Do Gamblers Think That Teams Tank? Evidence from the NBA

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Abstract

A growing body of literature indicates that sports teams face incentives to lose games at the end of the season. This incentive arises from league entry draft policy. We use data from betting markets to confirm the existence of tanking, or the perception of tanking, in the NBA. Results from a SUR model of point spreads and point differences in NBA games indicate that betting markets believe that tanking takes place in the NBA, even though the evidence that tanking actually exists is mixed. NBA policy changes also affect betting market outcomes.

Keywords: Incentives, betting markets, tanking

JEL Codes: : L83, D49

Introduction

Prediction markets, like sports betting markets, efficiently aggregate information in order to provide highly accurate forecasts of future outcomes. In betting markets, prices – point spreads or money line odds – take into account all relevant information related to games and provide a market-based forecast of game outcomes. In some cases, prices set in gambling markets may reflect negative or even illegal activities associated with sporting events. Forrest and Simmons (2003) point out that the existence of gambling markets makes it easier to detect undesirable behavior, like match fixing, that might otherwise go undetected. Wolfers (2006) developed evidence from point spread

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betting indicating that as many as one in every fifty NCAA men's basketball games involved illegal "point shaving." Larsen, Price, and Wolfers (2008) explore the idea that betting markets contain information about referees' racial biases. In this paper we examine point spreads for games in the National Basketball Association (NBA) for evidence that betting markets believe that NBA teams intentionally lose games at the end of the season in order to obtain a higher pick in the subsequent NBA entry draft; a behavior called "tanking" in the popular press.

Tanking appears to be a problem in some professional sports leagues that use reverse order entry drafts to allocate new talent to teams. in this sense, tanking occurs because of league policy decisions. In many North American professional sports leagues, picks in the amateur entry draft are awarded based on performance in the previous season, creating an incentive for teams to intentionally lose games late in the regular season in order to receive a higher draft pick (Preston & Szymanski, 2003). In response to the perception that tanking took place, the National Basketball Association (NBA) and National Hockey League (NHL) altered their draft formats on several occasions in an effort to deter teams from tanking and decrease the public perception that teams intentionally lost games.

Tanking affects betting markets in ways similar to match fixing. A front office executive for the Australian Rules Football League (AFL) commented on the relationship between the perception of tanking in that league and betting on AFL matches: "We want a clean and proper competition. And now that there is official betting on AFL games, the sport must be seen as clean - very clean" (Rucci, 2007, n.p.). In October 2009, the Minister of Gaming in Victoria, Australia, launched an investigation into the possibility that AFL teams were tanking the potential effect that tanking would have on the gambling revenue generated from AFL games (Dowling, 2009).

Tanking could also have a detrimental effect on bookmakers and government sponsored sports betting, which takes place in Canada. If some bettors have information about potential tanking, an "inefficiency" exists and informed bettors can earn rents from the information. This hurts bookmakers financially because they might not have enough money to pay the winners from the loser's pool. Also, bookmakers will be reluctant to set point spreads (or money lines) for games in which tanking could occur because the loss of uncertainty of game outcome harms their ability to select a proper point spread. If the uncertainty of game outcome is threatened, this affects the efficiency of betting markets, the revenue generated for bookmakers, the league, and in some cases governments. In the case of the NHL and NBA, the league has intervened and made adjustments to its draft format while in AFL, the government has investigated the consequences of tanking.

This research examines gambling market outcomes for evidence that bookmakers and bettors believed that tanking occurred in NBA regular season games from the 2003-2004 through 2008-2009 seasons. History indicates that tanking may be a persistent problem in the NBA. The NBA was the first professional league to alter its draft format in response to perceptions of tanking. Taylor and Trogdon (2002) concluded that NBA teams were tanking under certain draft formats because of the incentive created by the league through its policies. Price, Soebbing, Berri, and Humphreys (2010) found that as the league provided additional incentives for teams to tank, in the form of changes in the allocation of entry draft picks and rookie salary caps, NBA teams responded to that incentive. During the 2003-2004 through 2008-2009 seasons, there was significant debate in the popular press about the possibility of some NBA teams tanking late in the season (Soebbing & Mason, 2009). One such example occurred in the 2006-2007 season, when an article in the *Las Vegas Review-Journal* stated that handicappers could detect tanking by certain teams late in the regular season. According to a prominent handicapper, "it was very apparent to the betting public that those teams were tanking games" (Youmans, 2007, n. p.).

