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Abstract

In the National Basketball Association there are many external factors that affect the movement of a point spread from its opening line to its closing line. Injury updates, suspensions, recent game history, and public betting trends are amongst the most common reasons for a point spread to move, but it is virtually impossible to know the full reason why a line has moved. Once establishing that the bookmakers’ reasons are unknown, a careful look into the largest moving lines from open to close can provide an arbitrage opportunity for an individual gambler. This paper will analyze each NBA game’s line movement over the past six NBA seasons including playoffs to determine inefficient ratios of winning percentages when gambling on the closing line after the line has moved a certain amount. The results indicate that when the line moves three points or more, betting on the cold team can beat the bookie through repeated use of the strategy over the course of a season.
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Key Terms Defined

**Bookmakers** – Companies that offer online, over the phone, or in person bets on sports in this case, also referred to as bookies

**Point Spread** – An amount of points that serves to equalize the outcome of two unevenly matched teams, it creates a point difference between the teams, one team becomes the favorite while one becomes the underdog, to calculate which side actually wins the bet either the point spread is subtracted from the favorite’s final score or the point spread is added to the underdog’s final score (both create the same result), the team with more points than wins the bet, also referred to as the line

**Opening Line** – When a point spread is released for the public to bet on, usually this is a couple days before or early in the morning on the day of the game

**Closing Line** – The last point spread available to be bet on right before the game starts when the bet is no longer available for money to be placed on

**Line Movement** – When the point spread (line) changes any amount, but only in increments of 0.5 points

**Hot Team** – A term specific to this thesis, the team that the line removes points from, example: the Lakers point spread moves from -7 to -9

**Cold Team** – A term specific to this thesis, the team that the line moves towards, example: the Wizards point spread moves from +5 to +7

**Home Team** – The team that hosts the game in their own arena

**Away Team** – The team that is the visiting team

**Favorite** – The team that is favored to win

**Underdog** – The team that is not favored to win

**Push** – When a bet lands exactly on the point spread, it is called a push and no action is taken, both sides receive money back, for example if the Lakers were minus 7 and won 107-100, the bet is a push
Introduction

The market for gambling on professional sports has grown dramatically over the past decade and has developed similarities to traditional financial markets. Despite the legality of gambling on sports in the United States except for states like Nevada and Delaware, the gambling industry captures the attention and money of individuals and sports fan across the globe. Gamblers bet on sports game for a variety of reasons that range from trying to make profits to the adrenaline rush that ensues as one cheers their team on to win. Regardless of the individual gamblers who may be able to make a living off of gambling, the bookmakers always come out ahead. The reasons are simple; the bookmakers charge a commission on each bet and hold asymmetric information over gamblers.

In terms of taxing the bettors, the bookies return function is one such that the point spread is always considered a -110 bet in the National Basketball Association (NBA), meaning that the bettor must risk $11 to win $10. This is essentially a 10% tax on losing, which means, using simple math, an individual gambler must cover 52.38% of his or her bets just to break even. By implementing this strategy, the bookmakers have a little over 2% of leeway in terms of public winning percentage on each side of 50% for each game’s outcome. The other reason why bookmakers will always be around is because they contain more information than the individual bettors. Bookies have teams of research analysts utilizing every statistic from every NBA game combined with training in historical gambling models. In addition, bookmakers have information of past bettors history and how current bettors are placing bets; the individual gambler has no access to such information. They also possess the ability to change the point spread if they see fit. If a bettor has already placed a bet, then they are locked in at that line, but all future bets must be made at the current line, which is to the bookmakers’ advantage in order
to properly hedge their bets. By moving a line, the bookmakers are protecting themselves from an overload of bets on one side of the point spread through encouraging bettors to gamble on the cold team (see Key Terms Defined) because the cold team receives even more points; giving them a greater chance of covering the spread.

