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'Defense Wins Championships?' The Answer from the Gridiron

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Abstract

Economists have offered a plethora of studies examining various aspects of professional team sports. Such studies, though, often neglect the playoffs. Given the impact the post-season has on league revenue, as well as the utility generated for both participants and observers of professional sports, such neglect misses much of the story people wish to tell about sports. In an era of free agency and salary caps, teams must determine the optimal strategy for maximizing their probability of success. Is the best offense a good defense, or does defense win championships? The purpose of this paper is to fill in this gap in the literature by examining the relative effects of offense and defense on making and advancing in the playoffs.

Keywords: football, probability of success, salary cap

Introduction

Numerous sayings have been associated with professional sports. Among the most popular are "the best defense is a good offense" and "defense wins championships." On the one side, both observers and participants in team sports often note the primacy of defense. Although offensive showmanship is the subject of much adoration from fans, defense is often given credit for taking home a sport's ultimate prize. As "they" say, "Offense sells tickets, defense wins championships." Alternatively, the view exists that the best way to keep the other team from scoring is to keep the ball yourself. In this regard, having a strong offense not only results in points for your team, it can also keep the other team from scoring.

Such sayings lead one to wonder how teams should allocate resources. Teams in the National Football League face a salary cap and corresponding salary floor. In other words, teams are required to spend a minimum amount and are prevented from spending beyond a specific cap. How should these resources be allocated?

Assuming teams are motivated by winning,[1] they should allocate their resources on the side of the ball that generates the highest return. Before moving on, we should also note that returns to NFL games are not all equal. Specifically, as noted by Leeds and Von Allmen (2004), a disproportionate share of league revenue is generated in the post-season. This perspective is echoed in the work of Berri, Schmidt, and Brook (2004). In a study of the National Basketball Association these authors noted that one additional playoff win generated an average of more than one million dollars in gate revenue from the 1992-93 to 1995-96 seasons. These authors estimate that one would need fourteen regular season victories to generate an equivalent level of gate revenue.

Despite the importance of the playoffs, few studies have focused upon this aspect of professional team sports. For example, numerous past studies into the marginal revenue product of a professional athlete have focused solely on the regular season.[2] Studies of competitive balance have also frequently restricted the inquiry to the dispersion of regular season wins.[3] The importance of the championship to both a team's on-field participants and the organization's accountants suggest that economists should seek to shed light on the economics of the playoffs.

This study is a step towards this objective. Specifically, we seek to examine the simple question posed at the onset of this study for the National Football League (NFL). In particular, if a strong offense can compensate for a weaker defense or whether a stronger defense can compensate for a weaker offense. Depending on which is correct, NFL teams should devote a disproportionate share of resources to more efficiently use limited resources under the current salary cap. Before such a resource allocation should be made, one first needs to know whether offense or defense contributes more to a team's success. Success is measured based on whether the team qualifies for the playoffs, and whether the team is able to win playoff games.

Background

At the margin, should teams focus on offensive or defensive players? Since the advent of free agency teams have more flexibility in how they spend their money. At the same time, salary caps constrain teams to limit their total expenditures. Thus, a team has a classic constrained optimization problem.

One might expect the marginal contribution of offense and defense towards winning games to be equal. If improving offense contributed more to winning games (at the margin), then such players would be favored in the free agent market by teams. Such an emphasis on offense would decrease the marginal effect of offense and increase the marginal effect of defense until we reach equilibrium. However, if ticket prices and sales are increased by a high-scoring offense more than by a great defense, then teams may favor building a strong offense. If there is a premium on offensive players, then such a factor may move the marginal effects of offense and defense away from equilibrium.

Changes in the salary structure have been examined by Leeds and Kowalewski (1999, 2001). The authors found that the introduction of the salary cap and free agency increased income inequality within the league (Leeds & Kowaleski, 1999). They also found that the returns to playing a specific position had fallen over time, but that the returns to performance had increased. They found the effects were much stronger for quarterbacks and running backs than wide receivers, and were weakest for tight ends. Unfortunately, their studies did not compare offensive and defensive players.

