensive coordinator characteristic was if the coach was an external hire, and this gave an interesting result. All the offensive regressions resulted in an external hire being statistically significant at the 1% level. So, when the offensive coordinator is an external hire, it will result in 0.147 less yards per offensive play compared to an internal hire. Similarly, an external hire will result in 16.99 less points per season. Lastly an external hire is associated with 14.68 less first downs per season than an internal hire. These significant coaching variables tell an interesting story, showing that being an internal hire is very beneficial to a team. It also shows offensive coordinator tenure on the team makes an impact on a team's performance level.

Strength of schedule was significant for all three of the offensive regressions. Strength of schedule was significant at the 5% level for yards per offensive play, and 1% for both points scored and first downs. An increase in strength of schedule by 1 percentage point will decrease yards per offensive play by 0.32 yards. When looking at the next regression an increase in strength of schedule by 1 will decrease points scored per seasons by 7.1. Finally, an increase of strength of schedule by 1 point will decrease first downs by 3.2 per season. This result makes sense because as strength of schedule increases you are playing more difficult teams which could potentially make your team performance suffer. The next variable was the number of all-pros players on a team which was significant at the 1% level for all three of the offensive regressions. One additional all-pro will increase yards per play by 0.07, increase points scored in a season by 11.58 and add an additional 4.4 first downs in a season. Draft capital percentage was the next variable it showed to not be significant in all three of the regressions.

While this is an offensive regression, two defensive statistics were included in the regression to see if there was any correlation between a good offense and defense. Yards per offensive play given up was significant at 1% for all three of the regressions. A decrease in 1 yard per offensive play given up is associated with an increase of 0.48 yards per offensive play, increase points scored by 45.23 points per season, and finally adds an additional 27.08 first downs. When the defense is performing better the offense should get to have more chances to move the ball and positively effect team performance. On the other hand, if the defense gave up more yards, then the offense needs to compensate for their losses. The next defensive statistic include was turn over percentage. This was only significant for points scored, which was significant at the 1% level. This means that a decrease of 1 percentage point of defensive

turn over percentage is associated with an additional 5.22 points per season. Finally for the offensive regression, every year in the regression was controlled with 2010 being the omitted year. There were some years that we statistically significant, but none of them concluded in any interesting differences compared to 2010.

These results for the offense tell an interesting story. They show that the head coach has little to no impact, where the offensive coordinator tenure on their current team does. It also shows that it is more beneficial to hire internally rather than to go searching for a new coach outside of your organization.

Table 2: Defense

	Yards Per Off. Play Given Up	Interceptions	Turn Over Percentage Def.
HC Tenue on Team	0.003 (0.008)	0.093 (0.102)	0.09 (0.067)
HC Tenue in NFL	0.0015 (0.005)	-0.022 (0.064)	-0.022 (0.041)
HC External	-0.09 (0.06)	1.15 (0.73)	0.56 (0.48)
DC Tenue on Team	-0.014 (0.013)	-0.01 (0.16)	0.021 (0.104)
DC Tenure in NFL	-0.007*** (0.003)	-0.007 (0.034)	0.008 (0.022)
DC External	0.043 (0.059)	0.51 (0.69)	0.39 (0.45)
Strength of Schedule	0.008 (0.013)	0.057 (0.158)	0.047 (0.103)
All Pros	-0.07*** (0.011)	0.48*** (0.13)	0.355*** (0.084)
Bye Week	0.004 (0.009)	0.09 (0.112)	0.06 (0.073)
Draft Capital Percentage	0.009 (0.025)	0.037 (0.304)	-0.09 (0.2)
Yards Per Offensive Play	0.34*** (0.048)	-0.205 (0.565)	0.322 (0.37)
Turn Over Percentage Offense	-0.007 (0.007)	-0.107 (0.086)	-0.034 (0.056)
2011	0.03 (0.097)	-0.09 (1.14)	-0.41 (0.75)
2012	-0.037 (0.1)	-0.56 (1.15)	-0.21 (0.75)



2013	-0.0005 (0.095)	0.23 (1.12)	-0.47 (0.73)
2014	0.097 (0.096)	-1.7 (1.12)	-1.15 (0.73)
2015	0.063 (0.01)	-1.74 (1.16)	-1.28* (0.76)
2016	0.07 (0.1)	-2.35** (1.17)	-1.68** (0.76)
2017	-0.11 (0.1)	-1.85 (1.17)	-1.47* (0.769)
2018	0.11 (0.1)	-2.36** (1.18)	-1.36* (0.77)
2019	0.02 (0.1)	-3.03*** (1.16)	-1.41* (0.76)
Constant	3.96*** (0.32)	14.25*** (3.77)	9.34*** (2.47)
Number of Observations	291	291	291
F-Stat	5.31***	2.25**	2.39***
R <sup>2</sup>	0.2929	0.1496	0.1574

Note: Robust standard errors for independent variables are show in parentheses.

The symbols \*, \*\*, \*\*\* correspond to a 10%, 5%, and 1% level of significance.

