ANALYSIS OF TANKING IN THE NATIONAL FOOTBALL LEAGUE

by

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ABSTRACT

WILIAM BRITT NANCE. Analysis of tanking in the National Football League. (Under the direction DR. CRAIG DEPKEN)

Sports economics literature has recently explored the idea that there is an incentive to intentionally lose games in some professional sports leagues. This process is known as "tanking" and is largely related to a league's amateur draft policies. Considering the economic importance of the National Football League (NFL), it is important to develop an understanding of the incentive effects that guide team decisions. Analysis of Seemingly Unrelated Regressions of seasons from 2000 through 2010 shows some evidence that NFL betting markets account for tanking. There is also evidence from game outcome regressions that teams face a reduced incentive to win after clinching a playoff berth.

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INTRODUCTION

It has been said that the National Football League (NFL) is the only corporation in the world that owns a day of the week. It is difficult to find evidence to the contrary, as the NFL has transcended sport and entered into American culture, attracting even the most casual of fans. Recently, football has become a substantial source of revenue across nearly every industry, from almost annual releases of Hollywood films to the litany of corporate sponsorships that allow companies to become official NFL suppliers. This is most apparent during Super Bowl week, where the city that hosts the event can expect a positive economic impact and the price of a 30-second advertisement "is the single most valuable piece of real estate in all of American broadcast television" (Baade, 2012; Mondello, 2012).

While the Super Bowl is the NFL's most successful event, the league's performance throughout its regular season has been the hallmark of its success. It is the most successful sports league in the world in terms of total revenue and average attendance (Bloomberg, 2014; ESPN, 2014). With a total value of $62.89 billion[1], the NFL would have been the 146th most valuable company in the world in 2015 based on the *Financial Times* Global 500 list (Financial Times, 2015). The league's success can partially be attributed to its tremendous reach. Broadcasting rights are distributed across

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[1] Forbes 2015

five major networks and are watched by 80% of all television homes in the United States (Rocco, 2015).

This wide reach has also created a substantial market for legal and illicit gambling operations in the United States and abroad. Though data are difficult to collect, it is estimated that $81.5 million is wagered in Nevada for the Super Bowl alone, and that this amount only accounts for 1.5% of the total when illicit gambling is considered (Paul et al., 2012). In addition to the importance of its monetary impact, economic analysis and insight into NFL sports betting markets are useful for a multitude of reasons.

The seminal empirical study concerned with NFL betting markets was authored by Lyn Pankoff in 1968 and tested the overall efficiency of NFL betting markets. The results indicated that a point spread could be accepted as an optimal and unbiased predictor of game outcomes. Since then, empirical testing of overall market efficiency, and the Efficient Market Hypothesis in particular, have been conducted in various ways. Tryfos et al. (1984) tested seventy different betting strategies and, while finding evidence that some strategies exceeded expected returns, concluded that these gains were insufficient for remaining profitable after accounting for bookmaker commissions (i.e. vigorish). This contradicts a previous study by Vergin and Scriabin (1978), which claimed underdogs were undervalued from 1969 to 1974 and thus presented a profitable betting strategy and an inefficiency in the market. More recently, similar tests were performed that seem to confirm the result of Tryfos et al. (1984) (Badarinathi and Kochman, 1996).

A significant study conducted by Zuber et al. (1985) considers the validity of the Efficient Market Hypothesis in NFL betting markets. The level of efficiency is tested by measuring excess returns above or below bookmaker commissions during the 1983 NFL season. The authors found evidence that inefficiencies exist in the NFL gambling market, and posit that these deviations were substantial enough to make a profit from exploiting them. A reexamination of the study by Sauer et al. (1988) found this claim to be misinterpreted. The key difference between the two analyses is that Zuber et al. (1985) studied weekly NFL betting data, while Sauer et al. (1988) combined this information into a single-season dataset. Under the premise that increased sample size leads to more reliable estimation, Sauer et al. (1988) reject the hypothesis of Zuber et al. (1985) and claim the NFL gambling market is efficient. These findings strengthen the similarities proposed between NFL gambling and financial markets, where daily or weekly inefficiencies are present but overall the market is seen as efficient.

Further tests indicating overall market efficiency have since been performed, with only minor instances of market inefficiency discovered (Lacey, 1990; Boulier, 2006). In an important study of bettor behavior, Dana and Knetter (1994) investigate a gambler's ability to process market information and make informed decisions about game outcomes. The findings lead the authors to accept overall rationality and market efficiency, despite the massive amount of information available to bettors before each game (Paul et al., 2012).

Despite possessing some minor inefficiency, it is apparent that economic analysis of NFL gambling data can provide useful insight into a wide range of measures.

Recently, the sports economics literature has used betting market data to test for the possibility that gambling markets believe certain teams intentionally lose games during the regular season. This process, defined as “tanking,” is the result of incentive issues associated with a particular league’s policies, namely its amateur draft. The notion behind this lies in the fact that once a team is eliminated from playoff contention, it no longer has an incentive to provide maximum effort in subsequent games during that season. This reduced incentive is compounded by the league’s amateur draft, which awards the most favorable draft picks to teams with the worst regular season records. Due to the increased entertainment value provided by a league’s competitive balance and uncertainty of outcome, tanking should be seen as having a negative impact on the total value of a sport’s league (Szymanski and Késenne, 2004).

The incentives to tank in a given sports league are largely determined by its amateur draft policies. One method, used by the National Basketball Association (NBA), employs a weighted lottery format in which the worst teams are given the best probabilities of attaining the highest draft picks (Soebbing, 2013). Conversely, the method used by the NFL is known as a reverse entry draft and guarantees the first pick to the team with the worst record. This policy alone can potentially shift the incentives for a team to engage in tanking. For instance, the most recent NBA draft rules give the worst team a 25 percent chance of receiving the first pick, and includes a small probability that the team’s pick will be as low as thirteenth (NBA, 2016). Despite this uncertainty, bettors believe tanking is present in the NBA, and the stronger incentives associated with the NFL draft increase the importance of its analysis (Soebbing, 2013).

As revenues of sports leagues around the world have increased, more attention has been given to tanking and its effect on competitive balance. Numerous articles from a variety of sports media outlets have considered the possibility of tanking in the NBA and National Hockey League (NHL), among others (NESN, 2016; New York Post, 2016). This leads to the question of whether participants in sports gambling markets account for this factor when placing wagers.

The physical risk associated with playing football in the NFL also produces a unique incentive for the most successful teams to rest important players when possible. To investigate this idea, the analyses includes information pertaining to how the most successful teams are treated by betting markets, in addition to teams that may be participating in tanking.

An academic study by Borland et al. (2009) examines evidence of tanking by teams in the Australian Football League (AFL), whose structure is somewhat similar to the NFL's. Borland et al. (2009) are unable to find evidence that tanking took place, but posit that factors such as weak financial incentives and high uncertainty of a drafted player's future performance reduce the expected benefits when compared with other leagues. More recently, Soebbing and Humphreys (2013) examined the perception of tanking in NBA from the period 2003 to 2008. Using betting market data, the authors find evidence that bettors believe NBA teams tank at the end of the regular season.

Due to the increasing attention paid to tanking and the monetary impact it can potentially produce for a team, it is useful to examine bettor beliefs in all sports leagues that utilize an amateur draft. I am not aware of any previous literature that examines NFL bettor behavior as it pertains to tanking. Though the prevalent opinion amongst sports media outlets has been that tanking is not present in the NFL, an increasing number of journalists are beginning to question its validity.[2] Econometric analysis provides an opportunity to study the behavior of sports bettors and provide evidence to confirm or reject these beliefs.

[2] See (Gaines, 2016; Chase, 2015; Banks et al., 2015), among others

DATA

The information used in this analysis consists of panels of eleven NFL seasons from 2000 through 2010. The sample consists of 2,800 regular season games for every team in the league. Each team in the league plays exactly eight home games and eight away games in each season.

NFL expansion led to the creation of a new team, the Houston Texans, beginning in the 2002 season. This increased the number of teams in the league to thirty-two. As a result, there are 248 observations per season from 2000 through 2001, and 256 observations in each of the remaining seasons.

Summary statistics for point spreads and actual difference in points are presented in Table 1 and Table 2 below. Point spreads and game outcomes are calculated as the visiting team's point value minus the home team's point value. This follows the conventional method in point spread sports betting and produces a negative value for a home team (predicted) victory. Point spread information for each game is represented by a consensus value sourced from SportsInsight.com, indicating the average point spread of the most popular betting houses in the United States.

Table 1 shows summary statistics for NFL point spreads from the 2000 through 2010 seasons. The mean point spread is also identified as the home field advantage asssociated with the average team.

Table 1

Summary Statistics: Point Spread

N = 2,800

Season	Teams	n	mean	min.	max.	st. dev.	skew
2000	31	248	-2.60	-17.5	16.5	6.41	0.25
2001	31	248	-2.21	-19.5	14	5.77	0.07
2002	32	256	-2.27	-19.5	11.5	5.27	0.08
2003	32	256	-2.53	-14	10	5.06	0.22
2004	32	256	-2.54	-13.5	11	5.33	0.42
2005	32	256	-2.59	-17	15	5.90	0.16
2006	32	256	-2.81	-18.5	10.5	5.82	0.06
2007	32	256	-2.34	-24	20	6.75	0.07
2008	32	256	-2.65	-17	11	6.10	0.09
2009	32	256	-2.70	-16.5	14.5	7.24	0.34
2010	32	256	-2.43	-14.5	11	5.43	-0.03
Average	-	-	-2.52	-17.4	13.2	5.92	0.16

Table 2 shows summary statistics for NFL game outcomes from the 2000 through 2010 seasons. The mean difference in points is identified as the actual home field advantage asssociated with the average team. Game outcome results are subject to higher variability than point spreads, which can be seen when comparing Table 1 and Table 2

Table 2

Summary Statistics: Difference in Points

N = 2,800

Season	Teams	n	mean	min.	max.	st. dev.	skew
2000	31	248	-2.82	-48	28	14.80	-0.42
2001	31	248	-2	-37	38	14.10	0.14
2002	32	256	-2.25	-49	41	14.07	0.16
2003	32	256	-3.55	-42	38	14.84	0.03
2004	32	256	-2.51	-46	34	14.04	0.00
2005	32	256	-3.65	-49	42	14.70	-0.13
2006	32	256	-0.85	-41	35	14.42	-0.16
2007	32	256	-2.87	-45	46	15.43	-0.07
2008	32	256	-2.56	-44	37	15.31	-0.07
2009	32	256	-2.21	-59	38	16.48	-0.10
2010	32	256	-1.89	-42	-45	15.01	0.09
Average	-	-	-2.47	-45.6	30.2	14.84	-0.05

The mean point spread for an NFL game across the entire sample is -2.52, indicating the home team was expected to win by this margin on average. The mean of the actual difference in points across the sample is -2.47, meaning game outcomes, on average, were very closely related to what was predicted. However, there are several outliers when examining the summary statistics by season, most notably 2003, 2005, and 2006.

Game outcomes are associated with much more variation when compared to point spreads. This is a common occurrence in sports betting markets, and theory suggests this is the result of incomplete information. Though point spreads do not encompass all available information, they have been shown to be a reliable option for predicting game outcomes.

Examining the skewness associated with point spreads and game outcomes by season indicates the samples are not normally distributed. Skewness statistics for point spread imply betting markets generally give more weight to positive values. This is not present in the skewness statistics for difference in points.

One possible reason for this is known as the home-underdog bias and has been studied extensively in the literature. The central idea is that bettors are more averse to placing wagers on a home team that is predicted to lose. As more bettors take the side of the visiting team, the point spread shifts to a more positive value in an attempt to keep bets even on both sides. Levitt (2009) also found evidence that bookmakers are aware of this bettor bias and set point spreads accordingly, which could make the value even more positive.

Table 3 shows summary statistics for game outcomes relative to the point spread from 2000 through 2010. Results show that game outcomes are essentially evenly split on both sides of the point spread, suggesting overall efficiency on average. Point spreads set at even (i.e. 0) show evidence of a profitable betting strategy, but is not investigated in this paper.

Table 3

N=2,800		**Observations**	**Percentage**
Home Team Favored	**Home covered PS**	885	47.02%
	Did not cover PS	59	3.13%
	Push*	938	49.84%
	Total	1,882	100.00%
Away Team Favored	**Home covered PS**	432	48.38%
	Did not cover PS	433	48.49%
	Push	28	3.14%
	Total	893	100.00%
Even	**Home covered PS**	15	60.00%
	Did not cover PS	10	40.00%
	Total	25	100.00%
	Total	2,800	-

*"Push" is a term used to denote when a game outcome equals the point spread. In this case, bettors on both sides of the wager have their money returned, less the bookkeeper's vigorish

Summary statistics for betting outcomes seem to provide further evidence of this idea, and can be seen in Table 3. The home team is favored according to the point spread in 67.21% of observed games. Overall, the outcome is essentially evenly distributed between home and away teams covering the spread. This provides further general evidence that point spreads in NFL betting markets are efficient predictors of game outcomes.

However, it is worth noting that when the point spread is "even," there seems to be a profitable advantage when placing wagers on the home team. [3] Point spreads set at even are a rare occurrence throughout the sample, and investigating this claim goes beyond the scope of this paper.