Atkinson, Stanley, and Tschirhart (1988) examined factors that affect the likelihood of winning games. The authors examined both offensive and defensive statistics such as rushing yards gained, passing yards gained, interceptions given up by offense, interceptions by defense, quarterback sacks (for and against), yards given up by defense, punting yardage, and field goal percentage. The authors estimated separate models for home and away teams and found expected results. Offensively, teams that gain more yards and give up fewer turnovers and sacks tend to win games. Defensively, teams that give up fewer yards, get more turnovers, and sack the opponent quarterback more often tend to win games. However, the authors did not discuss the relative importance of the offenses and defenses.The authors examined the marginal revenue product for running backs and wide receivers, but once again did not make offensive and defensive comparisons.[4]

Hadley, Poitras, Ruggiero, and Knowles (2000) examine efficiency in the NFL. They examine the roles of offensive and defensive statistics in producing wins in a production frontier approach. In essence, they determine how efficient a team is at producing wins given their offensive and defensive talent. In particular, their discussion focuses on the role of the head coach in producing wins. The authors found that teams, on average, win only 64% of their potential victories given their talent.

The current literature shows that both offense and defense are important to winning games, and that free agency has increased the cost of acquiring high-caliber players. It's relatively straight-forward to claim that having an excellent offense and an excellent defense increases the probability of winning. Such a finding is hardly surprising. However, many teams are not excellent at both and given salary caps and the high cost of free agents, it is important to determine if the football market is operating efficiently. If the marginal contribution of offense and defense to the likelihood of winning is equal, then such a result would provide evidence that the market is efficient. If the marginal effect differs then this would be evidence that the current player compensation system and revenue sharing among teams is not operating efficiently.

In addition, prior research is less clear about the trade-off between offensive and defensive quality. While the optimal team may have a great offense and a great defense, most teams face a decision as to whether to invest in offense, defense, or to invest relatively equally. Can a great offense compensate for a weak defense? Or are teams being good at both? For example, the league may be operating relatively efficiently at the margin, but as suggested earlier individual teams may not operate efficiently depending on the utility function of owners.[5]

Even the popular press has discussed this issue. In an article on ESPN.com, Pasquarelli wrote an article that discusses some of the same issues. With a salary cap, teams face difficult choices. For example, Pasquarelli notes that of the six players that contributed the most to the salary cap for the 2002 Bills, only one was on the defense. Among the Colts, the three star offensive players (Manning, James, and Harrison) account for 25% of the team's salary cap. Other teams, such as the 2000 Baltimore Ravens focused on defense. The salary cap values of the starting defense were twice those of the offense. Indeed, between 1993 (the start of free agency) and 2001 there were never more than four teams that finished in the top 10 in both offense and defense in the NFL. Thus, it is apparent that teams have focused on offense or defense as a consequence of the salary cap and free agency. However, an interesting aspect from a research perspective is that different teams have focused on different sides of the ball. Some teams decided to focus on offense as the solution to their constrained optimization problem, while others have focused on defense.

Data and Methods

We began our study by gathering data from the regular seasons and each playoff game played from 1966 to 2009. There were a total of 1,258 observations across the 14 years for teams in the NFL (and AFL).

The quality of the offense and defense was measured by the average number of points scored, and the average number of points given up during the regular season. Of course, it could be argued that observed points scored (or given up) might not reflect offensive or defensive potential. However, Hofler and Payne (1996) used stochastic frontier estimation and found that NFL teams perform very close to their offensive potential. On average, teams scored only one point below their offensive potential. As such, observed points scored were considered to be a reasonable measure of offensive talent.[6]

We hypothesized that improvements in offensive ability enhance a team's ability to make and progress in the post-season. Similarly, improvements in defensive ability should increase the likelihood of playoff success. The primary question addressed by this study is not whether or not offense and defense impact the outcomes observed. Our interest primarily was in the magnitude of the effect. Specifically, the goal was to determine whether the impact defense had upon post-season participation and performance differed from the relative effect of a team's offense.

