An intra-week efficiency analysis of bookie-quoted NFL betting lines in NYC☆

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A B S T R A C T

We analyze the intra-week evolution of bookie-quoted National Football League betting lines in New York City and its implications for market efficiency. Our unique data set includes three sequential lines: (i) an outlaw line set by a single agent at the beginning of the week; (ii) Tuesday's opening line shaped by bets from a group of eight to ten agents; and (iii) a game-time closing line shaped by the wider public. While forecast encompassing tests show that information content increases during the betting week, consistent with a reasonably well-functioning market, we also uncover significant evidence of pricing inefficiencies relating to sentiment measures. In addition, actual bets made by a number of professional gamblers appear profitable, pointing to the existence of superior analysts.

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1. Introduction

The National Football League (NFL) betting market has long served as a laboratory for testing market efficiency. In fact, Pankoff (1968) published the initial study of NFL betting market efficiency soon after the seminal works on market efficiency by Fama (1965) and Samuelson (1965). The long list of subsequent studies in this area includes Avery and Chevalier (1999), Borghesi (2007), Boulier et al. (2006), Dana and Knetter (1994), Dare and Holland (2004), Dare and MacDonald (1996), Gandar et al. (1988), Golec and Tamarkin (1991), Gray and Gray (1997), Sauer et al. (1988), Tryfos et al. (1984), Vergin and Scriabin (1978), and Zuber et al. (1985). Overall, the evidence regarding NFL betting market efficiency is mixed. While tests in the mold of Mincer and Zarnowitz (1969) generally fail to reject market efficiency, there is also evidence that betting outcomes are significantly related to information available before the setting of market prices (i.e., betting lines).

In this paper, we employ a unique data set to study two previously unexplored aspects of NFL betting market efficiency: (i) the intra-week evolution of three sequential NFL betting lines and (ii) the performance of individual professional gamblers. Our data are culled from *The National Football Lottery*, in which Larry Merchant chronicles his weekly betting activities in New York City

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(NYC) during the 1972 NFL season. Merchant (1973) records three sequential betting lines for each week of the 1972 NFL season—the outlaw, opening, and closing lines—in addition to his complete set of bets and those of four other gamblers for the 1972 season.[1] We analyze the efficiency implications of the intra-week evolution of the betting lines using forecast encompassing tests, as well as tests of the predictive power of various sentiment measures (Avery and Chevalier, 1999). We also test whether the betting strategies pursued by the individual gamblers generate economically and statistically significant profits, thereby testing for the existence of superior analysts.[2]

The evolution of intra-week betting lines starts with the outlaw line, which is set by a single agent at the beginning of the betting week. Soon thereafter, a small group of eight to ten professional bettors shapes the outlaw line into the opening line. The market is then opened to all bettors—professional and public alike—and bets made during the remainder of the week move the opening line to the closing line. Illegal New York bookies provide the opening and game-time closing lines to Merchant. Our forecast encompassing test results identify significant differences in information content among the three sequential betting lines. In particular, the opening line contains information beyond that contained in the outlaw line, and the closing line contains information beyond that in the opening line. Our results thus indicate that the information content of betting lines increases as more agents participate in the betting market and as agents' potential relevant information set grows during the betting week. This pattern of increasing information content is expected in a reasonably well-functioning market.

We further scrutinize market efficiency using a sequence of regression models where the dependent variable is, in turn, the outlaw line, changes in the outlaw to opening line, and changes in the opening to closing line. The regressors are variables constructed using publicly available information that exists before the setting of any of the three betting lines, including power rankings based on a methodology from Dana and Knetter (1994) and eight sentiment measures similar to those used by Avery and Chevalier (1999). Power rankings and a number of the sentiment variables are significant determinants of the outlaw line, and these variables jointly explain nearly 75% of the variation in the outlaw line. Furthermore, power rankings and some of the sentiment variables are significant determinants of subsequent movements in betting lines. This latter finding is interesting because the information contained in the power rankings and sentiment variables is publicly available before the time the outlaw line is set; that is, this "stale" information continues to affect prices as the number of market participants grows during the betting week.[3]

Like Avery and Chevalier (1999), we estimate ordered logit models to examine whether the power rankings and sentiment variables are significantly related to the actual outcomes of betting into the three lines. If the market efficiently processes all relevant information contained in the power rankings and sentiment variables available at the start of the week, none of this information should be significantly related to actual outcomes when betting into the three lines, especially the opening and closing lines. We find, however, that the betting lines are inefficiently slanted (i) against prestige teams (i.e., teams that linemakers believe will attract considerable betting attention from the public) identified a priori by Merchant and (ii) toward teams that display a "hot hand" (i.e., teams that performed well recently relative to the betting lines). This discovery suggests that strategies based on betting with a group of prestige teams and against hot-hand teams are potentially profitable. Indeed, we show that such simple trading strategies earn economically and statistically significant profits during the 1972 season.

Finally, we study the payoffs of bets made by the five individual gamblers tracked by Merchant. One of the gamblers is identified by Merchant as a noise bettor, while he views the others as informed bettors (including, of course, himself). We find that Merchant and two of the three other informed bettors made handsome (and statistically significant) profits. The remaining informed bettor realized moderate (and statistically insignificant) profits. In contrast, the noise bettor suffered losses. We interpret the evidence of profitable trading by a number of informed bettors as reasonably strong evidence for the existence of superior analysts, because these traders were identified a priori by Merchant.

Overall, our results paint a nuanced picture of price formation in the 1972 NFL betting market in NYC. The information content of market prices clearly increases during the week, as the market becomes thicker with traders and the potential relevant information set grows. Despite the expected general increase in the information content of market prices over the course of the week, information is not processed in a completely efficient manner. As a result, systematic pricing errors exist. In addition, a set of a priori identified informed bettors earn economically and statistically significant profits, which, strictly speaking, represents a rejection of semi-strong-form market efficiency.

The remainder of the paper is organized as follows. The 1972 NFL betting market and our data are described in Section 2. We report forecast encompassing test results in Section 3. Results for a sequence of regression models that use power rankings and sentiment variables to explain the outlaw, opening, and closing lines appear in Section 4. This section also reports ordered logit model estimation results for betting outcomes, along with an examination of the profitability of trading strategies based on prestige and hot-hand effects. We investigate the performance of professional bettors in Section 5. Section 6 concludes.

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[1] The book focuses on the 1972 NFL season, so that Merchant provides data for this season only.

[2] We recognize that our results depend on the reliability of the data provided by Merchant in his book. We deem the data to be trustworthy for the following reasons: (i) Merchant states in the book that he mailed his bets to a lawyer each week before the games were played; (ii) Merchant's publisher gave him an advance on the book project, and his contract did not depend upon a successful NFL betting season; (iii) we do not believe that Merchant's book sales depended upon a successful NFL betting season, because the book does not tout any "you too could win" betting system but is instead largely focused on describing his interactions with the interesting characters populating the NYC NFL betting market.

[3] This finding is similar in spirit to the partial adjustment process for IPOs documented by Bradley and Jordan (2002).