[3] "Even" indicates neither team is favored

METHODOLOGY

The methods chosen for estimating the effect of tanking on sports betting markets are similar to that of Soebbing and Humphreys (2013), and require the estimation of three separate models. In the first step, Brown et al. (1993) established a method for determining individual team abilities that can be used to predict the point spread and actual difference in points for each game in a particular season. These values are then used with indicator variables in a Seemingly Unrelated Regression to determine the effect of tanking on the NFL betting market. Seemingly Unrelated Regressions allow for correlation among the error terms in each equation estimated. This leads to more efficient estimation of equations compared to Ordinary Least Squares (OLS), though OLS remains a consistent estimator. Since point spreads have been shown to be an efficient estimator of game outcomes, it is reasonable to assume the error terms in the regression will be correlated, though this will be tested/used as a robustness check.

Dummy variables corresponding to each team are used as the explanatory variables. These dummies take a value of 1 when the team is playing a home game, -1 when playing an away game, and 0 otherwise. To determine a team's ability based on

Table 4 presents regular season team abilities from 2005 for every team in the NFL. Using a method similar to Sauer et al., team abilities are shifted from the omitted team to the "average" team for presentation purposes. The value associated with a particular team indicates its ability when compared to the "average" team in the league. Much like the interpretation of point spreads, more negative team ability values correspond to better teams in a given season.

Table 4

2005 Regular Season Team Abilities

Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	3.54	4.86	6.85	3.92
Atlanta Falcons	-0.88	0.81	3.09	1.74
Baltimore Ravens	1.73	3.53	3.70	1.79
Buffalo Bills	3.09	4.91	7.71	3.17
Carolina Panthers	-2.40	-0.75	-3.20	0.22
Chicago Bears	1.40	3.2	0.47	1.27
Cincinnati Bengals	-2.43	-0.9	-1.95	0.41
Cleveland Browns	4.36	7.09	6.09	3.23
Dallas Cowboys	-1.21	0.42	-1.29	0.81
Denver Broncos	-4.14	-2.05	-8.93	-1.5
Detroit Lions	3.56	5.5	8.57	3.49
Green Bay Packers	2.80	4.92	5.59	2.03
Houston Texans	6.81	11.26	11.89	4.25
Indianapolis Colts	-6.89	-4.21	-8.94	-1.13
Jacksonville Jaguars	-1.39	0.27	-2.90	0.39
Kansas City Chiefs	-1.08	0.58	-5.14	-0.33
Miami Dolphins	2.98	3.81	2.63	1.99
Minnesota Vikings	1.89	4.42	5.39	1.81
New England Patriots	-2.74	-1.19	-1.28	0.63
New Orleans Saints	4.90	6.34	12.95	4.16
New York Giants	-2.40	-0.99	-5.63	-0.35
New York Jets	4.50	5.96	8.26	3.5
Oakland Raiders	2.21	3.49	4.67	3.36
Philidelphia Eagles	0.08	1.09	4.17	2.74
Pittsburgh Steelers	-3.19	-1.83	-5.95	-0.35
San Diego Chargers	-4.46	-1.97	-8.08	-1.28
Seattle Seahawks	-2.42	-0.93	-7.25	-0.83
San Francisco 49ers	10.02	15.01	13.01	4.06
Saint Louis Rams	2.13	4.67	7.01	3.18
Tampa Bay Buccaneers	-0.12	1.62	2.87	1.94
Tennessee Titans	4.66	6.65	9.43	3.99
Washington Redskins	-1.63	(omitted)	-4.13	(omitted)
Home Field Advantage	-2.59	-21.32	-3.65	-6.32

point spreads, the team dummy variables are regressed on the given point spread for each game. The team's ability corresponding to the difference in points is estimated in the same way, using the actual difference in points as the dependent variable. It should be noted that one team (Washington Redskins) is removed from each regression to avoid multicollinearity.

Table 4 presents results from the 2005 season. Team abilities for additional seasons can be found in the appendix. As noted by Brown et al. (1993), this model causes the coefficients associated with each team's ability to be presented in terms of the omitted team. Using a methodology similar to Brown et al. (1993), team abilities are shifted to account for a particular team's ability compared to the "average team" in the league for presentation purposes.

The interpretation of an individual team's ability can be thought of in much the same way as a conventional point spread. In both the point spread and difference in point's models, a more negative value is associated with greater overall team strength.

Computing the model's predicted point spreads and difference in points utilizes the following equations:

$$PSPred_g = HF_i + TA_i - TA_j$$

$$DPPred_g = HF_i + TA_i - TA_j$$

where *PSPred* and *DPPred* are predicted values for point spread and difference in points, TA is a measure of team ability[4], *g* is an index for game identification, *i* and *j* are indexes for the two opposing teams, and *HF* is the home field advantage assumed for team *i*.

These two equations can be thought of as an aggregation of the formula from Soebbing and Humphreys (2013).[5] Home field advantage is given by the intercept of the team ability regressions discussed above. It also corresponds to the average point spread and difference in points presented in Table 1 and Table 2.

In addition to using team abilities in each Seemingly Unrelated Regression, indicator variables are included specifying if the home and away teams in each game have clinched or been eliminated from playoff contention. Data detailing each NFL team's record on a week-to-week basis for each of the seasons analyzed was obtained from Pro-Football-Reference.com. [6]

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[4] Note that TA (team ability) values are attained from the team ability regressions on point spread and difference in points. Brown and Sauer (1993)

[5] Soebbing and Humphreys (2013) use the following regression equations:

(1) $\{ PS_{hags} = \alpha_{ps} + \theta_h^{ps} HT_{hgs} + \theta_a^{ps} AT_{ags} + \beta_1 hclinch_{hgs} + \beta_2 aclinch_{ags} + \beta_3 helim_{hgs} + \beta_4 aelim_{ags} + \epsilon_{hags}^{ps}$

(2) $dp_{hags} = \alpha_{dp} + \theta_h^{dp} HT_{hgs} + \theta_a^{dp} AT_{ags} + \gamma_1 hclinch_{hgs} + \gamma_2 aclinch_{ags} + \gamma_3 helim_{hgs} + \gamma_4 aelim_{ags} + \epsilon_{hags}^{dp} \}$

Where PS and dp are the actual point spread and difference in points associated with each game, α is a measure of home field advantage in both equations, $\theta_h^{ps} HT_{hgs}$ and $\theta_h^{dp} HT_{hgs}$ are measures of home team ability for point spreads and game outcomes, $\theta_a^{ps} AT_{ags}$ and $\theta_a^{dp} AT_{ags}$ are measures of away team ability for point spreads and game outcomes, ϵ is the error term associated with each equation, and the remaining variables are dummy variables which will be discussed in more detail later. The aggregation occurs on the first three variables of (1) and (2), i.e. $PSPred_g = \alpha_{ps} + \theta_h^{ps} HT_{hgs} + \theta_a^{ps} AT_{ags}$ and $DPPred_g = \alpha_{dp} + \theta_h^{dp} HT_{hgs} + \theta_a^{dp} AT_{ags}$.

[6] "The website has been used as a reliable source of information by publishers such as Bloomberg Businessweek, Forbes, the New York Times, and ESPN" (Wikipedia 2016)

This information is used in combination with the standard "magic number" formula associated with most sports, especially in North America.[7] The traditional magic number equation indicates when a team has clinched a playoff berth, and is easily manipulated to also show when a team has been eliminated from playoff contention. The formula is calculated using weekly records for each team from 2000 through 2010, and encompasses 577 total observations (5.2% of total).[8]

There are two conferences within the NFL, the American Football Conference (AFC) and the National Football Conference (NFC). These conferences are made up of divisions (i.e. AFC North) that are each guaranteed one playoff spot. In addition, the NFC and AFC each have two "Wild Card" spots that go to the best ranking teams that do not finish first in their division. Since NFL rules designate a fixed number of playoff spots to each of the two conferences, each team record is compared to the "Wild Card" team with the worst record in each conference for most scenarios. Using the lowest ranking "Wild Card" team as the comparison for all other teams in the conference is appropriate because it almost always identifies the last team to qualify. However, in cases where the top ranking team in a division has a record that is inferior to the lowest ranking "Wild Card" team, the top team in the division is used for the comparison.

In the final step, Seemingly Unrelated Regressions are performed for each individual NFL season. The same regression is performed on the entire data set, using the

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[7] Given by $G + 1 - W_A - L_B$, where G is total games in a season, W is the total wins by team A, and L is the total losses by team B. Wikipedia provides a detailed explanation under the title: "Magic number (Sports)" (See bibliography for the most recent web address). Also, see Copeland (2012) for an example of its practical use.

[8] Home Team clinch: 107 observations (4%), Away Team clinch: 97 observations (3%), Home Team eliminated: 178 observations (6%), Away Team eliminated: 195 observations (7%)

predicted point spreads and game outcomes corresponding to each season. The estimated models are similar to that of Soebbing and Humphreys (2013) and take the form:

$$\{PS_{hags} = \alpha_1 PSPred_{hags} + \beta_1 hclinch_{hgs} + \beta_2 aclinch_{ags} + \beta_3 helim_{hgs} + \beta_4 aelim_{ags} + \epsilon_{hags}$$

$$DP_{hags} = \mu_1 DPPred_{hags} + \gamma_1 hclinch_{hgs} + \gamma_2 aclinch_{ags} + \gamma_3 helim_{hgs} + \gamma_4 aelim_{ags} + \delta_{hags}\}$$

where *h* is an index for home teams, *a* is an index for away teams, *g* is an index for game identification, and *s* is an index for season. *PSPred* and *DPPred* correspond to predicted point spreads and game outcomes from the team ability regressions. The explanatory variables *hclinch* and *aclinch* are dummy variables indicating weeks when a team has clinched a playoff berth, *helim*, and *aelim* are dummy variables indicating weeks when a team has been eliminated from playoff contention, and ϵ and δ are the regression error terms.

RESULTS

Panel data analysis for each season was completed utilizing Stata statistical software. Due to the limited frequency with which NFL games are played when compared to other sports leagues, analysis was also conducted for the entire data set of 2,800 observations. It is important to note predicted values (for point spread and difference in points) in the total data set remain estimates based on individual seasons. This allows team abilities to be calculated without the need to account for management and personnel changes from year to year.[9] Additionally, the NFL is one of the most balanced sports leagues in the world, and it is not uncommon for a team's record to change drastically by season. For these reasons, accuracy would be reduced when estimating total team abilities for the entire data set, lending itself to the possibility of incorrect interpretation of results.

Findings for the total data set are presented in Table 5 below. Information pertaining to individual seasons can be found in the appendix. Note that bootstrapping methods are used to improve estimation of standard errors and confidence intervals. Doing so alleviates some of the bias associated with the generated regressor problem, which is discussed in the next section. The Seemingly Unrelated Regressions for the total data set give an R^2 value of 0.799 for point spreads, and a value of 0.354 for the difference in points. The large difference between R^2 values for point spread and the

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[9] For example, a team hiring a new coach or signing a new player in the offseason could experience a drastic change in team ability the following season.

difference in points is expected, due to the increased variability of game outcomes when compared to point spreads.

Table 5 presents results for the Seemingly Unrelated Regression on the total data set from 2000 through 2010. The Point Spread equation shows significant values for the dummy variables *helim* and *aelim*, indicating these point spreads are statistically different from other situations. The only significant value for the difference in points equation is *aclinch*, indicating game outcomes are statistically different when an away team has clinched a playoff berth.

Table 5

2000-2010 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	χ2
Point Spread	2,800	9	2.6637	0.799	11163.31
Difference in Points	2,800	9	11.927	0.3544	1541.72

Point Spread	Observed Coefficient	Bootstrap Std. Err.	Z-stat
PSPred	0.9935	0.0103	96.29
hclinch	-0.7057	0.6769	-1.04
aclinch	-0.3179	0.5024	-0.63
helim	1.1183	0.2973	3.76
aelim	-1.4656	0.3890	-3.77
hclinch*PSPred	-0.1423	0.0908	-1.57
aclinch*PSPred	0.0672	0.1061	0.63
helim*PSPred	-0.0409	0.0593	-0.69
aelim*PSPred	-0.0484	0.0495	-0.98
_constant	-0.0027	0.0564	-0.05

Difference in Points	Observed Coefficient	Bootstrap Std. Err.	Z-stat
DPPred	1.0091	0.0281	35.88
hclinch	2.7550	1.9677	1.4
aclinch	-5.7277	1.7759	-3.23
helim	-1.0754	1.1006	-0.98
aelim	1.1486	1.3496	0.85
hclinch*DPPred	0.1280	0.1886	0.68
aclinch*DPPred	0.1829	0.1958	0.93
helim*DPPred	0.0617	0.1206	0.51
aelim*DPPred	0.1012	0.1244	0.81
_constant	0.1619	0.2523	0.64

Overall, the coefficient for *PSPred* is estimated at 0.987 when interaction terms are removed. This indicates the predicted point spread slightly underestimates the actual point spread associated with each game. Conversely, the coefficient for *DPPred* is estimated at 1.024 when interaction terms are removed.[10] This indicates the predicted difference in points slightly overestimates the actual difference in points. Both variables are associated with highly significant p-values. The variables of interest for the presence of tanking, *helim* and *aelim*, are highly significant in point spread analysis. This signifies that point spreads associated with a team that has been eliminated from the postseason are statistically different from other observations.