We develop evidence that betting markets believe that teams tank and the point spreads on these games change systematically between 1 and 4 points. In addition, we examine the extent to which the type of opponent (conference or non-conference) faced in a game when tanking may occur affects point spreads. The results indicate that, in some instances, tanking against a conference foe affects the point spread more than tanking against a non-conference opponent. Our finding that prices set in betting markets reflect tanking strengthens the argument that tanking is a real economic phenomena, and not just a statistical artifact, and also reinforces the point that league policies have important economic consequences.

Sports Betting Markets

Two basic types of bets exist on the winner of an individual sports contest, money line bets and point spread bets. Money line betting prevails in sports such as hockey, baseball, and European football where little scoring occurs. Point spread betting is common in professional and college football and basketball where more scoring occurs. In point spread betting, the bets are based on the score difference in the game, not on the winner and loser. Bets on the favored team pay off if the favorite "covers" the point spread by winning by a margin larger than the point spread. Point spreads can be interpreted as the price a bettor must pay for a contingent claim on a given amount of money wagered on the outcome of a game. When the point spread is an integer and the difference in points scored by teams in the game is equal to the point spread, the game is a "push" and all money is returned to the bettors. Although point spreads can change as new information becomes available, all point spread bets are evaluated at the point spread posted by the book maker when the bet was made.

Point spreads are set by bookmakers. Bookmakers maximize profit by collecting money from losing bets and paying off winning bets. A book maker's profit margin is called "vigorish" or the "vig" in point spread betting. To illustrate the vig and profit in point spread betting, consider what happens when $100 is wagered on a favored team to win a game and $100 is also wagered on the underdog to "cover" when the point spread is 6 points. The book maker collects $220: $110 to win $100 from the bettor wagering on the favorite and $110 to win $100 from the bettor wagering on the underdog. If the favorite wins by 6 or more points, the book maker pays the bettor who wagered on the favorite $210 and keeps $10 in profit. If the underdog wins, or loses by 5 or fewer points, the book maker pays $210 to the bettor who wagered on the underdog and keeps $10 in profit.

Book makers set point spreads to maximize profits. The book maker can earn a certain profit, determined by the commission, by setting point spreads to equalize the dollars wagered on each team. Point spreads also accurately predict outcomes of games, suggesting that point spreads reflect all available information about a given game. This property has been investigated extensively in the literature, and has important implications for the efficiency of sports betting markets (Sauer, 1998). Research on point spread markets indicate that point spreads almost always predict game outcomes, and that instances where they do not are infrequent enough to reject the hypothesis of market efficiently. In the context of the betting market efficiency literature, tanking is a fundamental factor affecting game outcomes, and we look for evidence that this fundamental is priced in sports betting markets.

Tanking in the NBA

Tanking occurs when teams intentionally lose games. Tanking has been a concern in the NBA since the early 1980s, when accusations of teams intentionally losing regular season games first appeared in media reports. The benefit from tanking comes from the opportunity to move up in the following entry draft to acquire better players, leading to additional wins and revenues in future seasons (Price, et al, 2010). This behavior is problematic from the standpoint of the league because it decreases the uncertainty of game outcomes as well as year to year league competitive balance. As a result, the NBA strategically altered league policy, in terms of its draft format, three times over the last twenty-five years to deter tanking, or reduce he perception that tanking takes place.

In the early 1980s, the NBA used the traditional reverse order entry draft format. Under this format, the teams with the worst record in each conference would flip a coin to determine which team received the number one overall selection in he next entry draft. Based on concerns that teams were tanking late in the regular season to receive a 50-50 chance at the number one overall selection, the NBA altered its policy, beginning with the 1984-1985 season, to give all non-playoff teams an equal probability of receiving the number one overall selection in the next entry draft. This equal probability draft format displeased some owners who believed that it did not help the worst teams in the league to improve, thus affecting competitive balance. As a result, beginning with the 1989-1990 season, the NBA adopted a weighted lottery format that gave the worst teams in the league a higher probability of receiving the number one overall selection in the following entry draft. In 1993-1994 season, the NBA adjusted those probabilities to give the worst teams an even higher probability of receiving the number one overall selection in the draft.

Two previous papers examined how these changes in draft policy affected teams' effort late in the regular season. Taylor and Trogdon (2002) examined tanking in the NBA under the first three draft formats: the traditional reverse order draft, the equal probability draft, and the first weighted lottery draft. Taylor and Trogdon (2002) found evidence that teams tanked late in the regular season under the reverse order draft format and the weighted lottery draft format. These two draft formats explicitly rewarded teams for losing when compared to the equal probability lottery, which did not provide a strong incentive for teams to intentionally lose games late in the regular season.