Most prior research has focused on the regular season by measuring outcomes such as points scored and wins. While our focus was on the playoffs, teams must first qualify for post-season. Thus, we began by examining the probability of making the post-season and examined how the trade-off between offense and defense affects the probability of making the playoffs. For each season, we sorted teams into quartiles based on their average points scored and average points allowed per game. Teams were then placed into 16 groups based on the rankings of the offense and defense. G_{OD} denoted the quartiles for the offense and defense for a given team. For example, group G_{11}contained teams that were in the top quartile in both offense and defense, G_{12} contained teams in the top offensive quartile and the second defensive quartile, while teams in the lowest quartile offensively and defensively were in G_{44}.

While the probability of qualifying for the playoffs was expected to be higher for teams with better offenses and defenses, of particular interest is the trade-off between offense and defense. For example, whether the same proportion teams in G_{13} make the playoffs as teams in G_{31}, or whether teams in one group had a higher probability of making the playoffs is of interest. Duncan's (1955) multiple range test was used to determine whether the proportion of teams making the playoffs varied significantly (at the $p<.05$ level) across quartiles, and whether quartiles could be grouped based on having a similar playoff probability. The multiple range test is in the class of multiple comparison procedures that can be used to compare means across multiple groups.

While offensive and defensive potential may be important to making the playoffs winning post-season games also depends on the quality of the opponent. In a second approach each playoff match-up was examined. There were 410 playoff games in the data. Our dependent variable in the second approach was also a binary variable, equal to 1 if the team won the post-season game in question, 0 otherwise. In order to assign one participant to be "the team" and the other as "the opponent," one participant was randomly selected from each game to be the team. Random assignment was used because assignment based on an observed characteristic (e.g., the home team) would prevent inclusion of that variable in the regression specification. Consequently, it would be impossible to disentangle the effect of the assignment variable on winning the game from the effect of offensive and defensive ability.

The general model was:

$$Playwin_{it} = \alpha_0 + \alpha_1 {}^* offense_{it} + \alpha_2 {}^* defense_{it} + \alpha_3 {}^* X_{it} + e_{2it} \qquad (1)$$

where*i* denoted the team and *t* denotes the year. Three different measures of *offense* and *defense* were tested. First, average points scored per game in the regular season and average points allowed per game in the regular season were included in the specification. In this case, *X* contains two control variables. The quality of a team's opposition was measured by the regular season winning percentage for the opponent (*opctereg*). As the quality of the opponent increased, we expected the likelihood of winning to decline. The final factor considered was home field advantage, which was incorporated with a dummy variable (*HOME*). The dummy variable equaled 1 if the game was played on the team's home field, 0 otherwise.

We also more explicitly considered the relative offensive and defensive strength of the opponent. We respecified the regression using four categorical variables to denote the match-up between the team and the opponent. The variables indicated whether the team was better offensively based on average points scored and defensively based on points allowed per game in the regular season (*both*), better offensively but worse defensively (*offense*), better defensively but worse offensively (*defense*), or worse at both (the reference group). Given the link between points scored and allowed and a team's record, *X* was reduced to a single categorical variable denoting the home team.

The third measure of *offense* and *defense* compared the team's offense with the opponent's defense and vice versa. For each season, we sorted teams based on their average points scored and given up per game during the regular season. A categorical variable denoted whether the team's offense was ranked higher than the opponent's defense, and the team's defense ranked lower than the opponent's offense (*offense*). A second variable denoted whether the team's defense ranked higher than the opponent's offense, but the team's offense was ranked lower than the opponent's defense (*defense*). A third categorical variable denoted the team was ranked higher in both comparisons (*both*), while the reference group denoted the team was ranked lower in both.