Bookmakers employ endless methods in publishing the line of a game for the public to bet on, but three public perceptions about the bookies arise most obviously. The degree to which the bookmaker weighs on each perception is unknown to the public because if the public possessed this information the playing field becomes almost leveled. Knowing the opponent’s strategy, just like in sports, allows one to prepare against that particular strategy, but when strategies are mixed and unknown the opponent holds the advantage. The first intuition would be prediction of the game’s outcome of the game. If the bookie has faith in their system to predict the outcome then bookmakers would want to set a line that would entice the betting public to bet more on the side that will not cover the spread more than 50%. This is a very risky strategy because ill-advised predictions and evaluations of both the game’s outcome and the betting public’s behavior could lead to significant public profit on the particular game if the wrong team wins. A safer intuition for the bookies would be to equate the public money on both sides of the point spread and attempt moving the line in the direction that would split the money on both sides of the spread. In a sense, this associates the supply and demand for bets similar to the manner in which the stock market must find a buyer for each seller. Proper utilization results in guaranteed profits, unless of course there is a push, regardless of the outcome of the game due to the 10% tax on losing bets.

The third intuition in a way combines the first two and adds in the companies’ knowledge of betting biases. The main goal is to have more than half of the money bet on the side that wins
less than half of the time. They will use betters’ biases like betting on the home team because bettors may overvalue a team’s the home court advantage or a bettor could only bet on their fan favorite team regardless of the line. Using past information and betters’ trends, bookmakers exploit these tendencies to further push profits. An example of this would be the New York Knicks; based in the biggest metropolitan area for an NBA team, one would likely conclude their fan base to be large, if not the largest in the league. While a team like the Milwaukee Bucks, who have the 27th biggest metropolitan size of the 30 teams, would tend to have a lot fewer fans.

Bookmakers could combine an uneven fan base with standard analysis to create a more educated evaluation of their profit ratios based on different possible lines. They could set a line where Milwaukee has a much greater chance of covering (Milwaukee would be the underdog), but most of the money could still be bet on New York because of the large fan base, creating a large margin of profit for the bookies if Milwaukee covers the spread. The bookies implementations of all these public perceptions as well as the ones that are not known make it difficult for a single bettor to consistently beat the bookmakers’ lines.

Once concluding that evaluating the bookmakers’ decision process is almost impossible, a look into the point spread itself and its movement creates information that can be studied. Earlier it was mentioned that bookies use line movements to hedge their bets, but they also use them in instances where player news, suspensions, or any new information can alter either the outcome or public’s perceived outcome. Again, one must be careful to not come to any conclusion because exact reasons are unknown. This paper will focus, not on the reason for these line movements, but rather how the individual gambler can react to a possible arbitrage opportunity.
Relevant Studies

Two past studies that have relevance to this question only exist within analysis of the National Football League, but since both use identical point spread risk and return functions (-110) the theories will still hold. Steven D. Levitt’s “Why are Gambling Markets Organized so Differently from Financial Markets?” details how bookmakers appear to be strategically setting prices to exploit betters’ biases. In particular he notes that betters have biases toward favorites that are visiting teams and that when bookies exploit this they increase profits from 20-30%. He found that when the home team is an underdog, on average two-thirds of the wagers are on the visiting team, yet the visiting favorite only wins a little less than 50%. One of his main conclusions states that bettors overvalue favorites, especially away favorites.

Another study by Philip K. Gray & Stephen F. Gray entitled, “Testing Market Efficiency: Evidence From the NFL Sports Betting Market” discovered that favorites gave up 5.62 points in the spread, but on average only won by 5.20 points; concluding that favorites were slightly overvalued. While oppositely they found that the home teams gave up 2.56 points in the spread, but wins by 2.99 points determining that home teams are slightly undervalued. Their probit model highly influenced my study and helped to include variables in my regressions.

The third study entitled, “Informed Traders and Price Variation in the Betting Market for Professional Games” was very close to my thesis statement, but varied in that the study looked at informed traders influencing lines. The four economists looked at whether market-driven line changes contained information actually relevant to the game outcome, differing from this study because it did not look to see if it covered the spread. The results found that for each negative point change in the line for the home team (meaning the home team was the hot team) there was less of a chance of the home team winning. They conclude that bettors in the market that bet on
the opening line are able to bet on undervalued home teams and then the market (in this case the
bookmaker) adjusts the line. Line changes increase the accuracy of the game outcomes, not the
spread outcomes. In regards to informed bettors, the study concludes that they either possess
private information or are smarter than the bookmakers when gambling on the opening lines.