Price et al (2010) extended Taylor and Trogdon's (2002) research by including all regular season games in the 1977-1978 through 2007-2008 seasons, a period containing all entry draft formats used by the NBA. Their results showed that NBA teams responded to increasing incentives to tank by engaging in this behavior more frequently. Research on tanking in other sports, including the NCAA Men's College Basketball tournament (Balsdon, Fong, & Thayer, 2007) and Australian Rules Football (Borland, Chieu, & Macdonald, 2009), contains mixed evidence that teams tank, perhaps because of weaker incentives in those leagues.

This paper assumes that tanking exists, and looks for evidence that betting markets behave as if book makers and bettors believe that tanking takes place. Again, we assume that tanking can be thought of as an unobserved fundamental in the NBA betting market, much like Brown and Sauer (1993b), who identified factors like match up problems, changes in the composition of teams from season to season, and injuries to star players as important unobservable fundamentals affecting betting markets.

Data

We analyze point spreads, game outcomes, and game characteristics data from 7,339 regular season NBA games from the 2003-2004 through 2007-2008 regular seasons. The point spread data come from Sports Insights, a subscription service that provides data from betting markets. Game characteristics data were collected from multiple sources including ESPN and DatabaseBasketball (http://www.databasebasketball.com). We calculated the point at which teams clinched playoff berths or were eliminated from playoff contention by hand for each NBA season, based on the standard "magic number" formula. Table 1 contains summary statistics for the sample.

7,339 regular season games were played in the NBA over the sample period. The mean final point spread, expressed as favored home teams minus points and underdog home teams plus points, was -3.42 which means that the average home team was just under a 3.5 point favorite during the sample period. The mean difference in points scored was -3.29 meaning that the home team won by just more than 3 points on average. Note that the variance of the difference in points scored exceeds the variance of the point spread by a significant amount. Actual game outcomes are much more variable than point spreads, even though point spreads are good predictors of game outcomes.

Table 1: Summary Statistics (N=7,339)

Variable	Mean	Std. Dev	Min	Max	Skewness
Final Point spread	-3.42	6.04	-22.5	17	0.29
Difference in Points	-3.29	12.71	-52	50	0.05
Forecast Error	0.13	11.35	-46.5	46.5	-0.03
Total Points Scored	195.46	21.27	124	318	0.37
Home Team Covered	0.48	0.50	0	1	0.07
Away Team Clinch	0.06	0.23	0	1	—-
Home Team Clinch	0.06	0.23	0	1	—-
Away Team Elim.	0.05	0.21	0	1	—-
Home Team Elim.	0.05	0.21	0	1	—-

This feature also occurs in other betting markets. The forecast error shows that on average, the visiting team performed slightly better than predicted by the final point spread. The average total combined points scored by the two opposing teams in a game was 195. The home team covered, or won by more than the point spread if favored and lost by less than the point spread if not favored, in 48 percent of the games in the sample. A value of zero for the skewness statistic indicates a normally distributed variable.

The last four variables show the percentage of games in the sample in which the home and visiting team had already clinched a postseason appearance or had been eliminated from playoff contention. We identified the teams that had clinched playoff appearances or been eliminated from playoff contention using the standard "magic number" formula. The skewness statistic indicates variables with a large amount of probability mass in one tail. Skewness statistics cannot be applied to dichotomous variables. the last four variables identify teams with an incentive to tank late in the regular season. Teams who have been eliminated from playoff contention have a reduced incentive to win games, and an increased incentive to lose because losses improve their probability of getting the first pick in the next entry draft. in the next section, we perform formal tests of the importance of tanking in determining both game outcomes and point spreads.

Empirical Analysis

To examine the effect of tanking on point spreads in NBA games, we use a SUR regression model similar to the one used by Brown and Sauer (1993a) to analyze the relationship between game outcomes and point spreads in the NBA. Brown and Sauer (1993a) model the determination of point spreads as a function of team strengths and other fundamental factors that affect point spreads in a two equation seemingly unrelated regression model. The point spread equation is

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

where s indexes seasons, t indexes games, h indexes home teams and a indexes away teams. α_{ps} captures home court advantage built into NBA point spreads. HT_{hgs} is a vector of indicator variables that capture the ability or strength of the home team in game g in season s. AT_{ags} is a vector of indicator variables that capture the ability or strength of the away team in game g in season s. $hclinch_{hgs}$, $aclinch_{ags}$, $helim_{hgs}$, and $aelim_{ags}$ are indicator variables identifying home or away teams that already clinched (*clinch*) a postseason spot or were already eliminated (*elim*) from postseason contention before game g in season s. ϵ_{hags}^{ps} is the equation error term capturing all other factors that affect point spreads for regular season NBA games. We assume that ϵ_{hags} is identically and independently distributed with mean zero and constant variance σ_ϵ^2. α_{ps}, θ_a^{ps}, θ_h^{ps}, β_1, β_2, β_3, and β_4 are unknown parameters to be estimated.