Results

Descriptive Statistics

Descriptive statistics for the 1,258 regular season observations (one per team per year) are provided in Table 1. On average, 36% of teams made the playoffs during a season. This figure varied over time as the number of teams in the league and the number of teams making the playoffs has changed over time. The second set of columns report variable means for the playoff teams. For the years in the data, there were 454 team observations (one per team per year the team made the playoffs). As expected, teams making the playoffs tended to have more wins, fewer losses, more points scored, and fewer points allowed than the league average. The average team in this sample scored 23.5 points per game during the regular season. Defensively, these teams surrendered 17.6 points per game.

The Trade-Off between Offense and Defense

In Table 2, we examine the probability of making the playoffs based on offensive and defensive quality. The results illustrate the trade-off between offense and defense.

Table 1: Variable Means

	Regular season statistics for all teams				Regular season statistics for playoff teams			
	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max
Wins	7.60	3.09	0	16	10.6	1.8	4	16
Losses	7.60	3.09	0	16	4.67	1.7	0	11
Ties	.122	.39	0	3	.077	.29	0	2
Points for	20.5	4.4	7.4	36.8	23.5	3.7	15.0	36.8
Points against	20.5	4.1	9.2	50.5	17.6	3.1	9.5	29.4
Made playoffs	.360	.48	0	1	1.00	0	1	1
Home team	--				.482	.50	0	1
Opp Win %	--				.683	.10	0.44	1
1966-1969	.080	.27	0	1	.055	.23	0	1
1970-1977	.168	.37	0	1	.141	.35	0	1
1978-1989	.267	.44	0	1	.275	.45	0	1
1990-1999	.231	.42	0	1	.264	.44	0	1
2000-2009	.253	.44	0	1	.264	.44	0	1
	1,258				454			

Data sources: ESPN.com and NFL.com. The regular season sample contains one observation per all teams per year. The playoff sample contains one observation per team per year they made the playoffs.

Duncan's multiple range test placed the 16 groups derived based on the ranking of offenses and defenses into four categories with statistically similar playoff probabilities. Eighty-eight percent of teams that were in the top quartile in both offense and defense made the playoffs that season. A similar proportion of teams (86% and 87%) made the playoffs if they were in the top quartile in either offense or defense and in the second quartile in the other. The three groups were statistically similar in Duncan's multiple range test and were also statistically different than the next category.

The second category contained three groups (G_{13}, G_{22}, and G_{31}). Sixty-one percent of teams in the top offensive quartile and third defensive quartile made the playoffs, sixty-one percent of teams in the top defensive and third offensive quartile, and fifty-four percent of teams in the second quartile for both offense and defense made the playoffs. The third category contained teams that were very good either offensively or defensively and very poor defensively or offensively (e.g., G_{14}, G_{41}), and teams that were mediocre both offensively and defensively (G_{23} and G_{32}). The last category contained teams that ranked low in both offense and defense (G_{24}, G_{33}, G_{42}, G_{34}, G_{43}, G_{44}) and had a low probability of making the playoffs.

Table 2: Proportion of Teams Making Playoffs Based on Offensive and Defensive Rankings during Season

	Defensive quartile				
	1 (best)	**2**	**3**	**4 (worst)**	**N**
Offensive quartile					
1 (best)	88.4% 129	86.0% 86	61.2% 49	26.2% 42	306
2	86.6% 82	53.7% 93	30.5% 82	3.1% 64	321
3	61.4% 70	20.3% 74	3.5% 87	2.6% 78	309
4 (worst)	24.0% 25	8.8% 68	2.2% 91	0.0% 138	322
N	306	321	309	322	

Notes: Total sample size (N) = 1,258 (one observation per team per year). The top number is the percentage of teams that made the playoffs. The bottom number is the sample size for the combination of offensive and defensive rankings. The four broader groupings were determined using Duncan's multiple range test in SAS PROC GLM, and were replicated using the Student-Newman-Kuels procedure.

Not surprisingly, the results indicate that better teams are more likely to make the playoffs. However, the results also make clear that a great defense cannot offset a terrible offense, nor can a great offense offset a terrible defense. About 25% of teams placing in the top quartile in offense or defense and the bottom quartile in the other made the playoffs. Teams need to achieve some level of competence in both offense and defense to be likely to make the playoffs. Most relevant to this paper, the results also suggest there was a trade-off between offense and defense, with neither being clearly superior to the other.

