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Testing Efficiency Across Markets: Evidence from the NCAA Basketball Betting Market

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1. INTRODUCTION

This study examines whether differences in the availability of information across markets result in different efficiencies of price formation across those markets. We utilize the National Collegiate Athletic Association (NCAA) basketball betting market to make inferences about financial markets. The use of point spread betting markets to make inferences about the operations of traditional markets has become common in the finance literature (see Gandar, Zuber, O'Brien and Russo, 1988; Golec and Tamarkin, 1991; Brown and Sauer, 1993; Gray and Gray, 1997; and Gandar, Dare, Brown and Zuber, 1998). Betting markets provide a unique opportunity for such inferences because the fundamental values of the games in the betting market, namely the true score differentials between teams, are observable after the games are played. Thus, uncertainty about unobservable equilibrium prices, which is characteristic of testing conducted in conventional financial markets, is removed from the analysis and more definitive conclusions concerning the effect of information on the efficiency of markets can be made.

The National Football League (NFL) betting market and the National Basketball Association (NBA) betting market are the

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two point spread betting markets that have received the bulk of researcher attention.[1] Recently, Gray and Gray (1997) demonstrated in the NFL market that betting strategies based on a probit model can generate statistically significant profits. Their results are consistent with prior investigations of the NFL market that also demonstrate some degree of market inefficiency (e.g., Gandar et al., 1988 and Golec and Tamarkin, 1991). Brown and Sauer (1993) utilize the NBA market to show that variations in point spreads are a function of fundamental information. Similarly, Gandar et al. (1998) document in the NBA market that line changes from the opening line to the closing line reflect the introduction of fundamental information.

A common characteristic of the above studies is the exclusive focus on a single betting market over a specific period of time. However, while Gandar et al. (1998) examine the NBA market, they also compare their test results to similar test results from the NFL market reported a decade earlier in Gandar et al. (1988). The comparison reveals that the NFL market has larger forecast errors than the NBA market and that a smaller percentage of line changes in the NFL market moves the closing line towards the game outcome. The authors state that the apparent differences in these two markets, both in terms of absolute forecast errors and the ability of the markets to incorporate additional information, is intriguing. The authors state further that 'future research into the differences between these markets may be enlightening' (p. 399). They recognize, however, that differences in the scoring between football and basketball, as well as idiosyncratic factors such as weather, may make meaningful comparisons between these two markets difficult.

Our interest in comparisons between betting markets stems from the inferences that can be made about the hypothesized difference in efficiencies across various stock markets in the United States. This difference is posited to result from the difference in the amount and timeliness of information found on the stocks traded in these markets. A number of studies have attempted to measure the relative efficiencies of US markets. These studies have found evidence consistent with the notion that there is significantly greater availability of fundamental information on stocks traded on the New York Stock Exchange (NYSE) than on stocks traded in other markets. As a result, stocks traded on the NYSE have been found to be more accurately priced than those traded in other markets. For example, Brown (1988) finds that the American Stock Exchange (AMX) and over-the-counter (OTC) stocks are less efficiently priced than the NYSE stocks with respect to price reactions to depreciation changes. Also, Lease and Lewellen (1982) find that stocks traded on the NYSE are more accurately priced than stocks traded off the NYSE.[2] A natural limitation of these studies is the uncertainty regarding the equilibrium prices of stocks traded in these markets. The use of betting markets overcomes this limitation and allows for a more direct investigation of price efficiency.

We attempt to address the question of differences in stock market efficiencies by examining different betting markets. However, we do not focus on a comparison between the NBA and NFL markets because of the various differences between those markets. Instead, we focus on a previously unexamined market, the NCAA basketball betting market.

We consider the population of NCAA basketball games to be analogous to the population of publicly traded stocks. Further, much like the NYSE, the AMX, and the OTC market are separate markets within the universe of publicly traded stocks, we consider intra-conference games of the various NCAA recognized conferences (e.g., games among teams within the Atlantic Coast Conference or games among teams within the Big East Conference) to be clearly defined markets within the universe of NCAA basketball games. The advantage of considering intra-conference games as separate markets is the ability to test for differences across markets that are relatively homogeneous in nature. Thus, we remove most of the fundamental and idiosyncratic differences that would exist when comparing more heterogeneous markets such as the NBA and the NFL. Our comparisons then will allow for inferences to be made about the effects of differences in information availability across stock markets.