Starting with the main coaching variables for the defensive regressions, the head coach was not significant in anything on the defense just like the offense. Again, this raises some questions as to why this is the case, it could be that the defensive coordinator typically calls the play for the defense, and it is hard to show the impact of the head coach.

Moving forward with the defensive coordinator variables, where again it is surprising that only one was significant at any level. Defensive coordinator tenure in the NFL was significant at the 1% level with yards per offensive play given up. This shows that for every additional year of tenure in the NFL, yards per offensive play given up should decrease by 0.007 yards per season. Again, only having one significant is very surprising and it raises some questions as to why this might be the case. As the last decade has indicated, the NFL wants the league to have more offense, for example rules that help benefit the offense more than the defense such as pass interference, which is typically called on the defense more than not.

Moving onto the control variables, first starting with strength of schedule, which was not significant in all three of the defensive regressions. It was significant in all three of the offensive regressions, so again this raises some questions as to why this is the case. A more difficult schedule must only impact the offense and not the defense. There is no clear-cut answer as to why this is the case. Next, there is all pros and similarly to the offensive regression all three regressions in this case are significant at the 1% level. One additional all pro player on the team is associated with a decrease in yards per offensive play given up by 0.07, increases interceptions by 0.48 per season and increases turn over percentage of the defense by 0.355 percentage points. Bye week and draft capital percentage were not significant at any level like the offensive regression.

Like the offensive regression, there were two offensive variables for the defensive regression, and this time only one came out significant, compared to four with the offense. Yards per offensive play was significant at the 1% level. This shows that a one-yard increase per offensive play will also increase yards per offensive play given up. This result was opposite of what was expected. The only reason this could be the case is that when the offense is moving the ball at a higher level, they will typically score more. That means the other team will then have the ball more, giving them more chances to move the ball on the defense, potentially leading to an increase yards per offensive play for the defense. Finally, like the offensive regression, 2010 was omitted. Again, there were some significant years, but none saw any variations that were out of the ordinary.

## *Conclusion*

Several previous studies in the non-sports labor market conclude that managers do influence firm and worker productivity. Studies using sports data, have more mixed feelings on the topic of coaches impacting team and player productivity. I add to the literature by examining how the tenure of NFL head coach and offensive and defensive coordinators impacts overall team performance, looking at specific offensive and defensive statistics. In a previous study by Pitts and Evans (2020) they find that a team's defensive performance is shown to improve with increased defensive coordinators tenure. In this study, I arrive at a very different conclusion regarding the impact of defensive coordinator tenure on team performance. I find that defensive coordinator tenure has very little impact on defensive statistics. Defensive coordinator tenure in the NFL was positively correlated with a decrease in average yards per play. What is also found in my study is that offensive coordinators tenure in the NFL and on their current team positively impacts the offenses productivity.

Finally, the finding that an externally hired offensive coordinator negatively impacts offensive performance is potentially important for NFL teams. Every season a handful of coaches get fired and organizations are in search for who will replace them. If organizations would look to hire internally more often than spending more money trying to get a coach to leave their current team that might make your favorite NFL team more successful at least on the offensive side of the ball.

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## Appendix

Variable (Source)	Description	Mean	Standard Dev.	Minimum	Maximum
HC Tenure on Team	Number of years the head coach has coached their current team	4.63	3.97	1	20
HC Tenure in NFL	Number of years the head coach has coached in the NFL as a Head coach	6.65	5.64	1	25
HC External	Head coach was an external hire (Dummy Variable)	0.84	0.36	0	1
OC Tenure on Team	Number of years the offensive coordinator has coached on their current team	2.44	1.97	1	11
OC Tenure in NFL	Number of years the offensive coordinator has coached in the NFL as any offensive coach	14.20	6.30	1	37
OC External	Offensive coordinator was an external hire	0.64	0.47	0	1
DC Tenure on Team	Number of years the defensive coordinator has coach on their current team	2.48	1.81	1	13
DC Tenure in NFL	Number of years the defensive coordinator has coached in the NFL as any defensive coach	17.42	8.26	1	42
DC External	Defensive coordinator was an external hire	0.74	0.44	0	1
Strength of Schedule	Average quality of opponent as measured by SRS (Simple Rating System)	0.0015	1.63	-4.2	4.3
All Pros	Amount of all pros on a team for that given year	2.97	2.19	0	10
Draft Capital Percentage	Percent of draft picks you have	3.12	0.88	0.84	7.18
Bye Week	The week of the season which a team does not have to play	8.02	2.27	4	13
Yards Per Offensive Play	Average amount of yards the offense gains per play	5.42	0.49	4.1	6.8
Yards Per Offensive Play Given up	Average amount of yards the defense gives up per play	5.43	0.41	4.4	6.6
Turn Over Percentage Offense	Percent of time the offense turns the ball over to the defense	12.07%	3.20%	4.0%	21.0%
Turn Over Percentage Defense	Percent of time the defense caused and recovered a turnover	12.10%	3.03%	3.9%	21.0%
Points Scored	Totally number of points scored for a whole season by a given team	362.29	69.75	193	606
First Downs	Number of first downs recorded by a team for a given season	317.54	35.96	225	444
Interceptions	Number of interceptions a team has in a season	14.21	4.54	2	31