This is not the case for actual game outcomes, in which neither *helim* nor *aelim* are statistically significant. This finding lends itself to the idea that while betting markets may account for a team tanking at the end of the regular season, evidence that this actually occurs in NFL games is rejected.

Examining the coefficients for *helim* and *aelim* demonstrate that the results are consistent with what should be anticipated if betting markets account for tanking. The estimated value for *helim* is positive, indicating point spreads are more favorable to the away team in this situation. Conversely, the estimated value for *aelim* is negative, which signifies point spreads are more favorable to home teams in this situation.

Another noteworthy result from the analysis of the total data set is the result of *aclinch* when analyzing game outcomes. While the point spread analysis does not indicate betting markets treat an away team that has clinched a playoff berth any

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[10] Regression results can be seen in the Appendix

differently from other situations, the difference in points analysis shows a significant difference in game outcomes. The coefficient for *aclinch* is negative and larger than the value given in the point spread model, which is to be expected if teams in this situation have an incentive to lose NFL games. This result is similar in nature to tanking, and possible reasons for this outcome will be considered in the Discussion section.

When analyzing the results from the Seemingly Unrelated Regressions by season, there is much weaker evidence that betting markets account for tanking in NFL point spreads. The R^2 value for point spread ranges from 0.751 to 0.865 across seasons, with an average value of 0.807. The R^2 value for difference in points ranges from 0.318 to .458, with an average value of .376. The variables of interest, *helim* and *aelim*, are each significant in only three of the eleven seasons examined. Results from actual game outcome analysis by season provides even less evidence of tanking, with statistically significant values in none of the eleven seasons for *helim* and *aelim*. The *aclinch* indicator variable for difference in points is significant in four out of eleven seasons analyzed.

Investigating the seasons that produced significant values shows the sign of the coefficients are consistent with results from regressions on the total data set. This is not always the case when all values for *helim*, *aelim*, and *aclinch* are considered. The results were improved by various robustness checks and econometric techniques, which will be discussed in the next section.

ROBUSTNESS CHECKS

Robustness checks were utilized throughout the analysis due to the methodology and data that was used. The most significant issue in the analysis stems from the generated regressor bias, associated with using the predicted values for *PSPred* and *DPPred* in the Seemingly Unrelated Regressions. These values are obtained from the team ability regressions, and the effect of these coefficients on subsequent regressions is well documented in econometric literature. From Murphy and Topel (1985): "this two-step (T-S) procedure fails to account for the fact that imputed regressors are measured with sampling error, so hypothesis tests based on the estimated covariance matrix of the second-step estimator are biased, even in large samples."

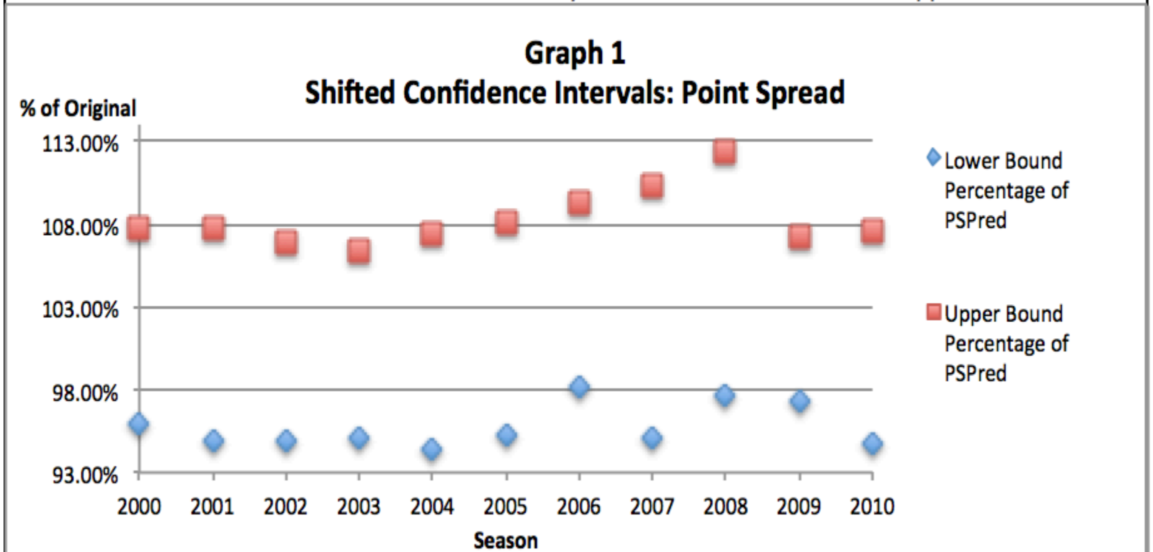
The generated regressor problem is a form of attenuation bias; meaning coefficients utilizing previously generated values are biased towards zero. For the purposes of this analysis, this attenuation bias causes a potential misinterpretation of the coefficients associated with *PSPred* and *DPPred*. This also causes subsequent issues with interpreting indicator variables of interest. Since both coefficients are very close to the expected value of one, it is useful to correct for this bias as much as possible.

Hole (2006) suggests a method that utilizes Murphy-Topel variance estimates to correct for this bias in two-stage regressions. Unfortunately, this method cannot be applied in situations where the second stage involves a Seemingly Unrelated Regression. As a second-best solution, bootstrapping methods are applied to second stage regressions. Each season (and the total data set) is tested using 500 replications, although a range of replication values were tested without a noticeable difference in results. In addition to improving the estimation of standard errors and confidence intervals, bootstrapping methods allow for an additional check on the stability of each estimated coefficient.

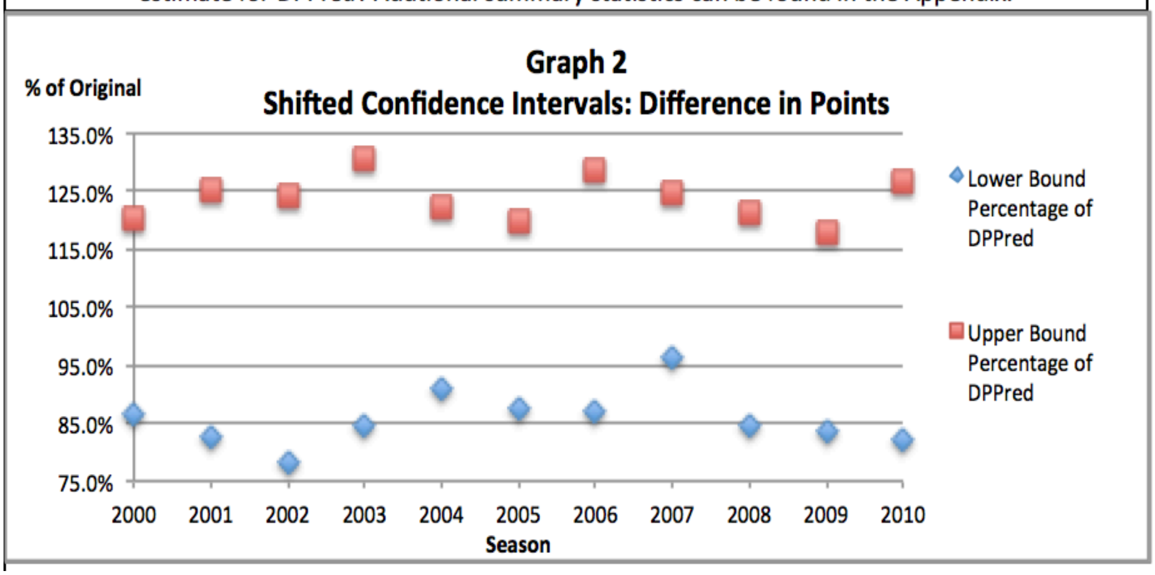
Another robustness check was the addition of several interaction terms to the Seemingly Unrelated Regressions. The indicator variables *hclinch*, *aclinch*, *helim*, and *aelim* are allowed to interact with *PSPred* in the point spread regressions, and *DPPred* in the difference in points regressions. Though the slopes associated with each interaction are small and not statistically significant, the coefficients for *PSPred* and *DPPred* are both closer to one when compared to estimation without interaction terms. This is an encouraging signal considering the previously mentioned attenuation bias.

An additional alteration performed on the results was shifting the 95% confidence intervals to be centered on one. Again, the reasoning behind this shift is to correct for the attenuation bias as much as possible. The difference between the estimated first stage parameters (*PSPred* and *DPPred*) and one is added to the lower and upper bounds of the bootstrapped confidence intervals. These shifted confidence intervals allow for the calculation of a percentage bias associated with the estimation of *PSPred* and *DPPred*, which is presented in Graphs 1 and 2. Additional summary statistics in tabular form can be found in the Appendix. The percentage bias estimates for *PSPred* range from 94.4% to 98.1% for the lower bound, and 106.4% to 112.4% for the upper bound. Estimates for *DPPred* range from 78.2% to 96.5% for the lower bound, and 118% to 130.6% for the upper bound.

Graph 1 shows percentage bias associated with the original parameter estimates for Point Spread. The values are calculated as the percentage difference of the lower and upper bound from the original estimate for *PSPred*. Addtional summary statistics can be found in the Appendix.



Graph 2 shows percentage bias associated with the original parameter estimates for Difference in Points. The values are calculated as the percentage difference of the lower and upper bound from the original estimate for *DPPred*. Addtional summary statistics can be found in the Appendix.



The total data set shows the shifted lower and upper bounds for the point spread are quite small, comprising a range within 5% of the original estimate for *PSPred*. The range around the shifted confidence intervals for *DPPred* is just outside the 10% range. Though the ideal scenario would have both estimates within a 5% window of the original parameter, factors such as the increased variance associated with *DPPred* cause much more uncertainty in its estimation.

A final robustness check is included for information purposes. The drastically increased value of the quarterback position compared to other positions in the NFL is widely documented.[11] This idea suggests point spreads and game outcomes could be different when a quarterback is injured early in an NFL game, or a previously unknown (to betting markets) quarterback starts an NFL game.

Table 6 presents summary results for dummy variables indicating when a home or away team suffered a quarterback injury early in the game, or started a game with a quarterback previously unknown to betting markets.[12] The p-values associated with *HNewQB* and *ANewQB* are highly significant in both the point spread and difference in points regressions. The results from the difference in points regression indicate game outcomes are significantly different when either team has a new or injured quarterback; but since these variables are also statistically significant in the point spread regression, the relevant game observations are viewed as valid and are included in the analysis.

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[11] See (Bell, 2013), among others.

[12] An early quarterback injury is defined as being a situation where the starting quarterback was involved in less than two-thirds of a team's pass attempts. A quarterback previously unknown to betting markets is defined as any starting quarterback who is making their first start of the season.

Table 6 presents results for the effect of a new or injured quarterback on point spreads and game outcomes. The results show that point spreads and game outcomes are statistically different in the presence of a new or injured quarterback. This information is not included in the analysis, but provides one of several situations that may affect overall results.

Table 6

The Effect of New or Injured Quarterbacks on Point Spread and Difference in Points, 2000-2010

Point Spread Equation

$R^2 = .0325$

	Coefficient	Robust Standard Error	Z-stat
HNewQB	2.1809	0.4495	4.85
ANewQB	-2.5997	0.3339	-7.79
_constant	-2.4707	0.3955	-6.25

Difference in Points Equation

$R^2 = .0353$

	Coefficient	Robust Standard Error	Z-stat
HNewQB	6.3532	1.1076	5.74
ANewQB	-7.0141	1.0728	-6.54
_constant	-2.4284	0.5915	-4.11

DISCUSSION

The results of the analysis provide somewhat mixed evidence pertaining to the presence of tanking in the NFL. Knowledge of NFL history and common beliefs among the sports media, of which a significant segment are former players, can be used to provide additional insight.

It has been previously mentioned that more of the sports media has recently considered the idea that certain teams may be tanking in the NFL. It is useful to investigate the reasons why this belief has not been as prevalent as other professional sports, namely the NBA.

Since the NFL regular season consists of approximately 80% fewer games when compared to the NBA, NFL participants have fewer opportunities to engage in tanking. Additionally, football players almost always compete exclusively on one side of ball (i.e. offense or defense), which is not the case for basketball. This implies many more team members must coordinate with one another in an effort to lose. There is also a higher level of uncertainty associated with assessing an amateur player's future performance compared to the NBA (Bursik, 2012; Soebbing and Humphreys, 2013). This idea is most apparent when examining the quarterback position, which is also the most scrutinized position in the NFL.[13] These differences, among others, suggest tanking in the NFL should be less prevalent than the NBA.

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[13] For example, Tom Brady is one of the most successful quarterbacks in NFL history and was drafted 199th overall. Conversely, there are numerous occasions where the top draft pick performed much lower than expectations, i.e. Ryan Leaf and Jamarcus Russell. (NFL)

One possible reason for why there is less evidence of tanking in the NFL is the relatively short amount of time coaches and players are given to prove themselves worthy of being a team member. The average tenures of NFL players and head coaches are both approximately three and a half seasons (NESN, 2011). This is most surprising for head coaches, whose performance is less dependent on age and thus have longer windows for possible employment. This demonstrates the high level of competition associated with remaining a member of an NFL team. As a result, team members may feel they do not have the job security required to participate in tanking. Also, players may view the addition of a top-level amateur player as more of a threat to their job security than a benefit to their current team's performance.