The parameters β_3, and β_4 will reflect the extent to which betting market participants believe that tanking takes place in the NBA. The only teams with a clear incentive to lose games to improve their position in the next entry draft are teams who have been eliminated from playoff contention. A team still in contention for a playoff spot will still have an incentive to win games, as the financial pay off from playoff appearances, in terms of additional home games and television appearances, is large. β_3, and β_4 will capture any systematic variation in point spreads for games involving teams who have an incentive to tank. If these parameters are different from zero, then some evidence that participants in betting markets believe that tanking takes place exists.

Brown and Sauer (1993a) also model the determination of game outcomes, in this context the difference in points scored, in a similar fashion

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

In equation 2, the game outcome equation, s, t, h and a and the explanatory variables are defined as in equation 1. α_{dp} captures the actual home court advantage in NBA games. ϵ_{hags}^{dp} is the equation error term capturing all other factors that affect point spreads for regular season NBA games. We assume that ϵ_{hags} is identically and independently distributed with mean zero and constant variance σ_ϵ^2. α_{dp}, θ_a^{ps}, θ_h^{ps}, β_1, β_2, β_3, and β_4 are unknown parameters to be estimated.

The parameters γ_3, and γ_4 reflect the extent to which taking occurs in the NBA. The only teams with a clear incentive to lose games to improve their position in the next entry draft are teams who have been eliminated from playoff contention. β_3, and β_4 will capture any systematic variation in game outcomes for games involving teams who have an incentive to tank. If these parameters are different from zero, then some evidence that NBA teams tanking late in the regular season.

Like Brown and Sauer (1993a), we estimate equations 1 and 2 using Seeming Unrelated Regression (SUR) technique using GLS to control for any heteroscedasticity in the equation error terms. We estimate equation 1 separately for each season in the sample, in order to control for year to year variation in team quality due to personnel and management changes. An alternative approach would be to pool games across seasons and add season-specific indicator variables. However, this would force the team quality indicators to be equal across seasons. The GLS approach also accounts for any correlation between the equation error terms, ϵ_{hags}^{ps} and ϵ_{hags}^{dp}.

Results and Discussion

Table 2 contains estimates of the home and away team ability index parameters, θ_a, θ_h in equations 1 and 2.[1] The parameter estimates capture the ability of each team in that season relative to the omitted team, the Atlanta Hawks. In 2004-2005, the Hawks were the worst team in the NBA, recording only 13 victories in the regular season. Recall that point spreads are expressed as home team minus the point spread when the home team is favored and plus the point spread when the

[1]The results for other seasons are available upon request. In addition, the Oklahoma City Thunder encompasses both the current Oklahoma City team and the old Seattle Supersonics team who relocated in Oklahoma City for the 2008-2009 season.

home team is the underdog. The estimated parameters on the home ability indicators are negative and generally significant, indicating that home teams were, on average, favored and stronger at home than the Hawks, although the Bobcats were not significantly stronger than the Hawks, based on the t-statistics on Table 2.[2] The away ability indexes are positive and generally significant, indicating that the away teams in the league were, on average, underdogs in games and stronger on the road than the Hawks. Brown and Sauer (1993b) point out that these estimates, combined with the estimated home court advantage, $\hat{\alpha}$, can be used to create a predicted point spread for any NBA game in the 2004-2005 NBA season.

