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Thesis Outline & First Draft

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Examining Asset Pricing Behavior through the lens of Sports Betting Markets

**Introduction:**

Asset pricing theory, which studies the fundamental drivers of prices across various asset classes, is a major source of study for economists looking to rationalize market behavior. This paper intends to build upon a small subset of the current literature by implementing the use of sports betting markets to test for behavioral tendencies which result in asset pricing anomalies. Yale professor Tobias Moskowitz’s prior study on this topic provides the motivation for my own work. In which, he tested momentum, value, and size trading strategies, eventually concluding evidence of overreaction that led to contract mispricing. Hence, the first section of this paper intends to follow a similar procedure to Moskowitz, albeit with modern data that will encompass the increased wagering volumes from the legalization of sports betting markets across 36 states. In the following section, the paper intends to gather data on contract pricing prior to and following major news events in sports betting markets. Evidence of behavioral anomalies in this sports betting study can provide a unique lens onto similar asset pricing anomalies in financial markets.

A central idea within asset pricing theory, that is critical for understanding this paper’s motivation for testing pricing anomalies within sports betting markets is Eugene Fama’s Efficient Market Hypothesis. The theory argues that the price of any asset is efficient, or at fair market value, because all market participants have access to all relevant information regarding prices. Accordingly, if the asset price were always at the fair market value it’s impossible to beat the market and the return of an asset should be proportional to its risk. In practice, however, this theory often fails to hold up to its strict definition. As a result, economists have devoted vast amounts of work to analyze and explain financial returns in relation to market efficiency. However, this literature on market efficiency must also deal with Fama’s Joint Hypothesis Problem, which claims that testing for market efficiency is extremely difficult, if not impossible because any test must use some form of an asset pricing model to predict returns. Thus, it is impossible to say whether the perceived deviation from the predicted returns is because of market inefficiency or rather because of an error in the asset pricing model that predicted the returns. Hence, this issue of needing to simultaneously prove the inefficiency of the market and the accuracy of the asset pricing model has conflicted with academia.

As a result, some economists looking to define certain behavioral properties have turned to sports betting markets as a laboratory for empirical research. Sports betting presents a clean testing ground because of a few properties. Importantly there is no correlation between the standard risk of the traditional financial market and the overall economy. While certain individuals betting amounts may decline during a recession, there is no impact on the line moving significantly in one direction for two football teams based on the latest jobs report. In addition, sport betting contracts have a fixed payoff set to mature on a defined day. This then alleviates the need to define an asset pricing model for sports betting markets, as we can simply look at the payoffs and compare that to the initial pricing to test for any potential mispricing.

While sports betting markets have certain characteristics that distinguish the industry from capital markets, they are largely subject to the same behavioral patterns that are seen in traditional finance. For instance, we know those market participants are strictly better off when their bet wins, regardless of whether they are primarily betting for the entertainment factor. A sports bet is simply another form of a risky decision that subjects the player to the same behavioral principles and models used to examine participants in capital markets. This basic premise allowed Yale Professor Moskowitz the motivation for using sports betting markets to test three behaviors influencing asset pricing theory: value, momentum, and size.

Thus, this paper intends to extend the work done by other researchers by now examining how the sports betting markets react to major news events surrounding the game. To begin, I will focus on looking at injury reports and evaluate what level of data this will provide. I plan on examining games with an injury report that caused a sizable move in the betting line, like the effects that an earnings surprise would instill. Then, having isolated these games, I will examine whether there are any mispricing effects once the game is actually played out. If there is a significant underreaction to the news, this phenomenon would partially help rationalize the behavioral activity demonstrated in the stock market and provide a better asset pricing model for capital markets.

One prominent example of financial market activity that can appear to contradict the efficient market hypothesis is stock price reactions around major news events, such as quarterly earnings or stock buyback announcements. For instance, academic researchers have conducted numerous studies on the phenomenon termed Post-Earnings-Announcement-Drift. Their findings of which demonstrate that a significant positive or negative earnings surprise has the tendency to lead to abnormal stock returns in the following trading days that drift in the direction of the surprise. This would suggest that investors underreact to the earnings announcement, which leads to the post-announcement drift. If the efficient market hypothesis were in full effect, then the information from the announcement would be quickly acted upon such that there were no empirical abnormal returns in the following days.

**Literature Review:**

As alluded to previously, there have been many studies that have analyzed the behavior of Post-Earnings-Stock-Drift. Fama has even coined it the “Grandaddy of underreaction events”. Bernard and Thomas examined this famously in a 1989 study where they grouped stocks by the size of their respective earnings surprise. They then constructed a portfolio with the groupings in which they went long in stock with positive earnings surprises and short on the ones with negative. This strategy resulted in a statistically significant excess return of 18%.