An alternative reason that may result in a lack of evidence for tanking in the NFL is that the incentive to do so is not uniform across all teams. There are likely a multitude of factors affecting the value each team places on tanking. For instance, the presence of a top tier quarterback is thought to greatly improve a particular team's overall ability (Bell, 2013). Consequently, these teams may feel it is in their best interest to put forth maximum effort, even once eliminated from playoff contention, in an attempt to retain as many complementary team members as possible for the following season.

Additionally, certain teams may place a higher value on experienced players due to their ability to perform at a high level immediately. This idea is strengthened when considering the difficulty of predicting an amateur player's future performance. Furthermore, the significantly larger roster size associated with the NFL means each amateur player added would typically have a lower effect on team performance compared to the NBA. There may also be an incentive for historically successful teams to put forth maximum effort regardless of their position in the league because the teams feel they are not performing up to expectation.

Although the incentive to participate in tanking is most likely lower in the NFL when compared to the NBA, the statistical tests performed in this paper show some evidence that betting markets account for tanking in point spreads. Analyzing the data by season gives relatively weak evidence that betting markets account for tanking (3 of 11 seasons); yet results from the total data set indicate point spreads including a team that has been eliminated from playoff contention are significantly different from other situations.[14]

The interpretation I find most fitting is that betting markets allow for the possibility that some teams participate in tanking, due to differing incentives for participating across all NFL teams. However, examining the presence of tanking on a team-by-team basis is difficult. For instance, the Detroit Lions are eliminated from playoff contention relatively early in six out of the eleven seasons examined. The underlying reason to pursue tanking is to increase a team's future performance. From this data set, it appears teams that repeatedly find themselves at the bottom of the league with high draft picks do not consistently improve in subsequent seasons.

This suggests certain teams may be fundamentally inferior compared to the rest of the league, possibly giving the impression they are tanking even when they are not.

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[14] Using the same logic applied by Sauer et al. (1985) to question the findings of Zuber et al. (1988), more observations tend to lead to more accurate results. This suggests the total data set is more reliable than the by-season data sets.

Therefore, even if statistical analysis of these teams shows evidence that point spreads are significantly different from other situations, it may be the result of betting market discounting due to other factors, such as historical performance. This causes issues with the interpretation of teams that are not frequently associated with losing seasons and high draft picks.

Soebbing and Humphreys (2013) found evidence of tanking in NBA point spreads and mixed evidence pertaining to game outcomes. Conversely, the results from the NFL only show evidence of tanking in point spreads, indicating it does not actually occur in regular season games. This leads me to conclude that betting markets treat teams eliminated from the NFL playoffs differently from other situations, though the difference likely cannot be fully explained by tanking. Factors such as a team's historical record could also influence bettor decisions.

An additional result worth mentioning is the interpretation of *aclinch* for game outcomes. In the total data set, away teams that have clinched a playoff berth are associated with statistically different game outcomes when compared to other situations. The evidence is also stronger on a by-season basis than for *helim* and *aelim* in the point spread analysis, with significant p-values below 0.05 in four out of eleven seasons. The incentive to lose generally increases once a team secures a playoff spot, similar to when a team is eliminated from postseason contention. In both cases, teams face a decreased cost for losing a game while also receiving an increased benefit. For playoff teams, this benefit comes in the form of rest for the most important players as opposed to a more favorable draft pick. Due to the litany of physical risks associated with professional football, the decision to rest players is likely highly valued in the NFL. In addition to increased performance, resting important players also allows a team to reduce the risk of its best players becoming injured in games with less significance. One caveat to this interpretation is that, in some cases, playoff teams are still competing for a higher playoff ranking after clinching a berth.

The underlying reason behind *aclinch* being significant while *hclinch* is not likely pertains to the way incentives are structured. For a home game, NFL teams are entitled to several revenue sources, such as luxury suite revenue, that are not shared with the rest of the teams in the league (Vrooman, 2012). In contrast, away teams receive a fixed portion of pooled revenues throughout the regular season. Since home teams enjoy increasing revenues relative to attendance, it is in their interest to field the best team possible. The NFL's revenue sharing rules dictate that each team receives the same amount of away team revenue each season (Rovell, 2015). Since away team revenues do not change nearly as much as a home team's, there is an increased incentive to rest players.

The idea that playoff teams rest starters is widely accepted among the sports media, and its value is high enough that some teams are willing to risk an undefeated season to do so (Battista, 2009). It is also easy to objectively detect when a team is resting starters, which is not the case for detecting tanking. It is interesting that betting markets do not seem to account for this phenomenon, especially when considering the widespread knowledge that it takes place. Teams attempting to suppress information pertaining to their intention to rest players may partly explain this result. Additionally, teams can make the decision to rest starters at any point before or during the game. If bettors do not realize a team will be resting its starters before placing a wager, point spread analysis will not be able to explain the differences.

CONCLUSION

The NFL is the most successful sports league in the world in terms of total revenue and average attendance. As a result, the league's popularity has led to a wide interest in wagering on the outcomes of NFL games. Using betting market data, an analysis that tests for the presence of tanking is performed, applying a methodology similar to Soebbing and Humphreys (2013) analysis of the NBA. The results suggest tanking is much less prevalent in the NFL when compared to the NBA.

The total data set implies a significant difference in point spreads for teams that have been eliminated from playoff contention. However, a by-season analysis only shows this evidence in three out of eleven seasons. Additionally, the game outcome equation implies tanking does not take place in actual NFL games. Interestingly, there is more evidence for the idea that away teams qualified for the playoffs are associated with significantly different game outcomes. This is likely due to the incentive for playoff teams to rest their most important players, especially when playing an away game. It is assumed the point spread market does not show evidence of accounting for this phenomenon because of the high degree of uncertainty associated with if and when a team will decide to rest players.

The results of this analysis are generally in line with popular opinion among the sports media. There have been periods where claims of tanking in the NFL were made, but the prevailing belief is that the incentive is not large enough to persuade most teams to participate. There is a more widespread belief that NFL playoff teams rest players at the end of the regular season, which is in agreement with the results of this paper.

Though this is not the first study of tanking in professional sports, I am not aware of any betting market research that pertains to tanking in the NFL. Additional studies will be necessary to substantiate the claims made in this paper. One possibility is to test the claim that certain teams have an increased incentive to participate in tanking relative to the rest of the league. If tanking works as it is intended, the same teams will not be associated with high draft picks in each season. Separating teams based on how often they appear at the top of the draft could improve the results.

An additional factor worth examining is the effect of television coverage on team performance. If a game receives national coverage, especially during the primetime Sunday and Monday night slots, it could lead to a reduced incentive to participate, skewing the results.

Testing the evidence relating to away teams that have clinched a playoff berth is another area for future research. Determining if a team is resting a player is much easier than determining if a team is tanking. Indicator variables can be constructed to go one step further than this paper's analysis, signifying when a team has clinched a playoff berth and rests players. This method may change the result that point spreads do not account for this occurrence. However, if the interpretation of point spreads is in line with this paper, it lends itself to the possibility of inefficiency in NFL betting markets.

REFERENCES

Baade, Robert A., and Victor A. Matheson. An Evaluation of the Economic Impact of the National Football League Mega-Events. In *Economics of the National Football League*, ed. Kevin G. Quinn, 243-258, Springer, 2012.

Badarinathi R, Kochman L. (1996) "Football Betting and the Efficient Market Hypothesis". *American Economic Review*. 40. 2. 52-55.

Banks, Don, Chris Burke, Doug Farrar, and Eric Single. "Roundtable: Is It Ever Acceptable for Teams to Tank, and to What Extent?" Sports Illustrated. November 13, 2015. Accessed April 28, 2016. http://www.si.com/nfl/2015/11/13/nfl-week-10-roundtable-teams-tanking.

Battista, Judy. "Jets End the Colts' Perfect Season and Burst Into the Postseason Picture." New York Times. December 27, 2009. Accessed May 8, 2016. http://www.nytimes.com/2009/12/28/sports/football/28jets.html?_r=0.

Bell, RJ. "If He Goes Down, We Go Down: NFL Injury Value in Vegas." Grantland. August 28, 2013. Accessed May 8, 2016. http://grantland.com/the-triangle/if-he-goes-down-we-go-down-nfl-injury-value-in-vegas/.

Borland, J., M. Chicu, and T. MacDonald. "Do Teams Always Lose to Win? Performance Incentives and the Player Draft in the Australian Football League." *Journal of Sports Economics*, 10, 2009, 451-484

Boulier BL, Stekler HO, Amundson S (2006) "Testing the Efficiency of the National Football League Betting Market". *Applied Economics*. 38. 3. 279-284.

Brooks, Larry. "Rangers Insist They Aren't Tanking — and That's the Scary Part." New York Post - Sports. April 8, 2016. Accessed April 28, 2016. http://nypost.com/2016/04/08/rangers-insist-theyre-not-tanking-which-makes-play-disturbing/.

Brown, William O., and Raymond D. Sauer. "Fundamentals or Noise? Evidence from the Professional Basketball Betting Market." The Journal of Finance 48, no. 4 (September 1993): 1193-209.

Bursik, Paul B. Behavioral Economics and the NFL. In *Economics of the National Football League*, ed. Kevin G. Quinn, 259-276, Springer, 2012.

Chase, Chris. "Tanking Doesn't Exist in the NFL." USA Today. December 28, 2015. Accessed April 28, 2016. http://ftw.usatoday.com/2015/12/nfl-tanking-nfl-draft-titans-eagles-cowboys-tanking-doesnt-exist.

Chemi, Eric. "If the NFL Were a Real Business." Bloomberg. September 13, 2014. Accessed April 27, 2016. http://www.bloomberg.com/news/articles/2014-09-12/the-nfl-could-be-a-big-business-with-puny-revenue.

Copeland, Kareem. "Indianapolis Colts' Playoff Magic Number Now Is 1." NFL.com. December 9, 2012. Accessed May 12, 2016. http://www.nfl.com/news/story/0ap1000000108084/article/indianapolis-colts-playoff-magic-number-now-is-1.

Dana DD Jr, Knetter MM (1994) Learning and Efficiency in a Gambling Market". *Managerial Science*. 40. 10. 1317-1328.

Dare, W., & Dennis, S. (2011). A test for bias of inherent characteristics in betting markets. Journal of Sports Economics, 12, 660-665.

Gaines, Cork. "The Tennessee Titans Are following the NFL's 3-year Tanking Plan to Perfection." Business Insider UK. April 15, 2016. Accessed April 28, 2016. http://uk.businessinsider. com/tennessee-titans-are-nfl-tanking-perfection-2016-4?r=US&IR=T.

Hartwell, Darren. "Celtics Notes: Nets Tank, Help C's Secure 3rd-Best NBA Lottery Odds." New England Sports Network. April 14, 2016. Accessed April 28, 2016. http://nesn.com/2016/04/celtics-notes-nets-tank-help-cs-secure-3rd-best-nba-lottery-odds/.

Howe, Jeff. "Andy Reid, Bill Belichick Represent Rare Models of Head Coaching Consistency and 19 Other NFL Thoughts." NESN. March 30, 2011. Accessed May 8, 2016. http://nesn.com/2011/03/andy-reid-bill-belichick-represent-rare-models-of-head-coaching-consistency-and-19-other-nfl-thought/.

Lacey NJ. (1990) "An Estimation of Market Efficiency in the NFL Point Spread Betting Market". *Applied Economics*. 22. 1. 117-129.

Levitt, Steven D. "What's With the Home Underdogs in the N.F.L.?" Freakonomics. January 2, 2009. Accessed May 5, 2016. http:// freakonomics. com/2009/01/02/whats-with-the-home-underdogs-in-the-nfl/.

Mondello, Michael J. Media Economics of the NFL. In *Economics of the National Football League*, ed. Kevin G. Quinn, 89-106 Springer, 2012.

Murphy, Kevin M, Topel, Robert H. (1985) “Estimation and Inference in Two-Step Econometric Models”. *Journal of Business & Economic Statistics*. 3. 4. 370-379.

NBA Official Release. "Ties Broken for NBA Draft 2016." NBA. April 15, 2016. Accessed May 2, 2016. http:// pr.nba. com/nba-draft-2016-ties-broken/.

Pankoff, Lyn D. "Marketing Efficiency and Football Betting." The Journal of Business 41 (1968). http:// EconPapers.repec. org/RePEc:ucp:jnlbus:v:41:y:1968:p:203.

Paul, Rodney, Simmons, Robert, and Weinbach Andrew. Gambling and the NFL. In *Economics of the National Football League*, ed. Kevin G. Quinn, 225-242, Springer, 2012

Rocco, Matthew. "TV Deals Boost NFL Revenue to New Record." Fox Business. July 21, 2015. Accessed April 27, 2016. http://www.foxbusiness.com/features/2015/07/21/tv-deals-boost-nfl-revenue-to-new-record.html.

Rovell, Darren. “NFL teams each earn $226.4M from national revenue sharing.” ESPN. July 22, 2015.

Sauer R, Brajer V, Ferris S, Marr M (1988) “Hold Your Bets: Another Look at the Efficiency of the Gambling Market for National Football League Games”. *Journal of Political Economy*. 96. 206-213.

Tryfos P, Casey S, Cook S, Leger G, Pylypiak B. (1984) “The Profitability of Wagering on NFL Games”. *Managerial Science*. 30. 1. 123-132.