Table 2: Home and Away Ability Index, 2004-2005 Season

	Point Spread Model				Game Outcome Model			
	Home Ability		Away Ability		Home Ability		Away Ability	
Franchise Name	Coef.	Z-stat	Coef.	Z-stat	Coef.	Z-stat	Coef.	Z-stat
Boston Celtics	-7.99	-12.10	7.41	11.29	-9.42	-3.94	9.71	4.09
Charlotte Bobcats	-1.09	-1.68	0.47	0.72	-4.64	-1.97	2.17	0.92
Chicago Bulls	-5.75	-8.68	5.01	7.63	-9.96	-4.16	10.10	4.25
Cleveland Cavaliers	-10.28	-15.53	7.97	12.16	-12.43	-5.19	6.44	2.71
Dallas Mavericks	-13.42	-20.22	12.76	19.34	-13.64	-5.68	17.09	7.15
Denver Nuggets	-10.34	-15.60	7.57	11.50	-13.83	-5.76	9.35	3.92
Detroit Pistons	-12.17	-18.42	11.48	17.46	-11.94	-5.00	13.51	5.68
Golden State Warriors	-6.59	-10.07	4.66	7.14	-7.72	-3.26	7.47	3.16
Houston Rockets	-10.28	-15.49	9.95	15.10	-11.60	-4.83	14.75	6.19
Indiana Pacers	-7.10	-10.74	6.43	9.81	-8.72	-3.64	10.70	4.51
Los Angeles Clippers	-8.07	-12.28	5.92	9.04	-10.68	-4.49	7.12	3.01
Los Angeles Lakers	-7.78	-11.81	6.31	9.63	-8.34	-3.50	5.41	2.28
Memphis Grizzlies	-10.57	-15.94	8.53	12.96	-10.87	-4.53	12.82	5.38
Miami Heat	-12.27	-18.52	12.56	19.04	-14.73	-6.15	15.36	6.44
Milwaukee Bucks	-6.68	-10.17	5.02	7.71	-9.56	-4.02	3.05	1.30
Minnesota Timberwolves	-10.86	-16.35	11.24	17.10	-9.64	-4.01	11.87	4.99
New Jersey Nets	-5.97	-9.05	4.97	7.60	-6.77	-2.84	7.96	3.36
New Orleans Hornets	-2.56	-3.92	1.20	1.84	-2.31	-0.98	4.07	1.73
New York Knickerbockers	-7.14	-10.86	5.16	7.92	-7.36	-3.09	5.46	2.32
Oklahoma City Thunder	-11.15	-16.82	9.36	14.20	-11.28	-4.70	13.01	5.45
Orlando Magic	-8.14	-12.33	6.33	9.69	-7.34	-3.07	5.78	2.45
Philadelphia 76ers	-7.97	-12.04	6.61	10.08	-7.41	-3.09	8.91	3.76
Phoenix Suns	-14.15	-21.22	14.88	22.54	-14.71	-6.10	17.74	7.42
Portland Trail Blazers	-6.28	-9.61	5.27	8.07	-5.35	-2.26	6.46	2.74
Sacramento Kings	-12.13	-18.34	10.30	15.65	-13.82	-5.77	9.93	4.17
San Antonio Spurs	-15.50	-23.30	15.33	23.05	-18.69	-7.77	16.09	6.69
Toronto Raptors	-5.60	-8.53	4.84	7.40	-6.87	-2.89	7.80	3.30
Utah Jazz	-7.24	-11.09	4.92	7.55	-6.42	-2.72	4.84	2.05
Washington Wizards	-8.68	-13.15	5.69	8.69	-10.60	-4.44	6.48	2.73

The parameters of interest are those on the indicator variables for teams that had clinched playoff sports or been eliminated from the playoffs at game time in the SUR model. Table 3 reports the SUR parameter estimates and P-values on each of the playoff clinch and elimination indicator variables for each season in the sample for the point spread equation, equation 1, and the game

[2] For the 2004-2005 season, the Charlotte Bobcats were an expansion team.

outcome equation, equation 2. The point spread equation explains between 75 and 82 percent of the observed variation in point spreads in each of the seasons, while the game outcome equation explains much less of the observed variation in points scored. This is not surprising, given that point differences are much more variable than point spreads. The parameter on the indicator variables for teams that had clinched playoff berths before the game was played in the point spread model are only occasionally significant, in 2003 for home teams, and in 2005 and 2008 for away teams. Point spreads for games involving teams that have clinched a playoff berth are not often different from point spreads for games not involving playoff bound teams, holding the relative quality of the teams involved constant. The estimated parameters on the indicator variables for games involving teams that have already been eliminated from playoff contention are all statistically significant.

The estimated parameters for home teams that have been eliminated are positive and significant, suggesting that home teams that have been eliminated from playoff contention are not favored by as much as teams that have not been eliminated from playoff contention, holding the relative quality of the teams involved constant. The estimated parameters for away teams that have been eliminated are negative and significant in the point spread model, suggesting that home teams playing opponents who have been eliminated from playoff contention are favored by more than home teams playing opponents that have not been eliminated from playoff contention, holding the relative quality of the teams involved constant. This is evidence that book makers and bettors believe that NBA teams are tanking. Home teams that have been eliminated from playoff contention could be planing to tank, and these teams are not favored in betting markets by as much as teams with no incentive to tank. Visiting teams that have been eliminated from playoff contention also have an incentive to tank, and these teams are bigger underdogs than visiting teams that have no incentive to tank. The point spreads for games involving teams with an incentive to tank differ systematically from the point spreads for games involving teams with no incentive to tank, and the point spread adjustment is consistent with the idea that betting markets expect teams with an incentive to tank to put forth less effort in the game.