Additionally, as mentioned earlier, a key study led by Yale Professor Tobias J. Moskowitz provides a large inspiration and rationalization for this paper to follow up on. Moskowitz makes the claim that asset pricing anomalies are well suited for analysis in the sports betting market because they lack exposure to systemic risk and have terminal values uncorrelated with betting activity. Moskowitz lays out the motivation for and rationale in depth in the paper but eventually decides to test for momentum, value, and size effects in sports betting markets because of their prevalence in the traditional finance industry. Ultimately, he concluded that sports contracts demonstrated momentum effects in their prices but that the transition costs in the form of the sportsbooks’ cut or vigorish were too high to offer a profitable strategy.

Thus, this paper provides a solid starting point for this paper to build off in a few ways. The first main addition is that Moskowitz only examined Data up until 2013. Since then, the sports betting market in the United States had radically changed since the overturn of a law in 2018 that had previously outlawed sports gambling outside of Nevada. Since then, 31 states now have sports betting licenses with many offering an online option that streamlines the betting process onto a user’s smartphone with the ability to place a bet whenever. This has resulted in increasing adoption of sports betting activity by the public as seen just from 2021 to 2022 as the number of people placing a bet increased from 20% to 25%. Furthermore, the total money wagered from 2018 to 2021 was $127 billion which resulted in nearly $8.9 billion in sportsbook revenue. Additionally, the major players in the U.S. market are now Fanduel and Draftkings who together hold two-thirds of the market. This then presents an entirely different scene from 2013 and thus ought to provide a worthwhile examination of how the sports betting markets may have changed. More maturity and funds would suggest a more efficient market as the potential for arbitrage should be even tougher with more participants and online technology. However, many of the new gamblers are average citizens looking for a chance to win some money while enhancing their enjoyment of the game. This is vastly different from the finance industry where nearly all trading activity stems from institutions. Thus, with the less smart money, the increased size of the market may demonstrate different pricing activity from the previous decade.

Secondly, whereas Moskowitz centered on the behavioral effects related to momentum, value, and size, I hope to do an in-depth analysis of surprise news reports. I believe that the hardest part of the paper will be how to define what constitutes a big enough injury that it would be comparable to something like an earnings surprise for a stock. I will need to flush this out to eliminate bias and strengthen the analysis of the experiment. I believe that this is possible, and I will now begin the process of looking at the best available sports games and betting data to perform this experiment. Once conducted, the next major step will be determining to what extent the results are useful for drawing connections to asset pricing theory in the financial markets. While I don’t anticipate a strict correlation between the two markets, I do believe that the behavior witnessed in reaction to major injuries surrounding a sporting event can provide a meaningful cross-analysis for the anomaly that is Post-Earnings-Announcement-Drift.

**Explanation of Sports Betting Markets and Data:**

Before giving a detailed account of the data used in this work, I shall provide a brief introduction regarding sports betting markets and the contracts used in this study. At a high level, sports betting markets enable individual agents to buy and sell various contracts which depend on some outcome in the game or season. This study, like Moskowitz, will examine the three most popular and heavily wagered contracts: point spread, moneyline, and over/under. To generalize these contracts for any game, let us consider two teams A and B, whose points scored are denoted as PA, and PB for A and B respectively.

The Point Spread then takes the following definition: PA - PB = X. In this case X would represent the Point Spread or simply the differential in points between teams. For example, if the spread between teams A and B is 5, i.e. PA – PB = 5, then any wager on the favorite team, A, would only pay off if team A wins by more than 5 points. Thus, anyone taking the opposite side would require Team B to win or lose by less than 5 points for the bet to pay off. In this specific case, if the game concludes with a point differential of 5 points between A and B, then the bets would be deemed a “push” and both sides are returned the principal. Furthermore, in the data the spread for a favorite will take the form of -X, or -5 for this example, while the underdog will be listed as +X, or +5.

Additionally, these contracts are established such that a wager on either team should take the form of a 50-50 wager, or coin toss. However, the sportsbook charge commission, also known as the vigorish, when setting the odds for the games. Thus, in order to win $100, one must place a $110 dollar bet, with the $10 difference representing this commission. Hence the payoffs for a standard bet would be: 210 when y > X, i.e. the team wagered upon “covers” the spread, 110 when the bet results in a push, and 0 if the bet is lost.

Next is the moneyline contract, which is simply a wager on the team to win the game. Unlike the point spread contract, which uses points to balance the opposing sides, a moneyline bet adjusts the payouts. For example, if team A is favored, then the moneyline bet will be listed as -MA, implying that a bet of MA dollars is needed to return $100 in winnings. On the contrary, the underdog will be listed at MB dollars, which means that a $100 wager would pay out MB dollars. Finally, the sportsbook sets the two values such that MA is greater than MB, with the difference representing the charged commission by the book.

This year’s Superbowl provides a good look into how the point spread and moneyline bets work in practice. The Philadelphia Eagles deemed by the oddsmakers are listed as the favorites, hence anyone looking to place a moneyline wager on the Eagles can do so at -125 odds. Additionally, confident Eagles fans can choose to “lay” the spread and take the Eagles point spread contract at -1.5 for -110 odds, implying that a $110 Point Spread wager on the Eagles would win $100 if the spread is greater than 1.5 points. Chiefs’ supporters then have access to the same point spread contract with the sportsbook allowing them to “take” the points at +1.5 for 110 odds. Additionally, if the individual thinks that the Chiefs can win the game outright, they could place a moneyline wager at +105 odds, implying that a $100 wager will win $105. In this example, the Point Spread sets the standard vigorish of 110-100 = 10, while the moneyline would be even greater at 125-105 = 20.