Vergin RC, Scriabin M. (1978) “Winning Strategies for Wagering on National Football League Games”. *Managerial Science*. 24. 8. 809-181.

Vrooman, John. The Economic Structure of the NFL. In *Economics of the National Football League*, ed. Kevin G. Quinn, 7-32, Springer, 2012.

Zuber R, Gandar J, Bowers B (1985) “Beating the Spread: Testing the Efficiency of the Gambling Market for National Football League Games”. *Journal of Political Economy*. 93. 4. 187-193.

"2014 NFL Football Attendance." ESPN. Accessed April 27, 2016. http:// espn.go. com/nfl/attendance/_/year/2014.

"Magic Number (sports)." Wikipedia. Updated March 31, 2016. Accessed May 12, 2016. https://en.wikipedia.org/wiki/Magic_number_(sports).

"National Football League: NFL Draft History." NFL. Accessed May 8, 2016. http://www. nfl. com/draft/history/fulldraft?season=2000&round=round1#round1.

"Pro-Football-Reference.com." Wikipedia. April 5, 2016. Accessed May 5, 2016. https://en.wikipedia. org/wiki/Pro-Football-Reference.com.

"Sureg - Zellner's Seemingly Unrelated Regression." Stata. Accessed May 8, 2016. http://www. stata. com/manuals13/rsureg.pdf

APPENDIX A: TABLES

Team Abilities from 2000 through 2010:

Table A.1				
2000 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	4.70	9.92	15.45	4.27
Atlanta Falcons	3.27	10.17	8.78	2.31
Baltimore Ravens	-6.12	0.13	-7.80	-1.86
Buffalo Bills	-3.19	3.06	0.24	0.24
Carolina Panthers	0.62	8.09	1.31	0.49
Chicago Bears	1.69	7.95	6.55	1.75
Cincinnati Bengals	5.34	12.96	10.69	3.46
Cleveland Browns	7.91	13.56	14.82	3.02
Dallas Cowboys	1.56	9.55	4.80	1.62
Denver Broncos	-4.15	2.04	-4.82	-0.93
Detroit Lions	-0.16	8.48	-1.19	-0.11
Green Bay Packers	-1.16	4.98	-2.28	-0.37
Indianapolis Colts	-6.17	-0.36	-7.69	-1.42
Jacksonville Jaguars	-3.74	2.60	-0.91	-0.04
Kansas City Chiefs	-2.02	4.17	-0.42	0.07
Miami Dolphins	-2.96	3.38	-6.88	-1.42
Minnesota Vikings	-5.32	0.76	-1.69	-0.23
New England Patriots	-0.30	6.46	2.72	0.77
New Orleans Saints	0.08	6.02	-0.66	0.02
New York Giants	-2.61	4.38	-2.21	-0.35
New York Jets	-2.72	3.57	-3.32	-0.55
Oakland Raiders	-4.22	1.96	-9.52	-1.93
Philidelphia Eagles	-0.92	5.69	-2.83	-0.42
Pittsburgh Steelers	-1.08	4.92	-3.69	-0.76
San Diego Chargers	4.13	11.59	8.32	1.96
Seattle Seahawks	1.29	8.81	3.96	1.26
San Francisco 49ers	2.25	9.20	4.07	0.97
Saint Louis Rams	-8.90	-4.26	-2.92	-0.55
Tampa Bay Buccaneers	-5.33	0.60	-7.10	-1.72
Tennessee Titans	-7.00	-1.88	-8.12	-2.04
Washington Redskins	-4.22	(omitted)	-0.75	(omitted)
Home Field Advantage	-2.60	-21.50	-2.82	-5.93

Table A.2				
2001 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	4.73	1.14	15.45	0.10
Atlanta Falcons	1.07	-2.70	8.78	0.17
Baltimore Ravens	-5.21	-8.93	-7.80	-1.50
Buffalo Bills	3.16	-0.56	0.24	1.14
Carolina Panthers	4.44	0.67	1.31	1.06
Chicago Bears	-0.03	-4.70	6.55	-2.76
Cincinnati Bengals	2.72	-0.91	10.69	-0.02
Cleveland Browns	2.76	-0.85	14.82	-0.69
Dallas Cowboys	5.47	2.43	4.80	0.55
Denver Broncos	-4.80	-10.67	-4.82	-0.78
Detroit Lions	4.25	0.49	-1.19	0.80
Green Bay Packers	-4.90	-8.73	-2.28	-1.82
Indianapolis Colts	-3.82	-6.19	-7.69	0.02
Jacksonville Jaguars	-0.28	-3.26	-0.91	-0.93
Kansas City Chiefs	0.16	-3.63	-0.42	-0.46
Miami Dolphins	-3.40	-6.30	-6.88	-1.15
Minnesota Vikings	-0.34	-3.52	-1.69	0.18
New England Patriots	1.02	-2.54	2.72	-1.53
New Orleans Saints	-2.66	-8.34	-0.66	0.18
New York Giants	-2.14	-6.82	-2.21	-0.52
New York Jets	-1.18	-4.39	-3.32	-0.83
Oakland Raiders	-6.14	-11.36	-9.52	-1.63
Philidelphia Eagles	-3.86	-14.21	-2.83	-2.13
Pittsburgh Steelers	-2.99	-5.56	-3.69	-2.15
San Diego Chargers	-0.59	-5.20	8.32	-0.81
Seattle Seahawks	-0.02	-4.17	3.96	-0.37
San Francisco 49ers	-3.13	-8.12	4.07	-2.38
Saint Louis Rams	-10.66	-16.62	-2.92	-3.19
Tampa Bay Buccaneers	-3.45	-7.63	-7.10	-1.46
Tennessee Titans	-2.00	-5.58	-8.12	-0.31
Washington Redskins	3.69	(omitted)	-0.75	(omitted)
Home Field Advantage	-2.21	-20.33	-2.82	-3.04

Table A.3				
2002 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	4.10	4.72	9.06	5.78
Atlanta Falcons	-1.08	-4.08	-5.89	2.42
Baltimore Ravens	2.19	1.23	1.29	-4.56
Buffalo Bills	0.93	-0.87	-0.55	-3.79
Carolina Panthers	4.00	4.16	2.44	-5.80
Chicago Bears	2.53	2.15	4.44	3.86
Cincinnati Bengals	5.63	6.06	9.68	0.71
Cleveland Browns	0.99	-0.91	-2.06	0.35
Dallas Cowboys	3.82	4.76	7.65	-3.78
Denver Broncos	-4.20	-9.36	-5.72	-5.78
Detroit Lions	5.57	7.19	8.34	5.13
Green Bay Packers	-3.29	-6.61	-4.41	-8.97
Houston Texans	8.95	11.52	8.61	7.49
Indianapolis Colts	-2.09	-5.64	-2.00	-10.45
Jacksonville Jaguars	0.92	-0.79	-0.63	1.67
Kansas City Chiefs	-0.77	-3.13	-6.94	-7.82
Miami Dolphins	-2.71	-6.29	-6.89	-8.24
Minnesota Vikings	2.49	2.14	2.18	-7.43
New England Patriots	-2.63	-7.10	-4.85	-6.47
New Orleans Saints	-2.03	-6.03	-3.25	-3.88
New York Giants	0.34	-1.65	-1.66	-2.44
New York Jets	-0.41	-2.35	-4.00	-1.27
Oakland Raiders	-5.01	-6.54	-11.46	-0.02
Philidelphia Eagles	-4.04	-12.94	-9.13	-7.61
Pittsburgh Steelers	-3.60	-7.71	-3.53	-2.68
San Diego Chargers	-0.04	-2.08	-0.11	2.62
Seattle Seahawks	2.12	0.93	0.42	-6.78
San Francisco 49ers	-4.48	-8.42	-1.46	-2.84
Saint Louis Rams	-3.64	-6.49	2.51	-8.93
Tampa Bay Buccaneers	-3.87	-8.58	-9.63	-8.46
Tennessee Titans	-0.80	-4.46	-2.59	-9.44
Washington Redskins	1.44	(omitted)	3.63	(omitted)
Home Field Advantage	-2.27	-26.09	-2.25	-27.86

Table A.4				
2003 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	7.09	5.78	12.12	1.19
Atlanta Falcons	4.07	2.42	6.99	0.36
Baltimore Ravens	-0.50	-4.56	-6.69	-2.33
Buffalo Bills	0.31	-3.79	0.56	-1.09
Carolina Panthers	-0.66	-5.80	0.50	-1.28
Chicago Bears	4.60	3.86	3.11	-0.58
Cincinnati Bengals	3.21	0.71	1.97	-0.93
Cleveland Browns	2.79	0.35	2.48	-0.64
Dallas Cowboys	0.06	-3.78	0.03	-0.94
Denver Broncos	-2.12	-5.78	-5.90	-2.37
Detroit Lions	5.87	5.13	5.41	0.03
Green Bay Packers	-2.31	-8.97	-8.56	-3.18
Houston Texans	6.49	7.49	5.52	0.06
Indianapolis Colts	-2.75	-10.45	-7.40	-3.01
Jacksonville Jaguars	3.29	1.67	1.99	-1.01
Kansas City Chiefs	-3.72	-7.82	-8.74	-2.57
Miami Dolphins	-1.83	-8.24	-3.86	-1.74
Minnesota Vikings	-1.61	-7.43	-3.34	-1.78
New England Patriots	-1.15	-6.47	-7.37	-4.42
New Orleans Saints	0.50	-3.88	-0.17	-1.54
New York Giants	0.56	-2.44	8.13	0.53
New York Jets	1.52	-1.27	0.14	-2.04
Oakland Raiders	2.44	-0.02	5.05	-0.06
Philidelphia Eagles	-1.92	-7.61	-4.84	-1.94
Pittsburgh Steelers	0.16	-2.68	0.65	-1.24
San Diego Chargers	4.40	2.62	6.37	0.26
Seattle Seahawks	-1.71	-6.78	-4.51	-2.13
San Francisco 49ers	0.23	-2.84	-3.51	-1.38
Saint Louis Rams	-3.37	-8.93	-6.29	-1.79
Tampa Bay Buccaneers	-3.05	-8.46	-2.04	-1.49
Tennessee Titans	-2.73	-9.44	-6.90	-3.15
Washington Redskins	2.47	(omitted)	5.31	(omitted)
Home Field Advantage	-2.53	-27.86	-3.55	-4.72

Table A.5

2004 Regular Season Team Abilities

Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	3.38	2.02	3.06	0.38
Atlanta Falcons	-1.67	-2.49	0.39	-0.26
Baltimore Ravens	-3.20	-5.43	-7.93	-3.09
Buffalo Bills	-1.34	-2.85	-9.86	-3.96
Carolina Panthers	-0.44	-1.44	-1.16	-0.82
Chicago Bears	3.76	2.54	6.43	1.65
Cincinnati Bengals	0.62	-0.44	-4.48	-1.68
Cleveland Browns	4.24	3.08	1.58	0.01
Dallas Cowboys	1.05	-0.18	5.96	2.18
Denver Broncos	-5.66	-6.82	-7.67	-2.97
Detroit Lions	1.44	0.2	3.36	0.5
Green Bay Packers	-2.06	-3.16	-2.11	-1.05
Houston Texans	1.89	0.72	-1.18	-0.72
Indianapolis Colts	-6.36	-6.51	-13.22	-5.17
Jacksonville Jaguars	-0.33	-1.56	-2.56	-1.41
Kansas City Chiefs	-3.21	-4.59	-7.09	-2.81
Miami Dolphins	3.24	2.4	0.42	-0.56
Minnesota Vikings	-3.74	-5.18	-0.12	-0.82
New England Patriots	-7.26	-9.11	-14.65	-5.72
New Orleans Saints	2.00	0.61	3.75	0.65
New York Giants	2.35	1.21	2.11	0.17
New York Jets	-3.22	-4.09	-8.36	-5.21
Oakland Raiders	0.82	-0.37	2.46	0.3
Philidelphia Eagles	-5.54	-7.09	-7.36	-3.19
Pittsburgh Steelers	-2.64	-3.15	-10.81	-5.33
San Diego Chargers	-0.63	-1.56	-10.93	-5.17
Seattle Seahawks	-3.62	-4.57	1.08	-0.2
San Francisco 49ers	5.56	4.5	11.81	3.12
Saint Louis Rams	-1.84	-2.51	4.18	0.54
Tampa Bay Buccaneers	0.28	-0.9	0.87	-0.27
Tennessee Titans	-0.81	-2	2.58	0.28
Washington Redskins	1.22	(omitted)	1.56	(omitted)
Home Field Advantage	-2.54	-20.9	-2.51	-4.52