The evidence that tanking actually occurs in the NBA is not strong, based on the results from the game outcome equation. The estimated parameters for away teams that have been eliminated are not statistically different from zero in any of the six seasons in the game outcome equation, suggesting that home teams playing opponents who have been eliminated from playoff contention do not outscore their opponents by more than would be expected, holding the relative quality of the teams involved constant. The estimated parameters for home teams that have been eliminated are not statistically different from zero in five of the six seasons in the game outcome model. Despite the fact that betting markets believe in tanking, little evidence of tanking can be found in the game outcome model. Recall that both Taylor and Trogdon (2002) and Price et al (2010) found evidence of tanking in the NBA. These papers estimated the probability that a team would win a given game, not the difference in points scored, a different approach to detecting tanking. Point differences on NBA games exhibit a great deal of variability, much more than point spreads, making it difficult to detect tanking in point differences. In addition, tanking requires only that a team loses a game, not that the team gets blown out; this makes tests based in the conditional probability of winning a game better suited to detecting tanking than tests based on the conditional analysis of the difference in points scored.

Some interesting patterns also emerge when the events surrounding some of the seasons in the sample is considered. For example, during the 2006-2007 season, one newspaper reported that the season was unusual from a tanking standpoint, going as far as to suggest that fans thought that games could be fixed (Youmans, 2007). Price et al (2010) did not find evidence that tanking took place in this season. From Table 3, the size of the estimated parameters on the elimination indicator variables from the 2006-2007 season are larger in the higher those for the 2005-2006 season; the size of the parameter on the away team being eliminated doubles from 2005-2006 to 2006-2007. The point spread adjustment for tanking was larger, suggesting that betting markets believed tanking was more likely in 2006-2007. This pattern is consistent with a newspaper reporter believing that tanking was worse in 2006-2007 than in the previous season. Interestingly, the estimated parameters on the elimination variables for the 2007-2008 season indicate that the point spread adjustment for tanking was even larger in 2007-2008 then in the previous two seasons. This could be due to variation in the quality of players available in the upcoming entry draft. Price et al (2010) point out that the incentive to tank may vary with expectations about the potential new entrants available in the draft. The top three picks in the 2007 draft were Greg Oden, Kevin Durant, and Al Horford. The top 3 picks in the 2008 NBA Draft featured players such as Derrick Rose (the number one pick), Michael Beasley, and O.J. Mayo. If the 2008 class was perceived as stronger at the end of the 2007-2008 NBA season, then book makers and bettors might expect that the incentive to tank was greater, and adjust point spreads accordingly. This period corresponds to the first two years that the NBA adopted a minimal age requirement for draft entrants. Previously, a player could be drafted straight from high school. The rule currently states that a players must be one year removed from high school in order to be eligible for the NBA draft. This extra year may provide teams with a better indication of player talent and how the player projects as player in the NBA.

Table 3: SUR Results by Season

Variable	2003	2004	2005	2006	2007	2008
			Point Spread Model			
Home Clinch	-0.961	0.051	0.585	-0.550	-0.113	0.695
	0.013	0.913	0.151	0.173	0.804	0.092
Away Clinch	0.347	-0.810	-1.134	0.593	-0.868	-0.847
	0.396	0.077	0.003	0.152	0.069	0.038
Home Eliminated	2.888	1.341	1.721	2.593	4.021	1.190
	<0.001	0.003	<0.001	<0.001	<0.001	0.003
Away Eliminated	-1.380	-0.976	-1.824	-2.173	-3.713	-1.365
	0.011	0.036	<0.001	<0.001	<0.001	<0.001
α	-3.711	-2.255	-3.384	-2.676	-3.900	-5.072
	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
R^2	0.757	0.762	0.772	0.755	0.818	0.822
			Game Outcome Model			
Home Clinch	-1.840	-2.301	3.043	2.023	-1.660	2.770
	0.214	0.172	0.070	0.223	0.339	0.099
Away Clinch	-1.331	-4.762	-3.037	-0.474	-2.461	-4.261
	0.396	0.004	0.052	0.780	0.176	0.010
Home Eliminated	2.681	3.017	2.529	4.842	2.428	1.025
	0.198	0.069	0.205	0.022	0.135	0.523
Away Eliminated	2.204	-0.131	-0.434	-0.959	-0.193	-0.812
	0.290	0.938	0.830	0.656	0.901	0.597
α	-8.421	-2.402	-2.674	-5.549	-4.609	-4.953
	<0.001	0.320	0.282	0.030	0.065	0.045
R^2	0.239	0.247	0.203	0.203	0.330	0.284