All three studies greatly influenced and helped shape views on the gambling companies
and their methods, information, intuitions on bettors’ biases, and preferences towards setting
lines.
Hypothesis & Methodology

Through testing degrees of line movement, I will test to see if profit opportunities are created as the line movement increases as well as possibly within variables of hot versus cold, favorite versus underdog and home versus away. As stated in the Key Terms Defined (p. 5) the hot team is the team that the line movement is hurting a potential gambler because it will take a larger margin of victory now for the hot team to cover. The cold team is just the opposite and receives more points. The hot and cold teams are derived solely off of line movement and favorite/underdog or home/away have no effect on the application of these terms. For example, if the Los Angeles Lakers are minus 2 as the away team and the line moves to minus four; they would be coded as hot team, favorite, and away team. Through this coding, it will test the effect of change from opening to closing line on the outcome of the spread. Using data from 8,598 NBA games from the sports handicapping site, www.sportsinsights.com, for the time period of 10/28/03 – 12/2/09, the line movement trends will be derived through the opening line, closing line, and outcome of each game. This study will answer the following questions: How big of a role does line movement play in percentage outcome of a spread when relating to the hot and cold teams? How can an individual bettor profit off of the closing line?
Results

A histogram below shows the range of the games when lines differed from their open to close. 77.5% of games moved from open to close greater than or equal to 0.5 points, while only 44.5% moved 1 or more after that. Lines moved 3 or more in 4.5% of games:

Once identifying line movement ranges, 0.5-2.5 line movements were deemed significant due to the fact that they contained a representable number of NBA games in a season. The next step was to code teams either hot or cold, favorite or underdog, home or away, and also if they went from being a favorite to an underdog. The first test was to see the percentage that hot teams covered in different situations. With line changes of 0.5 to 1.5 there was nothing to be learning since the percentage an individual bettor would cover was in the range of 48-52%. To find
anything significant, a spread cover percentage would have to be below 48% or above 52% disregarding ties. Ties are important because they result in a push, in which case the bettor gets his or her money back, therefore in this study they will be removed to find the percentage a team covers the spread to the percentage it does not cover. The results for hot teams covering given a variable and the line movement are below:

![Percentage Hot Teams Cover Spread Based on Line Movement](image)

As shown above, nothing was significant until the line moved two points or more (purple), but in those instances and onward an individual gambler would be losing money at a large negative rate of return. The only instance where an opportunity to make a profit looks like when the line movement is 2 or more and the hot team is either the underdog or the away team, but still this is not much of a trend. When the line moves 2.5 points or more, an individual bettor only covers the spread 47% of the time regardless of any variables and when it moves to 3 points
or more of line movement that value falls to close to 46%. This demands a look at the percentage the cold team is covering the spread:

A clear trend is noticeable especially when the line has move three points or more where all games cover the spread on average 53.56%. A closer look is shown below:
While those games average to cover 53.56%, it should be noted that when the cold team is the underdog or the away team they cover at a much higher percentage, 54.05% and 55.90% respectively.

If one were to bet on the cold team when the line has moved 3 points or more for every situation over the course of the NBA season, an individual would bet on 55 games (4.55%) in an NBA season, meaning roughly 1 bet every 2 days. Assuming the normal risk/return function (-110) of risk 11 dollars to win 10 (this simulation takes in to account that when a bet is won the original $1000 is returned to the better and $909.09 is received as profit), if one bets $1000 dollars on each of these 55 games over the course of the season, they will, if the outcomes follow the history of the results, make $1259.72, meaning this strategy provides a return of 125.97%.

The graph below details the return function:
An even more refined look can specify an even more advanced strategy. Using the above graph, only bet when the lines move 3 or more points and the cold team is the underdog and or the away team. If one bets in only those situations using the $1000 bet scenario, the return is 215.3%. $1000 bets would make $2,153 over the course of the season. Imagine gambling with even more money. The opportunity to likely profit off of this is feasible. An interesting fact was that the average cold away team line movement that was greater than or equal to 3 points had an average of -4.01 points, but when the average cold away team covered in those instances the average line movement was -4.24 points. This suggests that the larger the line movement the more likely one is to cover the spread by betting on the away cold team. This also holds true for the cold underdog team as the average line movement in those instances was -3.63 points with the average line movement when the cold underdog team covered being -4.16 points.