Table A.6				
2005 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	3.54	4.86	6.85	3.92
Atlanta Falcons	-0.88	0.81	3.09	1.74
Baltimore Ravens	1.73	3.53	3.70	1.79
Buffalo Bills	3.09	4.91	7.71	3.17
Carolina Panthers	-2.40	-0.75	-3.20	0.22
Chicago Bears	1.40	3.2	0.47	1.27
Cincinnati Bengals	-2.43	-0.9	-1.95	0.41
Cleveland Browns	4.36	7.09	6.09	3.23
Dallas Cowboys	-1.21	0.42	-1.29	0.81
Denver Broncos	-4.14	-2.05	-8.93	-1.5
Detroit Lions	3.56	5.5	8.57	3.49
Green Bay Packers	2.80	4.92	5.59	2.03
Houston Texans	6.81	11.26	11.89	4.25
Indianapolis Colts	-6.89	-4.21	-8.94	-1.13
Jacksonville Jaguars	-1.39	0.27	-2.90	0.39
Kansas City Chiefs	-1.08	0.58	-5.14	-0.33
Miami Dolphins	2.98	3.81	2.63	1.99
Minnesota Vikings	1.89	4.42	5.39	1.81
New England Patriots	-2.74	-1.19	-1.28	0.63
New Orleans Saints	4.90	6.34	12.95	4.16
New York Giants	-2.40	-0.99	-5.63	-0.35
New York Jets	4.50	5.96	8.26	3.5
Oakland Raiders	2.21	3.49	4.67	3.36
Philidelphia Eagles	0.08	1.09	4.17	2.74
Pittsburgh Steelers	-3.19	-1.83	-5.95	-0.35
San Diego Chargers	-4.46	-1.97	-8.08	-1.28
Seattle Seahawks	-2.42	-0.93	-7.25	-0.83
San Francisco 49ers	10.02	15.01	13.01	4.06
Saint Louis Rams	2.13	4.67	7.01	3.18
Tampa Bay Buccaneers	-0.12	1.62	2.87	1.94
Tennessee Titans	4.66	6.65	9.43	3.99
Washington Redskins	-1.63	(omitted)	-4.13	(omitted)
Home Field Advantage	-2.59	-21.32	-3.65	-6.32

Table A.7				
2006 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	4.19	1.71	7.20	0.67
Atlanta Falcons	-0.42	-3.19	3.28	-0.31
Baltimore Ravens	-1.51	-5.36	-9.08	-3.37
Buffalo Bills	4.15	3.32	-1.93	-1.63
Carolina Panthers	-2.11	-5.11	2.94	-0.37
Chicago Bears	-3.72	-7.93	-7.64	-3.3
Cincinnati Bengals	-2.11	-7.33	-3.82	-2.05
Cleveland Browns	4.65	3.25	6.11	0.56
Dallas Cowboys	-3.84	-9.64	-3.40	-2.34
Denver Broncos	-2.54	-5.4	-1.06	-1.53
Detroit Lions	5.44	4.73	6.62	0.6
Green Bay Packers	4.94	2.89	4.68	0.08
Houston Texans	6.72	8.27	4.77	0.15
Indianapolis Colts	-5.20	-15.47	-5.61	-2.09
Jacksonville Jaguars	-1.08	-6.02	-7.22	-1.74
Kansas City Chiefs	0.35	-2.29	-0.73	-1.04
Miami Dolphins	1.81	-0.55	-0.42	-1.21
Minnesota Vikings	2.96	1.2	4.36	0.01
New England Patriots	-2.95	-4.43	-9.97	-2.79
New Orleans Saints	0.92	-2.49	-3.78	-1.52
New York Giants	-1.17	-7.14	0.18	-1.23
New York Jets	3.90	2.58	-1.76	-1.36
Oakland Raiders	7.62	6.68	9.87	1.59
Philidelphia Eagles	-2.11	-5.07	-3.13	-2.33
Pittsburgh Steelers	-2.34	-4.09	-3.15	-1.73
San Diego Chargers	-3.76	-5.41	-9.93	-4.44
Seattle Seahawks	-0.15	-3.02	3.83	-0.12
San Francisco 49ers	6.78	6.32	8.98	0.98
Saint Louis Rams	2.66	0.54	4.22	-0.03
Tampa Bay Buccaneers	3.67	2.26	8.19	1.45
Tennessee Titans	6.13	4.6	1.55	-0.69
Washington Redskins	2.19	(omitted)	4.31	(omitted)
Home Field Advantage	-2.81	-25.78	-0.85	-1.32

Table A.8				
2007 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	2.85	1.7	6.92	2.74
Atlanta Falcons	6.47	4.58	13.58	4.27
Baltimore Ravens	1.60	0.96	9.72	2.81
Buffalo Bills	4.65	3.8	7.08	2.67
Carolina Panthers	3.45	1.98	8.78	2.36
Chicago Bears	1.22	0.82	1.75	1.25
Cincinnati Bengals	0.29	-0.17	5.36	1.93
Cleveland Browns	1.63	0.87	4.04	1.69
Dallas Cowboys	-4.68	-2.74	-6.50	-1.94
Denver Broncos	0.68	0.16	6.92	1.78
Detroit Lions	3.22	2.96	6.53	1.35
Green Bay Packers	-0.79	-0.97	-6.03	-1.34
Houston Texans	2.52	1.63	2.95	0.95
Indianapolis Colts	-5.73	-3.88	-9.03	-1.98
Jacksonville Jaguars	-1.13	-0.96	-3.85	-0.6
Kansas City Chiefs	4.38	2.49	8.43	2.4
Miami Dolphins	6.03	7.11	11.35	2.79
Minnesota Vikings	1.58	0.95	-0.82	0.21
New England Patriots	-12.92	-10.23	-17.08	-4.47
New Orleans Saints	-0.58	-0.89	5.50	1.49
New York Giants	-0.25	-0.67	-0.29	0.29
New York Jets	4.21	3.61	6.67	1.99
Oakland Raiders	5.44	3.98	8.95	2.87
Philidelphia Eagles	-0.75	-0.97	-2.28	-0.16
Pittsburgh Steelers	-4.70	-5.04	-2.23	-0.2
San Diego Chargers	-4.48	-3.45	-5.81	-1.07
Seattle Seahawks	-1.22	-1.21	1.22	0.73
San Francisco 49ers	7.19	5.4	14.91	5.52
Saint Louis Rams	6.01	4.53	15.94	5.64
Tampa Bay Buccaneers	1.30	0.71	1.75	0.91
Tennessee Titans	-0.66	-0.79	2.27	0.87
Washington Redskins	0.50	(omitted)	-1.50	(omitted)
Home Field Advantage	-2.34	-12.7	-2.87	-4.42

Table A.9				
2008 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	-0.65	-0.54	2.04	0.02
Atlanta Falcons	1.08	1.56	-3.66	-1.64
Baltimore Ravens	-0.99	-1.04	-9.65	-2.96
Buffalo Bills	0.56	0.97	3.50	0.4
Carolina Panthers	-2.45	-2.63	-5.48	-1.78
Chicago Bears	-1.07	-0.84	-1.95	-0.91
Cincinnati Bengals	5.34	4.65	7.13	1.65
Cleveland Browns	3.60	3.97	4.80	0.98
Dallas Cowboys	-4.67	-4.76	-0.41	-0.53
Denver Broncos	0.20	0.35	5.95	0.82
Detroit Lions	7.38	5.51	13.27	2.03
Green Bay Packers	-1.15	-0.8	-2.74	-1.59
Houston Texans	0.67	1.11	0.55	-0.44
Indianapolis Colts	-4.65	-5.08	-6.33	-2.5
Jacksonville Jaguars	-0.61	-0.33	2.67	0.22
Kansas City Chiefs	7.37	9.48	9.38	2
Miami Dolphins	1.01	1.48	0.69	-0.27
Minnesota Vikings	-1.84	-1.84	-3.88	-1.8
New England Patriots	-3.10	-4.18	-3.75	-1.42
New Orleans Saints	-0.20	0.1	-3.89	-1.48
New York Giants	-4.42	-6.12	-8.21	-3.19
New York Jets	-1.25	-1.07	-0.07	-0.49
Oakland Raiders	6.68	8.05	7.64	1.23
Philidelphia Eagles	-3.76	-5.52	-7.67	-3.6
Pittsburgh Steelers	-4.16	-5.91	-9.64	-3.08
San Diego Chargers	-3.90	-3.47	-4.80	-1.72
Seattle Seahawks	3.62	7.09	7.79	1.48
San Francisco 49ers	3.65	4.7	5.47	1.53
Saint Louis Rams	8.12	8.5	15.25	3.2
Tampa Bay Buccaneers	-2.25	-1.98	-2.11	-1.33
Tennessee Titans	-3.81	-2.57	-8.79	-3.3
Washington Redskins	-0.28	(omitted)	1.94	(omitted)
Home Field Advantage	-2.65	-23.38	-2.56	-4.09

Table A.10				
2009 Regular Season Team Abilities				
Team Name	**Point Spread Regression**		**Difference in Points Regression**	
	Team Ability	**Z-Stat**	**Team Ability**	**Z-Stat**
Arizona Cardinals	-2.53	-4.29	0.09	-0.82
Atlanta Falcons	-0.76	-4.29	-5.22	-2.17
Baltimore Ravens	-4.56	-6.74	-7.67	-2.59
Buffalo Bills	2.92	0.51	1.63	-0.55
Carolina Panthers	1.08	-1.65	-4.10	-1.79
Chicago Bears	0.32	-2.27	3.70	-0.13
Cincinnati Bengals	-0.71	-2.62	-0.85	-1.08
Cleveland Browns	6.73	4.26	8.19	0.89
Dallas Cowboys	-4.82	-9.04	-7.34	-3.11
Denver Broncos	-0.31	-3.17	-0.51	-1.39
Detroit Lions	8.08	6.07	14.19	2.19
Green Bay Packers	-4.28	-7.63	-7.55	-2.54
Houston Texans	-1.30	-3.76	-2.16	-1.58
Indianapolis Colts	-4.97	-5.49	-6.12	-2.11
Jacksonville Jaguars	0.85	-1.92	6.30	0.34
Kansas City Chiefs	6.78	4.95	8.24	0.69
Miami Dolphins	0.54	-2.31	-1.88	-1.54
Minnesota Vikings	-5.67	-6.89	-7.36	-1.85
New England Patriots	-5.85	-7.24	-11.40	-2.84
New Orleans Saints	-6.61	-7.01	-10.95	-3.92
New York Giants	-4.21	-8.31	-0.28	-0.85
New York Jets	-1.87	-5	-8.77	-3.09
Oakland Raiders	7.94	6.35	10.08	1.28
Philidelphia Eagles	-5.02	-7.14	-6.18	-2.12
Pittsburgh Steelers	-5.61	-9.64	-1.88	-1.45
San Diego Chargers	-3.21	-6.23	-6.83	-2.12
Seattle Seahawks	2.56	0.1	9.12	0.96
San Francisco 49ers	0.38	-2.42	-0.25	-1.01
Saint Louis Rams	8.86	7.6	17.25	2.3
Tampa Bay Buccaneers	6.24	6.26	5.45	0.23
Tennessee Titans	-1.41	-4.76	2.57	-0.33
Washington Redskins	2.47	(omitted)	4.38	(omitted)
Home Field Advantage	-2.70	-24.88	-2.21	-3.36

Table A.11				
2010 Regular Season Team Abilities				
Team Name	Point Spread Regression		Difference in Points Regression	
	Team Ability	Z-Stat	Team Ability	Z-Stat
Arizona Cardinals	5.24	2.04	13.54	1.82
Atlanta Falcons	-2.82	-7.29	-5.21	-2.95
Baltimore Ravens	-3.62	-8.68	-5.57	-3.51
Buffalo Bills	5.35	1.94	5.48	0.21
Carolina Panthers	6.53	3.09	14.06	2.76
Chicago Bears	1.78	-2.34	-3.24	-2.23
Cincinnati Bengals	2.09	-1.33	2.30	-0.9
Cleveland Browns	3.59	0.13	2.35	-0.77
Dallas Cowboys	0.20	-2.83	3.03	-0.5
Denver Broncos	3.11	-0.44	9.78	1.37
Detroit Lions	5.41	2.43	-1.04	-1.53
Green Bay Packers	-3.41	-11.97	-10.06	-5.2
Houston Texans	0.06	-4.65	2.72	-0.69
Indianapolis Colts	-3.75	-9.76	-2.00	-2.31
Jacksonville Jaguars	2.22	-1.46	5.39	0.19
Kansas City Chiefs	0.72	-3.1	1.56	-0.72
Miami Dolphins	1.12	-2.63	0.57	-0.97
Minnesota Vikings	0.87	-2.96	2.47	-0.64
New England Patriots	-3.54	-8.57	-14.51	-4.62
New Orleans Saints	-4.13	-8.18	-1.44	-1.66
New York Giants	-2.19	-10.63	-1.24	-1.74
New York Jets	-1.36	-5.55	-5.60	-2.7
Oakland Raiders	3.73	0.24	0.69	-0.74
Philidelphia Eagles	-3.27	-10.33	-3.34	-1.95
Pittsburgh Steelers	-3.48	-8.18	-9.34	-4.05
San Diego Chargers	-4.30	-9.22	-3.94	-1.59
Seattle Seahawks	4.96	2.1	10.32	1.4
San Francisco 49ers	1.30	-2.13	6.71	0.42
Saint Louis Rams	4.48	0.8	7.55	0.68
Tampa Bay Buccaneers	2.88	-0.62	1.46	-0.88
Tennessee Titans	-0.02	-3.61	-0.14	-1.17
Washington Redskins	3.47	(omitted)	4.69	(omitted)
Home Field Advantage	-2.43	-20.54	-1.89	-3.25

Seemingly Unrelated Regressions from 2000 through 2010:

Table A.12
2000 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	$\chi 2$
Point Spread	248	9	2.4466	0.8537	1451.43
Difference in Points	248	9	10.9247	0.4526	203.42