We ran a number of robustness checks to test the strength of these results. The robustness checks focus on whether or not $helim_{hgs}$ and $aelim_{hgs}$ actually identify the perception or presence of tanking in the point spread model, or just reflect poor team performance at the end of the season and examine if the ability indexes estimated for the entire regular season represent an appropriate time frame to control for home and away team ability. Injuries, exhaustion, and player acquisions/releases over the course of a season could lead to significant changes in a team's ability, especially later in the season. Estimating team ability over the entire regular season assumes constant team ability. To address this issue, we estimated a separate model which allowed a team's ability to vary across groups of about 20 games. This model included the team fixed effects from the SUR model interacted with a vector of indicator variables for each 20 game period. The results from this regression were qualitatively similar to the results on Table 3 that assume constant team ability over the entire season. This suggests that the elimination variable captures tanking, and not just poor play at the end of the season.

The incentive for a team to tank might also change depending on the conference affiliation of the opposing team. Teams may be reluctant to tank in a game against a conference opponent, because conference opponents are bigger rivals, or because they play each other more frequently. To investigate this possibility, we estimated an alternative model that interacts the elimination indicator variables with an indicator variable for conference opponents. Table 4 shows the results for a this model. The home clinch variables are significant in 2003, 2006, and 2007. The away team clinch variables are significant in 2003 and 2006. Based on the estimated parameters on the elimination indicator variables interacted with the conference opponent indicator variable, the perception that tanking exists when eliminated home teams are playing non conference opponents, but not for games involving conference opponents. Eliminated away teams playing conference opponents did have a significant point spread adjustment of approximately 2.3 points to the home team.

The variable for when home team eliminated from playoff contention and playing a conference opponent is significant in 2003, 2004, and 2007. If the home team is eliminated and plays an opponent from the other conference, that parameter is significant in 2006 and 2007. If the away team is eliminated and plays against a team from the same conference, that parameter is significant in 2006 and 2007. For an eliminated visiting team who plays a team from the other conference, none of the seasons are significant.[3] These models explain between 75 and 82 percent of the observed variation.

Did point spreads vary systematically by the type of opponent? Under the current draft format there is no additional incentive for a team to tank against a conference opponent; under earlier draft formats the bottom two teams in each conference flipped a coin for the number one overall

[3]The parameter in the 2004 season has a p-value of 0.051.

Table 4: SUR Results with Elimination Interaction Term by Season

Variable	2003	2004	2005	2006	2007	2008
	Point Spread Model					
Home Clinch	-1.285	-0.513	-0.055	-0.940	-1.351	0.253
	0.001	0.255	0.884	0.019	0.003	0.523
Away Clinch	1.005	-0.306	-0.623	1.251	0.398	-0.449
	0.009	0.474	0.083	0.001	0.395	0.249
Home Eliminated*Conf Opponent	1.675	1.531	1.520	1.529	4.338	0.822
	0.049	0.045	0.067	0.117	<0.001	0.263
Away Eliminated*Conf Opponent	-2.022	-0.215	-1.533	-2.326	-4.616	-0.568
	0.034	0.768	0.125	0.029	<0.001	0.452
Home Eliminated*NonConf Opponent	1.445	-0.089	-0.026	2.969	2.465	0.953
	0.212	0.925	0.981	0.013	0.001	0.165
Away Eliminated*NonConf Opponent	-0.981	2.310	0.121	-1.461	-1.037	-1.097
	0.290	0.051	0.898	0.234	0.155	0.084
α	-3.385	-2.251	-3.448	-2.706	-3.937	-8.200
	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
R^2	0.753	0.762	0.769	0.751	0.807	0.820
	—	—	—	—	—	—
	Game Outcome Model					
Home Clinch	-2.051	-3.043	2.707	1.741	-1.880	2.746
	0.148	0.062	0.080	0.285	0.258	0.086
Away Clinch	-0.481	-3.680	-2.473	0.393	-1.922	-3.929
	0.744	0.017	0.093	0.803	0.267	0.012
Home Eliminated*Conf Opponent	-2.544	1.489	1.763	2.476	2.931	2.332
	0.431	0.590	0.604	0.533	0.395	0.432
Away Eliminated*Conf Opponent	4.132	0.386	0.274	1.123	-0.403	-3.985
	0.254	0.884	0.947	0.796	0.902	0.192
Home Eliminated*NonConf Opponent	1.827	0.722	1.524	12.602	2.337	-4.468
	0.678	0.833	0.728	0.010	0.381	0.107
Away Eliminated*NonConf Opponent	6.013	4.444	0.333	-10.860	0.308	-0.765
	0.088	0.299	0.931	0.030	0.909	0.765
α	-7.644	-1.984	-2.626	-5.243	-4.652	-4.930
	0.001	0.411	0.294	0.040	0.062	0.046
R^2	0.239	0.246	0.202	0.206	0.330	0.287
	—	—	—	—	—	—