The opportunity to profit off on gambling when studying line movements from open to close is at the greatest chance of covering when the line has moved three points in more in favor of the cold away team or cold underdog team. Money is not guaranteed in this strategy as this market could easily correct itself, but the past six seasons of NBA data suggests that one has over a 55% of covering his or her bets over an NBA season; which when compared with the 10% tax on losing and the general assertion that the bookmakers always prevail is a somewhat telling statistic.
Caveats

The problem with this strategy is that it requires time, patience, and a decent bankroll. A better must monitor many game lines to find the right situation to bet. While many gambling companies have expensive products available for purchase that will notify you when a line moves a certain amount, a service that allows bettors to be electronically notified just like a stock alert. However, the systems cannot make bets for the gambler when that notification occurs meaning that some will have to sacrifice time if they want to implement this strategy. Also, when the notification occurs the better must wait until the line closes because this study is based off of movement from opening line to closing. Even if a line moves four points one cannot lock in a bet until right before the line closes. Waiting until game time also will be difficult to make bets because it requires time that some people simply do not have. Betters must be very patient because these opportunities will come approximately once every 3 days (55 opportunities/180 days in the season = .30 opportunities/day).

Another potential problem with this theory is lack of injured player data. With more sufficient data for all of the games, there is a greater possibility to single out opportunities where a team will cover either because a player is injured or because no big-time player is injured; this helps to better understand the reasoning behind a line movement. A gathering of the first team All-NBA team (5 players) from each year and the games they missed due to injury received mixed results as injuries to the top five players in the league generally had no effect as teams covered the spread around 50%. Collecting more injury data would be helpful since there were only 181 injuries over the six year span, which accounted for 2.1% of all games.

The biggest problems were due to lack of available data in terms of the amount of money pet on each side, when the bets were placed, and the timeline for data movements. With this
data, the results would have been more reliable and could possibly infer bookmakers’ tendencies in moving lines.
Concluding Remarks

The most important finding in this study notes that bookmakers tend to undervalue cold away and cold underdog teams when moving the lines and that they overadjust the line in favor of these cold teams. This is not to say though that they are wrong in doing this because their value in hedging their bets is greater than allowing a profit opportunity for an individual gambler right before the line closes. This paper makes no conclusions about the actual motives of the bookmakers in moving line nor does it make statements about individual betters’ behaviors. There are too many factors combined with too much hidden and undisclosed information. What is important to note is that for whatever reason the bookies do move their line and that they tend to overestimate that unknown reason in certain instances, and this is where the arbitrage opportunities present themselves. In line movements of 3 or more, the cold team covers the spread an opportune amount of times more than the hot team especially in instances where the cold team is the underdog and or the away team. As a result, over the course of an NBA season continually betting the same amount in these situations will increase the individual gambler’s opportunity to generate profits.
### Additional References

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<th>For ties</th>
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<tr>
<td>Away</td>
<td>50.72%</td>
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#### Accounting for Ties % Hot Team Covers

| >.5 | >1 | >1.5 | >2 | >2.5 |
| Cover | 48.98% | 48.56% | 49.33% | 47.25% | 46.44% |
| Favorite | 49.62% | 49.76% | 49.38% | 48.93% | 45.95% |
| Underdog | 51.36% | 51.51% | 52.92% | 49.31% | 48.83% |
| Dog to Fav | 50.32% | 50.32% | 50.32% | 47.56% | 49.22% |
| Home | 48.91% | 49.53% | 47.86% | 47.12% | 44.10% |
| Away | 51.63% | 50.99% | 54.01% | 50.59% | 50.46% |

#### Accounting for Ties % Cold Team Covers

| >.5 | >1 | >1.5 | >2 | >2.5 |
| All Games | 51.02% | 51.44% | 50.67% | 52.75% | 53.56% |
| Underdog | 50.38% | 50.24% | 50.62% | 51.07% | 54.05% |
| Favorite | 48.64% | 48.49% | 47.08% | 50.69% | 51.17% |
| Fav to Dog | 49.68% | 49.68% | 49.68% | 52.44% | 50.78% |
| Away | 51.09% | 50.47% | 52.14% | 52.88% | 55.90% |
| Home | 48.37% | 49.01% | 45.99% | 49.41% | 49.54% |
Works Cited


Data purchased from www.sportsinsights.com by the Haverford College Economics Department