Point Spread	Observed Coefficient	Bootstrap Std. Err.	Z-stat	P>|z|	95% Confidence Interval[1]	
					Lower Bound	Upper Bound
PSPred	0.9818	0.0295	33.30	0.000	0.9422	1.0578
hclinch	-1.8283	1.3701	-1.33	0.182	-4.5137	0.8570
aclinch	1.9553	1.5887	1.23	0.218	-1.1585	5.0691
helim	1.7742	1.1419	1.55	0.120	-0.4639	4.0123
aelim	-3.0360	1.4750	-2.06	0.040	-5.9270	-0.1450
hclinch*PSPred	-0.2608	0.2352	-1.11	0.267	-0.7218	0.2001
aclinch*PSPred	0.1679	0.4047	0.41	0.678	-0.6254	0.9611
helim*PSPred	0.0453	0.3114	0.15	0.884	-0.5651	0.6557
aelim*PSPred	-0.1511	0.1888	-0.80	0.423	-0.5210	0.2189
_constant	-0.1039	0.1913	-0.54	0.587	-0.4788	0.2711

Difference in Points	Observed Coefficient	Bootstrap Std. Err.	Z-stat	P>|z|	95% Confidence Interval	
					Lower Bound	Upper Bound
DPPred	0.9668	0.0829	11.66	0.000	0.8375	1.1625
hclinch	4.1770	6.6752	0.63	0.531	-8.9062	17.2602
aclinch	-9.4521	3.5779	-2.64	0.008	-16.4646	-2.4396
helim	-1.4926	3.7280	-0.40	0.689	-8.7994	5.8142
aelim	-1.0222	8.1616	-0.13	0.900	-17.0187	14.9743
hclinch*DPPred	1.1921	0.8768	1.36	0.174	-0.5264	2.9105
aclinch*DPPred	0.5872	0.4268	1.38	0.169	-0.2494	1.4238
helim*DPPred	-0.3592	0.3499	-1.03	0.305	-1.0451	0.3266
aelim*DPPred	0.1641	0.6337	0.26	0.796	-1.0780	1.4061
_constant	0.7720	0.7779	0.99	0.321	-0.7526	2.2967

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.13
2001 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	$\chi 2$
Point Spread	248	9	2.4114	0.8244	1165.1
Difference in Points	248	9	11.4337	0.3397	127.06

Point Spread	Observed Coefficient	Bootstrap Std. Err.	Z-stat	P>|z|	95% Confidence Interval[1]	
					Lower Bound	Upper Bound
PSPred	0.9868	0.0321	30.76	0.000	0.9371	1.0629
hclinch	-0.9383	10.5382	-0.09	0.929	-21.5928	-21.5928
aclinch	1.5314	1.7751	0.86	0.388	-1.9478	5.0106
helim	1.1244	1.2050	0.93	0.351	-1.2373	3.4861
aelim	-1.3553	1.7173	-0.79	0.430	-4.7212	2.0105
hclinch*PSPred	-0.1177	1.2028	-0.10	0.922	-2.4751	2.2397
aclinch*PSPred	0.1274	0.5806	0.22	0.826	-1.0106	1.2654
helim*PSPred	-0.3281	0.4268	-0.77	0.442	-1.1646	0.5084
aelim*PSPred	-0.0718	0.3070	-0.23	0.815	-0.6736	0.5300
_constant	-0.0966	0.1740	-0.56	0.579	-0.4377	0.2445

Difference in Points	Observed Coefficient	Bootstrap Std. Err.	Z-stat	P>|z|	95% Confidence Interval	
					Lower Bound	Upper Bound
DPPred	0.9616	0.1046	9.20	0.000	0.7951	1.2049
hclinch	-2.9840	13.3626	-0.22	0.823	-29.1743	23.2063
aclinch	6.8959	19.6917	0.35	0.726	-31.6992	45.4909
helim	1.8178	4.4745	0.41	0.685	-6.9521	10.5877
aelim	-2.9170	3.7197	-0.78	0.433	-10.2075	4.3734
hclinch*DPPred	0.7166	1.0681	0.67	0.502	-1.3768	2.8099
aclinch*DPPred	-0.3489	2.2319	-0.16	0.876	-4.7233	4.0255
helim*DPPred	-0.2708	1.0768	-0.25	0.801	-2.3812	1.8396
aelim*DPPred	-0.6496	0.6659	-0.98	0.329	-1.9546	0.6555
_constant	-0.0259	0.7981	-0.03	0.974	-1.5900	1.5383

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.14
2002 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	$\chi 2$	
Point Spread	256	9	2.2194	0.8222	1205.76	
Difference in Points	256	9	11.5719	0.3211	123.47	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	0.9910	0.0301	32.95	0.000	0.9410	1.0590
hclinch	-1.3989	21.9110	-0.06	0.949	-44.3437	41.5458
aclinch	0.8808	1.9217	0.46	0.647	-2.8856	4.6472
helim	0.8389	0.8972	0.94	0.350	-0.9196	2.5975
aelim	-1.8179	1.5044	-1.21	0.227	-4.7664	1.1307
hclinch*PSPred	-0.1217	3.3751	-0.04	0.971	-6.7366	6.4933
aclinch*PSPred	-0.1113	0.6818	-0.16	0.870	-1.4476	1.2251
helim*PSPred	-0.0156	0.1546	-0.10	0.919	-0.3186	0.2873
aelim*PSPred	-0.2005	0.2015	-1.00	0.320	-0.5954	0.1944
_constant	-0.0112	0.1693	-0.07	0.947	-0.3430	0.3206
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	0.9873	0.1161	8.51	0.000	0.7725	1.2275
hclinch	6.6447	61.7534	0.11	0.914	-114.3897	127.6791
aclinch	-5.9559	13.4208	-0.44	0.657	-32.2603	20.3484
helim	-7.7287	3.3517	-2.31	0.021	-14.2980	-1.1595
aelim	5.4524	4.5797	1.19	0.234	-3.5236	14.4284
hclinch*DPPred	0.9247	8.6596	0.11	0.915	-16.0477	17.8972
aclinch*DPPred	1.6515	2.6554	0.62	0.534	-3.5529	6.8560
helim*DPPred	-0.1730	0.4320	-0.40	0.689	-1.0197	0.6736
aelim*DPPred	0.7856	0.3750	2.10	0.036	0.0507	1.5205
_constant	0.4420	0.8499	0.52	0.603	-1.2237	2.1078

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.15
2003 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	$\chi 2$	
Point Spread	256	9	2.2484	0.8017	1036.71	
Difference in Points	256	9	12.2257	0.3183	120.58	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	0.9923	0.0287	34.62	0.000	0.9438	1.0562
hclinch	-0.4812	3.9128	-0.12	0.902	-8.1501	7.1876
aclinch	0.7696	3.5482	0.22	0.828	-6.1847	7.7239
helim	-1.6343	1.4393	-1.14	0.256	-4.4553	1.1866
aelim	-0.1894	0.8395	-0.23	0.821	-1.8348	1.4560
hclinch*PSPred	0.1475	1.4776	0.10	0.920	-2.7485	3.0436
aclinch*PSPred	0.5120	7.1927	0.07	0.943	-13.5854	14.6094
helim*PSPred	-0.0652	0.2853	-0.23	0.819	-0.6244	0.4941
aelim*PSPred	-0.0209	0.1233	-0.17	0.865	-0.2626	0.2208
_constant	0.0903	0.1559	0.58	0.563	-0.2153	0.3958
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	0.9303	0.1097	8.48	0.000	0.7851	1.2149
hclinch	1.5514	6.7771	0.23	0.819	-11.7316	14.8344
aclinch	-6.7720	20.2086	-0.34	0.738	-46.3802	32.8361
helim	0.8091	8.7323	0.09	0.926	-16.3059	17.9242
aelim	-0.5931	2.8931	-0.21	0.838	-6.2634	5.0772
hclinch*DPPred	1.0601	1.0570	1.00	0.316	-1.0115	3.1317
aclinch*DPPred	0.2946	2.5262	0.12	0.907	-4.6566	5.2457
helim*DPPred	-0.1812	0.8014	-0.23	0.821	-1.7520	1.3896
aelim*DPPred	0.6067	0.3116	1.95	0.052	-0.0040	1.2174
_constant	0.0650	0.9601	0.07	0.946	0.9601	1.9468

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.16
2004 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	χ2	
Point Spread	256	9	2.6551	0.7512	773.28	
Difference in Points	256	9	11.0094	0.3824	158.5	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	1.0088	0.0335	30.11	0.000	0.9519	1.0832
hclinch	0.8740	2.3076	0.38	0.705	-3.6488	5.3968
aclinch	-1.5626	1.7431	-0.90	0.370	-4.9790	1.8539
helim	1.1810	1.6150	0.73	0.465	-1.9844	4.3463
aelim	-2.5359	2.8575	-0.89	0.375	-8.1366	3.0648
hclinch*PSPred	-0.0668	0.3553	-0.19	0.851	-0.7630	0.6295
aclinch*PSPred	0.0587	0.5270	0.11	0.911	-0.9743	1.0916
helim*PSPred	0.2624	0.5463	0.48	0.631	-0.8083	1.3330
aelim*PSPred	-0.2920	0.3772	-0.77	0.439	-1.0314	0.4473
_constant	0.0003	0.1877	0.00	0.999	-0.3675	0.3682
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**		**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	1.0705	0.0863	12.41	0.000	0.9719	1.3101
hclinch	3.2239	4.9293	0.65	0.513	-6.4374	12.8852
aclinch	-3.7942	3.8516	-0.99	0.325	-11.3432	3.7547
helim	2.3344	3.8061	0.61	0.540	-5.1253	9.7941
aelim	2.4517	9.6575	0.25	0.800	-16.4766	21.3800
hclinch*DPPred	0.2619	0.6646	0.39	0.694	-1.0407	1.5644
aclinch*DPPred	-1.0900	0.4732	-2.30	0.021	-2.0175	-0.1624
helim*DPPred	0.6122	0.4161	1.47	0.141	-0.2033	1.4278
aelim*DPPred	-0.7331	0.8799	-0.83	0.405	-2.4577	0.9916
_constant	-0.1081	0.7619	-0.14	0.887	-1.6015	1.3852

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.17
2005 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	χ2	
Point Spread	256	9	2.7085	0.7886	955.06	
Difference in Points	256	9	11.3211	0.4047	174.00	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	0.9834	0.0323	30.42	0.000	0.9366	1.0634
hclinch	-6.5956	4.5874	-1.44	0.151	-15.5868	2.3956
aclinch	-0.9825	2.6675	-0.37	0.713	-6.2107	4.2457
helim	2.8151	1.0496	2.68	0.007	0.7579	4.8723
aelim	-2.7558	1.4221	-1.94	0.053	-5.5430	0.0314
hclinch*PSPred	-0.7813	0.6282	-1.24	0.214	-2.0126	0.4500
aclinch*PSPred	0.3557	1.0894	0.33	0.744	-1.7795	2.4910
helim*PSPred	-0.1529	0.2163	-0.71	0.480	-0.5769	0.2711
aelim*PSPred	-0.1144	0.2441	-0.47	0.639	-0.5928	0.3640
_constant	-0.0477	0.1930	-0.25	0.805	-0.4259	0.3305
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	1.0361	0.0855	12.12	0.000	0.9048	1.2398
hclinch	8.8677	9.6268	0.92	0.357	-10.0005	27.7360
aclinch	-5.2260	7.8449	-0.67	0.505	-20.6017	10.1497
helim	-2.0633	4.4260	-0.47	0.641	-10.7380	6.6114
aelim	-1.7443	5.2724	-0.33	0.741	-12.0781	8.5895
hclinch*DPPred	0.8917	0.7726	1.15	0.248	-0.6225	2.4059
aclinch*DPPred	0.1205	1.6090	0.07	0.940	-3.0331	3.2740
helim*DPPred	0.5110	0.6300	0.81	0.417	-0.7238	1.7459
aelim*DPPred	-0.8375	0.5505	-1.52	0.128	-1.9165	0.2415
_constant	-0.0325	0.7654	-0.04	0.966	-1.5327	1.4677

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.18
2006 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	$\chi 2$	
Point Spread	256	9	2.4776	0.8180	1163.48	
Difference in Points	256	9	11.7669	0.3316	128.22	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	1.0384	0.0295	35.19	0.000	1.0189	1.1346
hclinch	-2.0104	5.2394	-0.38	0.701	-12.2794	8.2587
aclinch	-0.6312	1.5887	-0.40	0.691	-3.7449	2.4825
helim	-0.7131	2.0694	-0.34	0.730	-4.7691	3.3429
aelim	-3.0885	4.8515	-0.64	0.524	-12.5973	6.4202
hclinch*PSPred	-0.3809	0.7009	-0.54	0.587	-1.7547	0.9928
aclinch*PSPred	-0.5454	0.4165	-1.31	0.190	-1.3617	0.2709
helim*PSPred	0.4485	0.8277	0.54	0.588	-1.1737	2.0708
aelim*PSPred	-0.3455	0.5614	-0.62	0.538	-1.4458	0.7549
_constant	0.1291	0.1770	0.73	0.466	-0.2179	0.4761
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	1.0836	0.1139	9.52	0.000	0.9441	1.3904
hclinch	-1.5114	10.4633	-0.14	0.885	-22.0191	18.9963
aclinch	10.4947	8.4289	1.25	0.213	-6.0257	27.0151
helim	8.3834	8.9903	0.93	0.351	-9.2371	26.0040
aelim	-1.4367	6.6709	-0.22	0.829	-14.5114	11.6381
hclinch*DPPred	-1.2014	1.2589	-0.95	0.340	-3.6688	1.2659
aclinch*DPPred	-0.8910	0.9215	-0.97	0.334	-2.6971	0.9152
helim*DPPred	-1.2177	1.2364	-0.98	0.325	-3.6410	1.2056
aelim*DPPred	0.0604	0.8967	0.07	0.946	-1.6972	1.8180
_constant	-0.5693	0.8165	-0.70	0.486	-2.1696	1.0310