Playoffs—Game Level Analysis

Table 3 contains the estimates for equation (1) using the three measures of offensive and defensive ability as well as the corresponding marginal effects. With respect to the direction of the estimated effects the results conform to expectations. Improvements in offensive ability and home field advantage enhanced the probability of winning post-season games. Specifically, the marginal effect for *offense* (an additional one point scored per game) and *home* was 0.035 and 0.243, respectively. Thus, teams playing at home had a distinct "home field advantage." In contrast, a weaker defense, manifested by increases in points allowed, and a better opponent reduced the likelihood a team was victorious. The corresponding marginal effects for *defense* (an additional point allowed per game) and *opponent winning percentage* (a one percentage point increase) were -0.037 and -0.848, respectively.

Table 3: All Post-Season NFL Games 1966-2009

	(1)			(2)			(3)		
	Coef	**Std Err**	**MargEff**	**Coef**	**Std Err**	**MargEff**	**Coef**	**Std Err**	**MargEff**
Intercept	1.53**	1.31	--	-0.533	0.977	--	-1.08**	0.218	--
Points against per game	-0.140**	0.037	-0.035	--					
Points for per game	0.121**	0.035	0.03	--					
Both offense and defense better	--			1.21**	0.359	0.302	1.30**	0.343	0.325
Offense better	--			0.331	0.296	0.083	0.387	0.303	0.097
Defense better	--			0.004	0.288	0.001	0.694**	0.294	0.173
Home team	0.973**	0.261	0.243	1.22**	0.252	0.305	1.19**	0.228	0.297
Opp Winning %	-3.39**	1.28	-0.848	--			--		--
Observations	410			410			41065.5**		
Likelihood ratio	77.0**			68.8**					

** denotes significance at the P<.05 level; * the p<.1 level.

Specification (2) compares each team's offenses, and each team's defenses. Specification 3 compares a team's offense with the opponent's defense, and the team's defense with the opponent's offense. The likelihood ratio statistic tests the null hypothesis that the fit of the estimated model is the same as an intercept-only model.

Again, the key issue was the relative magnitude of the impact offense and defense had upon the outcomes observed. Comparing the coefficients and marginal effects, in absolute terms, $\alpha_1$was not statistically different than α_2 (t=.387). In other words, offensive and defensive ability were equally important to a team's post-season success.

The second measure of offensive and defensive ability compared each team's offense and each team's defense. Teams that were better than their opponent in offense *and* defense were most likely to win the game. The coefficients on *offense* and *defense* were not statistically different from zero nor did the coefficients differ significantly from each other. Thus, teams that were better at offense were not significantly more likely to win games than teams that were better at defense, and teams that were better at offense *or* defense were no more likely to win the game than a team that was worse offensively *and* defensively.

The third measure of offensive and defensive ability matched up the team's offense with the opponent's defense, and the team's defense with the opponent's offense. Teams were most likely to win when their offense was better than the opponent's defense and when their defense was better than the opponent's offense. Teams were also more likely to be victorious (relative to the reference group) when their defense was better than the opponent's offense, but the opponent's defense was ranked higher than the team's offense. Thus, in games where the opponent had a superior defense (relative to the team's offense), the team's odds of winning were increased if they also had a superior defense (relative to the opponent's offense). Teams were not significantly more likely to win when their offense was better than the opponent's defense, but not the defense. In other words, in games where the opponent had a superior offense, the team's odds of winning weren't increased by also having a superior offense. One might conclude that a strong defense could win the game, but offensive ability would not determine the winner. However, while the coefficient for *defense* was statistically different from zero and the other for *offense* was not, the coefficients for *offense* and *defense* were not significantly different from each other.