selection. This format created an additional incentive to lose to a conference opponent, as the easiest way to improve draft position was to lose to conference opponents. The results from Table 4 show that when the eliminated home team plays a conference opponent, the point spread increases by 1.5 to 4.3 points depending on the season. Three of the six seasons are significant (2003, 2004, 2007). When facing non-conference opponents, the point spread increases between 2.5 and 3 points.

Eliminated road teams facing conference opponents increase the point spread between 2 and 4.5 points than road teams that had not been eliminated from playoff contention. This is significant in two of the six seasons. That could be due to a strong real or perceived home court advantage in the NBA. When facing non conference opponents, only one of the elimination indicators are significant. This would seem to give credence to the perception among bettors that conference games have additional benefit for a team who tanks late in the regular season. When examining the actual difference in points, only two of the parameters are significant. Both of these significant results occur in the 2006-2007 NBA.

Conclusion

This paper examines that participants in betting markets believe NBA teams tank late in the regular season. We examine both point spreads and differences in points scored in regular season NBA games from the 2003-2004 through 2008-2009 seasons. We find that the perception of tanking affects point spreads in games involving teams eliminated from playoff contention during these seasons, and it affects the point spread systematically based on the presence of a conference opponent in the game. Only an insider familiar with the strategies discussed and implemented by NBA teams out of contention late in the season can know with certainty if teams tank to improve their prospects in the entry draft. Previous evidence analyzed only game outcomes to assess the likelihood that teams tank. Our evidence indicates that participants in betting markets behave in a way consistent with the existence of tanking in NBA games late in the regular season, providing additional evidence that tanking actually takes place. The evidence that tanking takes place, based on the game outcome model, is weaker than the evidence that the betting market believes that tanking takes place. However, this result could be attributed to the fact that the difference in points is possibly the wrong margin in which to look for evidence of tanking - a team that tanks only has to lose the game, it does not have to lose the game by a large margin. The fact that tanking is harder to detect in point differences than in tests based on the conditional probability of losing a game, the approach used by Taylor and Trogdon (2002) and Price et al (2010), highlights the fact that tanking is not easy to detect and a complex phenomena.

Our result that betting markets believe that tanking takes place, despite little evidence that tanking actually takes place, is similar to the results in Brown and Sauer (1993a), who found that betting markets believe in the hot hand, but find little evidence that the hot hand actually exists in NBA games. This result is also consistent with the idea that prediction markets efficiently aggregate information. Even though tanking appears to be difficult to detect, betting markets clearly build a tanking adjustment into point spreads on games involving teams with an incentive to tank.

The results of this research could be important for the NBA, as it provides information about the effects of policy changes on team behavior. The NBA has been the most active of the four major North American professional sports leagues in altering its draft policy in response to the perception that teams tank late in the regular season. The results here show that this perception exists, in that betting markets continue to adjust point spreads for tanking in late season games. Based on Camerer's (1989) research and our results, it appears that the NBA believes in the "myth of tanking" and altered league policies in order to manage these perceptions. Managing this public perception is important, regardless of the existence of actual tanking in the NBA, because the perception affects the legitimacy of the NBA's core product, professional basketball games with uncertain outcomes. The results of our research from recent seasons with no change in draft policies indicates that betting markets still believe tanking takes place. The NBA may need to consider adjusting its draft format once again.

Future research could examine the point spreads and differences in points scored for older NBA games. By using point spreads back to the 1980s, an analysis of point spreads could see if tanking had effects in betting markets under other draft formats, and compare the size of the tanking adjustments to assess the effectiveness of the NBA draft policy. In addition, analyzing older games could help to assess the effectiveness of the equal weight draft lottery used in the mid 1980s, which was implemented to completely eliminate any incentive for teams to tank. Taylor and Trogdon (2002) concluded that no tanking took place under this draft format.

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