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.19
2007 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	$\chi 2$	
Point Spread	256	9	3.1554	0.7809	913.24	
Difference in Points	256	9	11.3417	0.4576	216.01	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	0.9731	0.0379	25.66	0.000	0.9257	1.0743
hclinch	0.3854	2.6740	0.14	0.885	-4.8556	5.6264
aclinch	-0.9105	4.2050	-0.22	0.829	-9.1521	7.3310
helim	0.8856	1.4619	0.61	0.545	-1.9797	3.7509
aelim	-1.4012	2.1138	-0.66	0.507	-5.5442	2.7419
hclinch*PSPred	-0.1051	0.3270	-0.32	0.748	-0.7461	0.5358
aclinch*PSPred	0.5028	0.6518	0.77	0.441	-0.7748	1.7804
helim*PSPred	-0.4455	0.4014	-1.11	0.267	-1.2322	0.3413
aelim*PSPred	0.1599	0.2949	0.54	0.588	-0.4181	0.7378
_constant	-0.0804	0.2069	-0.39	0.698	-0.4860	0.3252
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	1.1167	0.0795	14.05	0.000	1.0776	1.3892
hclinch	0.8294	5.8705	0.14	0.888	-10.6765	12.3354
aclinch	-15.6797	9.2674	-1.69	0.091	-33.8435	2.4841
helim	1.1382	4.2062	0.27	0.787	-7.1059	9.3823
aelim	-3.2989	8.3441	-0.40	0.693	-19.6532	13.0553
hclinch*DPPred	0.0036	0.4236	0.01	0.993	-0.8267	0.8338
aclinch*DPPred	0.1640	0.7365	0.22	0.824	-1.2796	1.6076
helim*DPPred	-0.1180	0.3179	-0.37	0.710	-0.7410	0.5050
aelim*DPPred	-0.3248	0.7596	-0.43	0.669	-1.8137	1.1641
_constant	0.9957	0.8011	1.24	0.214	-0.5745	2.5659

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.20 2008 Seeminging Unrelated Regression						
Equation	**Observations**	**Parameters**	**RMSE**	**R^2**	**χ2**	
Point Spread	256	9	2.7442	0.7966	1004.48	
Difference in Points	256	9	12.1334	0.3693	149.51	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	0.9525	0.0358	26.61	0.000	0.9298	1.0702
hclinch	1.4963	15.4345	0.10	0.923	-28.7548	31.7475
aclinch	0.5436	8.8292	0.06	0.951	-16.7614	17.8486
helim	2.6925	0.8593	3.13	0.002	1.0084	4.3766
aelim	-2.3075	1.7060	-1.35	0.176	-5.6512	1.0362
hclinch*PSPred	0.2081	3.0623	0.07	0.946	-5.7939	6.2101
aclinch*PSPred	-0.4396	4.4169	-0.10	0.921	-9.0966	8.2174
helim*PSPred	-0.0007	0.1314	-0.01	0.996	-0.2582	0.2569
aelim*PSPred	0.0022	0.1446	0.02	0.988	-0.2811	0.2856
_constant	-0.2131	0.2006	-1.06	0.288	-0.6061	0.1800
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	1.0301	0.0965	10.68	0.000	0.8712	1.2494
hclinch	-9.5221	18.6606	-0.51	0.610	-46.0962	27.0519
aclinch	-4.9883	11.3941	-0.44	0.662	-27.3205	17.3438
helim	-1.7552	4.0253	-0.44	0.663	-9.6446	6.1343
aelim	0.6060	4.2290	0.14	0.886	-7.6826	8.8946
hclinch*DPPred	-0.6603	2.1827	-0.30	0.762	-4.9382	3.6177
aclinch*DPPred	-1.3442	3.0084	-0.45	0.655	-7.2406	4.5523
helim*DPPred	0.0767	0.5906	0.13	0.897	-1.0809	1.2342
aelim*DPPred	-0.0550	0.4130	-0.13	0.894	-0.8645	0.7545
_constant	0.3697	0.8160	0.45	0.651	-1.2297	1.9690

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.21 2009 Seeminging Unrelated Regression						
Equation	**Observations**	**Parameters**	**RMSE**	**R^2**	**χ2**	
Point Spread	256	9	2.6576	0.8649	1652.41	
Difference in Points	256	9	12.4752	0.4248	191.04	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	1.0232	0.0262	39.02	0.000	0.9949	1.0977
hclinch	-4.0310	2.3182	-1.74	0.082	-8.5746	0.5126
aclinch	-3.1985	3.4912	-0.92	0.360	-10.0412	3.6441
helim	0.3270	1.6992	0.19	0.847	-3.0035	3.6574
aelim	-1.1747	1.0765	-1.09	0.275	-3.2846	0.9353
hclinch*PSPred	-0.4463	0.3410	-1.31	0.191	-1.1147	0.2220
aclinch*PSPred	-0.8647	1.3653	-0.63	0.526	-3.5406	1.8112
helim*PSPred	-0.0472	0.2429	-0.19	0.846	-0.5233	0.4290
aelim*PSPred	-0.0669	0.1179	-0.57	0.570	-0.2980	0.1642
_constant	0.3010	0.1923	1.57	0.117	-0.0758	0.6779
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	0.9919	0.0869	11.41	0.000	0.8296	1.1704
hclinch	8.5914	9.8109	0.88	0.381	-10.6376	27.8203
aclinch	-12.8770	64.6839	-0.20	0.842	-139.6551	113.9010
helim	-5.9557	6.2518	-0.95	0.341	-18.2089	6.2976
aelim	10.4106	4.6584	2.23	0.025	1.2803	19.5409
hclinch*DPPred	0.4849	0.9708	0.50	0.617	-1.4179	2.3876
aclinch*DPPred	1.3715	9.1549	0.15	0.881	-16.5718	19.3148
helim*DPPred	-0.1413	0.5077	-0.28	0.781	-1.1364	0.8538
aelim*DPPred	0.8140	0.3343	2.43	0.015	0.1587	1.4693
_constant	0.3090	0.9175	0.34	0.736	-1.4893	2.1073

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Table A.22
2010 Seeminging Unrelated Regression

Equation	Observations	Parameters	RMSE	R^2	$\chi 2$	
Point Spread	256	9	2.602349	0.7693	862.08	
Difference in Points	256	9	12.21064	0.3359	130.23	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1]**	
					Lower Bound	**Upper Bound**
PSPred	0.9888	0.0321	30.80	0.000	0.9371	1.0629
hclinch	-1.0154	4.7359	-0.21	0.830	-10.2976	8.2669
aclinch	-0.3545	2.9766	-0.12	0.905	-6.1885	5.4795
helim	1.4179	0.9145	1.55	0.121	-0.3744	3.2103
aelim	-0.8418	1.4168	-0.59	0.552	-3.6186	1.9350
hclinch*PSPred	-0.2532	0.6186	-0.41	0.682	-1.4656	0.9593
aclinch*PSPred	0.2879	0.5336	0.54	0.589	-0.7579	1.3337
helim*PSPred	-0.2325	0.1937	-1.20	0.230	-0.6121	0.1471
aelim*PSPred	0.0343	0.2730	0.13	0.900	-0.5008	0.5694
_constant	-0.0201	0.1845	-0.11	0.913	-0.3817	0.3416
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
DPPred	0.9574	0.1092	8.76	0.000	0.7859	1.2141
hclinch	11.5269	10.5654	1.09	0.275	-9.1808	32.2347
aclinch	5.9032	13.3344	0.44	0.658	-20.2317	32.0381
helim	-2.6825	2.4574	-1.09	0.275	-7.4989	2.1339
aelim	-2.1219	3.4802	-0.61	0.542	-8.9430	4.6992
hclinch*DPPred	0.8729	1.1356	0.77	0.442	-1.3529	3.0986
aclinch*DPPred	0.3933	1.0500	0.37	0.708	-1.6647	2.4513
helim*DPPred	0.2920	0.3695	0.79	0.429	-0.4321	1.0161
aelim*DPPred	-0.0966	0.3459	-0.28	0.780	-0.7746	0.5814
_constant	-0.1072	0.8810	-0.12	0.903	-1.8340	1.6196

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1

Additional summary statistics concerning shifted confidence intervals:

Table A.23 presents shifted confidence intervals for *PSPred* and *DPPred*. Due to the effect of the generated regressor (attenuation bias), theses coefficients will tend towards zero. Shifting these confidence intervals to be centered around one allows for the calculation of a percentage bias associated with each estimate.

Table A.23

Shifted confidence intervals and their percentage difference from *PSPred* and *DPPred*

Season	PSPred	Difference from 1	New Lower Bound	New Upper Bound	Lower Bound Percentage of PSPred	Upper Bound Percentage of PSPred
2000	0.9818	0.0182	0.9422	1.0578	96.0%	107.7%
2001	0.9868	0.0132	0.9371	1.0629	95.0%	107.7%
2002	0.9910	0.0090	0.9410	1.0590	95.0%	106.9%
2003	0.9923	0.0077	0.9438	1.0562	95.1%	106.4%
2004	1.0088	0.0088	0.9519	1.0832	94.4%	107.4%
2005	0.9834	0.0166	0.9366	1.0634	95.2%	108.1%
2006	1.0384	0.0384	1.0189	1.1346	98.1%	109.3%
2007	0.9731	0.0269	0.9257	1.0743	95.1%	110.4%
2008	0.9525	0.0475	0.9298	1.0702	97.6%	112.4%
2009	1.0232	0.0232	0.9949	1.0977	97.2%	107.3%
2010	0.9888	0.0112	0.9371	1.0629	94.8%	107.5%
Total	0.9935	0.0065	0.9798	1.0202	98.6%	102.7%
Season	**DPPred**	**Difference from 1**	**New Lower Bound**	**New Upper Bound**	**Lower Bound Percentage of DPPred**	**Upper Bound Percentage of DPPred**
2000	0.9668	0.0332	0.8375	1.1625	86.6%	120.2%
2001	0.9616	0.0384	0.7951	1.2049	82.7%	125.3%
2002	0.9873	0.0127	0.7725	1.2275	78.2%	124.3%
2003	0.9303	0.0697	0.7851	1.2149	84.4%	130.6%
2004	1.0705	0.0705	0.9719	1.3101	90.8%	122.4%
2005	1.0361	0.0361	0.9048	1.2398	87.3%	119.7%
2006	1.0836	0.0836	0.9441	1.3904	87.1%	128.3%
2007	1.1167	0.1167	1.0776	1.3892	96.5%	124.4%
2008	1.0301	0.0301	0.8712	1.2494	84.6%	121.3%
2009	0.9919	0.0081	0.8296	1.1704	83.6%	118.0%
2010	0.9574	0.0426	0.7859	1.2141	82.1%	126.8%
Total	1.0091	0.0091	0.9631	1.0734	95.4%	106.4%

Seemingly Unrelated Regression for total data set without interaction terms:

Table A.24 presents results for the Seemingly Unrelated Regression for the total data set without interaction terms. This is useful to confirm the parameter *PSPred* slightly underpredicts the actual point spread, while *DPPred* slightly overpredicts the actual difference in points.

Table A.24

2010 Seeminging Unrelated Regression

Equation	**Observations**	**Parameters**	**RMSE**	**R^2**	**χ2**	
Point Spread	2,800	5	2.6684	0.7983	11110.16	
Difference in Points	2,800	5	11.9292	0.3542	1537.35	
Point Spread	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval[1] Lower Bound**	**Upper Bound**
PSPred	0.9869	0.0100	98.53	0.000	0.9804	1.0196
hclinch	0.1860	0.2762	0.67	0.501	-0.3553	0.7274
aclinch	-0.2879	0.2878	-1.00	0.317	-0.8520	0.2762
helim	1.0708	0.2245	4.77	0.000	0.6308	1.5108
aelim	-1.0736	0.2163	-4.96	0.000	-1.4975	-0.6497
_constant	-0.0235	0.0599	-0.39	0.695	-0.1409	0.0939
Difference in Points	**Observed Coefficient**	**Bootstrap Std. Err.**	**Z-stat**	**P>|z|**	**95% Confidence Interval Lower Bound**	**Upper Bound**
DPPred	1.0239	0.0270	37.86	0.000	0.9470	1.0530
hclinch	1.4239	1.2359	1.15	0.249	-0.9984	3.8461
aclinch	-4.7383	1.2902	-3.67	0.000	-7.2670	-2.2095
helim	-0.6055	1.0018	-0.60	0.546	-2.5690	1.3579
aelim	0.1184	0.9674	0.12	0.903	-1.7777	2.0144
_constant	0.1991	0.2519	0.79	0.429	-0.2947	0.6929

[1]Confidence intervals pertaining to *PSPred* and *DPPred* are shifted to be centered around 1