The remainder of the paper proceeds as follows. Section 2 provides an overview of the NCAA betting market; Section 3 describes the data; Section 4 contains a discussion of the empirical tests and results; and Section 5 provides a summarization of the paper.

2. THE NCAA BETTING MARKET

The NCAA betting market is similar to other point spread betting markets. The point spread can be viewed as both a market clearing price and a prediction of an outcome. The opening point spread, or line, is established by a bookmaker. The goal of the bookmaker is to establish a line that equalizes the dollars bet on each competing team. If balanced betting is achieved, then the 'eleven for ten' rule guarantees the bookmaker a riskless profit.[3] Therefore, bookmakers evaluate not only the potential game outcome but also the market's perception of the potential game outcome when establishing opening lines. As bettors begin to place a larger proportion of bets on a given team, the bookmaker adjusts the line to balance the betting and maintain the riskless profit. As a result, the closing line should reflect all information from both the bookmaker and the market.[4] These lines can then be used in conjunction with actual game scores to test for efficiency within a market or, in this case, efficiency across markets.

3. DATA

Like Gandar et al. (1998), data for our analysis were obtained from *Computer Sports World*, which reports lines from the Stardust Race and Sports Book located in Las Vegas, Nevada. As stated previously, we consider intra-conference games of the various conferences as separate markets within the population of NCAA games.[5] The NCAA recognizes a total of 34 Division I conferences, of which 30 sponsor basketball programs.[6] Because the Stardust Race and Sports Book does not post lines for all teams, we collect data for the 17 conferences whose teams' lines are routinely posted.[7] These 17 conferences, which are listed in Table 1, include 174 teams in the most recent sample year (1996/97). These 174 teams represent roughly 75% of all the teams for which the Stardust Race and Sports Book posted a game line during the 1996/97 season. Some conferences, such as the Big Sky Conference, changed membership during the three year window examined. For any conference changing its membership, calculations are based only on those teams in the conference for a given year.

Table 1

Conference RPI Ratings

Conference	*1994/95 RPI Rating (Rank)*	*1995/96 RPI Rating (Rank)*	*1996/97 RPI Rating (Rank)*	*Three-year RPI Rating (Rank)*
Atlantic Coast	0.588 (2)	0.586 (1)	0.592 (1)	0.589 (1)
Big 12	0.595 (1)	0.568 (2)	0.566 (2)	0.576 (2)
Big East	0.581 (3)	0.556 (6)	0.553 (5)	0.563 (3)
Southeastern	0.568 (5)	0.563 (4)	0.556 (4)	0.562 (4)
Big 10	0.559 (6)	0.563 (3)	0.563 (3)	0.561 (5)
Pacific 10	0.579 (4)	0.548 (7)	0.549 (6)	0.559 (6)
Conference USA	N/A	0.560 (5)	0.533 (8)	0.547 (7)
Atlantic 10	0.545 (7)	0.526 (8)	0.536 (7)	0.535 (8)
Western Athletic	0.537 (8)	0.520 (9)	0.533 (9)	0.530 (9)
Missouri Valley	0.535 (9)	0.512 (11)	0.518 (10)	0.522 (10)
Mid-American	0.517 (11)	0.501 (12)	0.501 (11)	0.507 (11)
West Coast	0.522 (10)	0.520 (10)	0.476 (14)	0.506 (12)
Midwest Collegiate	0.480 (13)	0.500 (13)	0.468 (15)	0.483 (13)
Sun Belt	0.472 (14)	0.490 (14)	0.482 (12)	0.482 (14)
Big Sky	0.495 (12)	0.471 (15)	0.468 (16)	0.478 (15)
Ivy League	0.435 (15)	0.466 (16)	0.480 (13)	0.460 (16)
Southern	0.433 (16)	0.449 (17)	0.468 (17)	0.450 (17)

Notes:
The Ratings Percentage Index (RPI) measures the relative strength of all National Collegiate Athletic Association basketball teams and conferences. The 17 conferences above are those conferences for which the Stardust Race and Sports Book posts lines for all teams. The RPI rating for each conference is the average RPI rating for all teams within that conference for that year. No rating is reported for Conference USA for the 1994/95 season because the conference was formed after the season.