Championship Games and the Super Bowl

We considered one more test. The post-season sample included all post-season games. At the onset of the sample time frame, the post-season only included a league championship game and the Super Bowl. As the NFL expanded, participation in the playoffs also increased. Today, 12 teams qualify for the playoffs. Consequently, four rounds are necessary to crown the Super Bowl champion. Does the relationship between offense and defense change as a team approaches the ultimate prize?

To address this question, we restricted the sample of games to the Super Bowl and conference championships. With this smaller sample we again estimated equation (1) using the three measures of offensive and defensive ability. These results are posted in Table 4. Again, each independent variable has the expected impact on the probability of winning the game. When using points per game as the measures of offensive and defensive ability, both *offense* and *defense* were found to be important determinants of victory, with neither being more important than the other. The second measure compared each team's offenses and each team's defenses. Similar to the results from all playoff games, teams that were better than their opponent in both offense and defense were most likely to win the game. Being better in one or the other did not significant-

Table 4: Post-Season NFL Games 1966-2009
Conference Championships and Super Bowls

	(1)			(2)			(3)		
	Coef	**Std Err**	**MargEff**	**Coef**	**Std Err**	**MargEff**	**Coef**	**Std Err**	**MargEff**
Intercept	1.87**	2.68	--	-0.929	2.2	--	-1.47**	0.434	--
Points against per game	-0.175**	0.064	-0.04	--			--		
Points for per game	0.137**	0.062	0.034	--			--		
Both offense and defense better	--			2.16**	0.69	0.539	2.44**	0.639	0.609
Offense better	--			0.663	0.531	0.165	1.35**	0.555	0.337
Defense better	--			0.725	0.554	0.181	0.978*	0.556	0.244
Home team	1.10**	0.539	0.274	1.06*	0.545	0.264	1.08**	0.470	0.270
Opp Winning %	-3.58**	2.6	-0.893	-0.311	2.65	-0.077	--		
Observations	132			132			410		
Likelihood ratio	26.8**			26.5**			30.4**		

** denotes significance at the P<.05 level; * the p<.1 level.
Specification (2) compares each team's offenses, and each team's defenses. Specification 3 compares a team's offense with the opponent's defense, and the team's defense with the opponent's offense. The likelihood ratio statistic tests the null hypothesis that the fit of the estimated model is the same as an intercept-only model.

ly increase the likelihood of victory. The third measure compared the team's offense with the opponent's defense, and vice versa. Having a better *offense* or *defense* increased the probability of winning the game relative to being inferior at both. However, once again, the coefficients did not differ significantly from each other.

Sensitivity Checks

Several sensitivity checks were also performed. Duncan's test has been criticized as having a high risk of type I error. In other words, significant differences may be falsely indicated. While this may have increased the possibility of finding that teams would benefit from focusing on offense or defense, we repeated the analysis using alternative multiple comparison tests (Tukey-Kramer, Bonferroni, Ryan-Einot-Gabriel-Welsch). All of the tests supported the conclusion in this paper that there is a trade-off between offense and defense, with neither offense nor defense being superior.

We also distinguished between the time period before and after 1994 when the salary cap was first implemented. In addition, we distinguished between two time periods (1966-1977 and 1978-2009) to examine the effects of rules changes that benefited the passing game. However, in both cases the results did not differ substantively between the time periods, and we combined the time periods for the analysis. We also added an array of time variables to denote changes in the number of teams in the league with no affect on the conclusions. Finally, we included variables denoting whether the team played its home games in a dome, whether the game was in a dome, and an interaction between the two variables. Somewhat surprisingly, when controlling for offensive and defensive ability, and whether the team was playing at home, there was no significant difference in the likelihood of victory for dome teams. More importantly for this paper, offensive or defensive ability remained significantly associated with the probability of victory, and the coefficients remained statistically similar.

Concluding Observations

We began with a simple question. Is offense or defense more important for making the playoffs and advancing in the playoffs? We examine a variety of dependent variables and tests to determine whether offense or defense contribute more to making the playoffs and advancing in the playoffs. Regardless of whether we examine the probability of advancing in the playoffs or a game-by-game analysis, we find no evidence that teams benefit from focusing on offense or defense. In a sense it provides evidence that the league is fairly efficient. The marginal benefit from improving the offense is similar to the marginal benefit from improving the defense.