Last is the Over/Under contract, which unlike the Spread and Moneyline is not a wager on contest winner and loser but rather on the combined points scored between opponents. Thus, if the Point Spread is defined as y = PA-PB, then the Over/Under is similarly defined as y = PA + PB. Thus, in the data, you will see the Over/Under contract listed at a set number T, implying that those individuals taking the Over need more than T points to receive a payoff, whereas the under contract participants need less than T points. As in the case of the Point Spread, the Over/Under contract is balanced between the two sides such that this is roughly equivalent to a coin toss. Also, we have the same format as the Point Spread with a $110 bet resulting in a $210 payoff in the case of a win, $110 payoff in the case of a push, and $0 if the bet loses. Again the $10 difference between the amount wagered, $110, and the winnings $100 represents the book vigorish.

Thus, for the purposes of this work, the data used will consist only of these three types of sports betting contracts. It should be noted though that since the legalization of sports betting in many states across the United States that there has been a significant rise not only in the volume for these mainstream contracts but also in Prop Bets. These are side bets in a contest on much more specific events, including but not limited to, the over/under on the number of points, yards, rebounds, etc. a certain player will attain in a game, the coin toss, or even the Gatorade color dumped on the head coach of the winning team in the Super Bowl. While access to this data may present its own sets of challenges, I do see the possibility of future research using these more niche markets to compare pricing activity related to the standard Spread, Moneyline, and Over/Under contracts. It would be interesting to see if these markets, because of their smaller size, were less liquid and thus more susceptible to mispricing.

Lastly, in the primer, I would like to briefly discuss how the lines are initially set and adjusted, as this will be a focus when testing price movements in the underlying contracts. While there are certain markets which enable agents to trade the contracts directly with one another, the vast majority of sports betting activity is conducted through sportsbooks. Like in financial markets, where investment banks and other brokers will intermediate trades by offering prices that they will both sell and buy an asset, the sportsbook is acting as the intermediary between bettors by offering both sides prices at which they can enter the various contracts.

Thus, when the contracts for a contest are first released, the sportsbook sets an initial betting line or price with bookmaker’s goal of balancing the odds such that money is placed evenly on both sides. To do this, the books employ computer algorithms and mathematical models factoring in a wide range of variables such as team power rankings, weather, injuries, etc. Additionally, once this initial betting line is released to the public, the betting limit, or amount that can be wagered upon the contest, is set low to prevent sharp bettors from seizing a potential pricing mistake. Hence, following the opening of the contract, the betting lines will continue to move up and down in reaction to betting volumes. Using the Superbowl example from above, if all the early betting volume came in on the Eagles Point Spread (-1.5), then the oddsmakers would adjust the line upwards to 2, and then 2.5, and so on, as they attempt to balance out the two sides. Doing so allows the Sportsbook to mitigate risk as they attempt to rake in the vigorish without exposing themselves to excessive risk. Additionally, if new information about the game’s potential outcome is released, such as a sports injury, the betting line can move without being affected by volume.

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Notes and Thoughts:

Moskowitz examines sports betting data through 2013, I think that this presents a better opportunity for using current data to see if there are any changes that have occurred due to the legalization of sports betting across many states.

Would propose using his methods for modelling momentum, value, and size and then building these tests to include the newer data. Potentially could model changes from his subset, with 13-23, and then all the data together.

Main addition though would be attempting to model major news events in sports and the corresponding reactions to these events. Could potentially only look at games with large changes in betting lines from open to close and then examine the result.

Furthermore, I would like to model some type of event study focused on injuries. Its hard to determine at this point whether there is suitable data to look at games on an individual basis; however, there is data by season which I could then use to isolate key position players like qb, rb, wr and see if there are any anomalies when certain players are potentially going to be unavailable. This may not be useful for post earning announcement drift but could be used to look at how investors handle the presence of information for both high value and low value teams.

DATA: Currently have access to nfl data on spread, moneyline, and over/under as well as injuries. Could begin with this league and expand to include other entries.

Moskowitz focuses on modelling three financial markets trading strategies: Momentum, Value and Size

* Momentum – NBA point spread; past performance over last 8 games (wins, point differential and betting returns); uses the same for money line and then uses a sum of two teams measures for the over/under tests.
  + Rank games based on quintile and then goes long on the top quintile and short on the bottom.
  + Demonstrates an overreaction from past performance.
* Value –
  + Long term past performance over previous 1,2,3 seasons. Ratio of fundamental value of contract relative to price. Pythagorean win expectation formula
  + Team talent to market ratio. Player bankroll divided by current price on betting contract
  + Value index: weighted average of the value measures. Enhance momentum trading strategies.
* Size:
  + Annual franchise value, ticket revenue, total revenue of the team. No significant effects present.
* However, when including transaction costs all profits go away.