Table 2 presents some descriptive information on the sample. The sample contains 4,130 intra-conference games played over three consecutive seasons. The mean difference between the points scored by the home team and the visiting team (SCORE = HPOINTS − VPOINTS) represents the home court advantage. For our three-year sample, the home court advantage was 4.31 points. This advantage is comparable to that found by Brown and Sauer (1993) and Gandar et al. (1998) in the NBA market. The mean closing line (CLINE), also reported on a home points minus visitor points basis, reflects the market forecast of the home court advantage. As CLINE is insignificantly different from SCORE in each of three seasons, CLINE appears to be a good predictor of SCORE. Similar to Brown and Sauer (1993) and Gandar et al. (1998), the variation in actual game outcomes is

Table 2

Descriptive Statistics on Intra-Conference Game Scores and Betting Lines

Season	*Games Played*	*SCORE*	*CLINE*
1994/95	1,291	3.93 (13.45)	4.37 (8.42)
1995/96	1,370	4.21 (13.56)	4.36 (7.97)
1996/97	1,469	4.74 (13.53)	4.43 (7.84)
All seasons	4,130	4.31 (13.52)	4.39 (8.07)

Notes:
This table reports descriptive information on the 17 National Collegiate Athletic Association conference basketball games with lines posted by the Stardust Race and Sports Book during the 1994/95, 1995/96 and 1996/97 seasons. SCORE is the points scored by the home team less the points scored by the visiting team. CLINE is the closing line from Stardust Race and Sports Book stated on a home team basis. Standard deviations are reported in parentheses.

much higher than the variation in market forecasts for those games.

4. EMPIRICAL TESTS AND RESULTS

We seek to identify differences in efficiencies of price formation across the betting line markets of the various conferences under the assumption that differences in information availability exist between the conferences.[8] Therefore, it is necessary that we first establish a proxy for the degree of information that is readily available for each of the 17 betting line markets.

(i) Proxy for Information Availability

The level of information that is readily available on the various conferences, or teams within a conference, is likely to be correlated with the overall strength of the teams within each conference. Presumably, the teams and conferences with the greatest success during the year likely would receive the most coverage in both the print and television media. Casual observation provides some support for this hypothesis. For example, the covers of pre-season issues of college sports magazines are likely to picture a team or player from the Atlantic Coast Conference (ACC), the Southeastern Conference (SEC) or the Big 10 Conference rather than a team from the Big Sky Conference or the Southern Conference. In addition, nationally televised games are likely to feature teams from the stronger conferences. During these broadcasts, information about the teams in the conference is usually provided. Consistent with the previous studies that attempt to measure the relative efficiency of the various stock markets, we expect that the conferences with the greatest amount of available information will have the greatest efficiency in price formation.

We use the basic formula from the Ratings Percentage Index (RPI) to measure the relative strength of the teams and conferences. The RPI is a measure of team strength that is based both on the win-loss record of the team and the strength of the team's schedule.[9] As a result, although two teams may finish the season with twenty wins and ten losses, the team that played the more difficult schedule will have a higher RPI. The RPI for a conference for a particular year is the average RPI of all of the teams in that conference for that year. Table 1 contains yearly RPI rankings and the three-year average RPI rankings for the 17 sample conferences. No RPI rating is reported for Conference USA for the 1994/95 season because the conference was formed after the season.

We assume that the RPI is a reasonable proxy for the degree of information available on a given conference of teams. However, we do not believe that RPI rankings enable us to assign to each conference some factor representing the amount of available information on the teams in that conference. For example, we do not expect that the rankings in Table 1 indicate that the Atlantic Coast Conference has 0.013 more units of available information than the Big 12 Conference. Rather, we believe that the RPI rankings are best suited to identify those conferences with the most extreme differences in available information. Comparisons of the extreme conferences then minimizes the potential for the measurement error inherent in the RPI proxy to conceal any true differences in efficiencies across the conferences. As seen in Table 1, the ACC and the Southern Conference are the first and last conferences in the three-year average RPI, respectively, and are therefore the two conferences that are compared.[10]

Various aspects of the ACC and the Southern Conference make a comparison between these two conferences attractive. First, they have a comparable number of teams (nine in the ACC and eleven in the Southern Conference). Second, they have a comparable number of intra-conference games (240 versus 238). Finally, they are located in the same geographic region of the country, with over 50% of the teams in each conference located in either North or South Carolina. This homogeneity between conferences minimizes concerns about confounding variables that might bias the comparisons in any meaningful way.