These results have implications for teams in an era of free agency and salary caps.Free agency was introduced in 1993 while a salary cap was instituted in 1994. The introduction of free agency allowed players much greater ability to move between teams. However, the salary cap explicitly limited the amount of money a team could spend on players. As such, each year teams face decisions on where to invest constrained resources. Several studies have attempted to examine parity in professional sports by looking at the inequality within the league. One effect of the salary structure in the NFL is that teams have the opportunity to improve quickly. Great teams have trouble staying on top as the team must release or trade players to stay within the salary cap. Teams that are not elite both offensively and defensively have the ability to acquire new players. While injuries and other factors play a role, one can easily see the dramatic changes in team fortunes between seasons. However, teams attempting to improve are also constrained by the salary cap, forcing teams to make decisions about where to spend constrained resources and whether improvements in the offense or defense may bring greater returns. Not surprisingly, a team that is able to assemble an elite offense and an elite defense stands the best chance of winning. For teams that are not elite at both, there appears to be little difference between teams that invest heavily in offense and teams that invest heavily in defense. The likelihood of qualifying for the playoffs and winning playoffs games will only increase if the overall quality of the team improves.

Future work may examine a number of additional questions. For example, more detailed variables (e.g., run vs. pass) might be examined to determine whether specific types of offenses or defenses are more important to winning. In addition, additional variables may be important when examining specific games. For example, offense or defense may be more important when playing indoors versus outdoors, or in good versus bad weather. Finally, there have been a number of rules changes over time that influenced how the game is played. While we differentiated between several time periods in sensitivity analysis, more detailed analysis of differences over time may be beneficial.

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Endnotes

[1] This may appear to be a strong assumption. After all, it is not clear whether teams are motivated by wins or profit (for an early discussion of this topic one is referred to Demsetz and Lehn, 1985).One might suspect, though, that wins and profits are strongly linked in football. This suspicion is derived from the work of Berri, Schmidt, and Brook (2004). This work—subsequently updated in Berri, Schmidt, and Brook (2006) and Berri and Schmidt (2010)—indicate that wins drive revenue in basketball. In other words, star power, or offensive power, doesn't actually sell tickets in basketball. Although a similar study doesn't exist for the NFL, it seems reasonable to assume that a similar story may be true for the NFL. Given that each team in the NFL faces the same salary cap—and a corresponding salary floor—revenues might be the primary driver or profits in the NFL. So a focus on winning in the NFL may also be consistent with profit-maximizing behavior.

[2] For example, see Scully (1974), Medoff (1976), Raimondo (1983), Scott, Long, and Sompii (1985), Zimbalist (1992a, 1992b), Blass (1992), and Krautmann (1999).

[3] Competitive balance is often measured in terms of the dispersion of regular season wins. A number of such measurements have been offered in the literature. A sample would include the Competitive Balance Ratio [Humphreys (2002)], the Gini Coefficient [Schmidt (2001), Schmidt & Berri (2001)], the Hirfindahl-Hirschman Index [Depken (1999)], and the ratio of standard deviation to idealized standard deviation. This latter measure was developed in the work of Noll (1988) and Scully (1989) and employed, with many other measures, by Quirk and Fort (1997).

[4] A more recent study by Berri (2007) also looked at the factors that determine outcomes in the NFL. The Berri study, though, also failed to look at the relative returns to offense and defense.

[5] These questions could also be discussed in a game theory framework where there are multiple teams with each making decisions about players, and uncertainty regarding which teams you will face in the playoffs.

[6] While points scored and allowed are reasonable proxies for offensive and defensive ability, we acknowledge that they are imperfect. For example, defenses can score points, which would make the offense appear better, but have no effect on our measure of defensive ability. In addition, special teams can score or allow points. However, over the course of a 14- or 16-game schedule, teams with better offenses are expected to score more points, and teams with better defenses are expected to give up fewer points.

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