(ii) Tests of Market Efficiency

If the ACC and Southern Conference betting markets are efficient, then closing lines should be unbiased predictors of actual game outcomes. In other words, the expected value of the markets' forecast errors of game outcomes, conditional on available information within each conference, should equal zero. Traditionally, this notion of efficiency has been tested by estimating the following regression and examining whether $\beta_0 = 0$ jointly with $\beta_1 = 1$:

$$Y^j = \beta_0^j + \beta_1^j X^j + \varepsilon^j, \tag{1}$$

where Y is the difference in points scored by the two teams, X is the bookmaker closing line, j is a superscript denoting whether the scoring differences and closing lines between teams are stated on a favorite minus underdog basis or a home minus away basis, and ε is a random disturbance term.

However, Dare and MacDonald (1998) suggest that equation (1) is a potentially biased test of market rationality because it fails to incorporate the symmetry and lack of independence inherent in a game that, for example, is both a favored versus underdog game and a home versus away game at the same time. As a result, Dare and MacDonald develop the following extension of equation (1) to test for market rationality, which we also employ to test whether the ACC and Southern Conference markets are rational:

$$\begin{bmatrix} Y^{FH} \\ Y^{FA} \\ Y^{FN} \\ Y^{HP} \\ Y^{PN} \end{bmatrix} = \beta_0^F \begin{bmatrix} 1 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix} + \beta_0^P \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 1 \end{bmatrix} + \beta_0^H \begin{bmatrix} 1 \\ -1 \\ 0 \\ 1 \\ 0 \end{bmatrix} + \beta_0^N \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 1 \end{bmatrix} + \beta_1^F \begin{bmatrix} X^{FH} \\ X^{FA} \\ X^{FN} \\ 0 \\ 0 \end{bmatrix} + \beta_1^H \begin{bmatrix} X^{FH} \\ -X^{FA} \\ 0 \\ 0 \\ 0 \end{bmatrix} + \beta_1^N \begin{bmatrix} 0 \\ 0 \\ X^{FN} \\ 0 \\ 0 \end{bmatrix} + \varepsilon^F. \quad (2)$$

The dependent variable Y^{jk} is the difference in points scored by two teams while the independent variable X^{jk} is the closing line from Stardust Race and Sports Book. The superscript j denotes whether the scoring difference between teams (Y) and the closing line (X) are stated on a favorite minus underdog basis (F) or a home minus away basis (H). The superscript k denotes whether the team that is first in the order of differencing is the home team (H), is the away team (A), is playing on a neutral site (N), or is a 'pick-em' (P) team. The random disturbance term is represented by ε. Similar to tests of efficiency in equation (1), the market is considered rational if the following conditions are satisfied:

$$\beta_0^F = \beta_0^P = \beta_0^H = \beta_0^N = \beta_1^H = \beta_1^N = 0 \text{ and } \beta_1^F = 1.$$[11]

Table 3 reports the results of estimating equation (2) for both the ACC and the Southern Conference. For each individual season as well as the pooled seasons, the null hypothesis that:

$$\beta_0^F = \beta_0^P = \beta_0^H = \beta_0^N = \beta_1^H = \beta_1^N = 0 \text{ and } \beta_1^F = 1$$

cannot be rejected at conventional levels for either conference. This suggests that both the ACC betting market and the Southern Conference betting market are efficient given the information available in each market. In other words, market expectations of game outcomes are rational expectations. Such evidence is consistent with findings from the NFL betting market reported in Gandar et al. (1988).

Table 3

Tests of Market Rationality in the Atlantic Coast Conference and the Southern Conference

	1994/95 Season		*1995/96 Season*		*1996/97 Season*		*Three Seasons*	
	ACC	*Southern*	*ACC*	*Southern*	*ACC*	*Southern*	*ACC*	*Southern*
β_0^F	0.09	3.55	0.33	0.23	3.44	2.04	0.90	1.76
	(2.73)	(3.45)	(4.19)	(3.20)	(2.61)	(2.81)	(1.58)	(1.76)
β_0^P	2.98	−8.25	−5.45	−11.45	1.33	7.93	−1.71	−3.13
	(5.78)	(9.51)	(6.08)	(11.09)	(7.36)	(9.04)	(3.34)	(5.62)
β_0^H	1.52	−1.75	0.85	−2.99	0.17	−4.43	1.53	−3.00
	(2.67)	(3.30)	(4.19)	(3.20)	(2.51)	(2.81)	(1.53)	(1.72)
β_0^N	1.45	−6.87	2.02	6.88	−0.15	7.39	0.09	1.82
	(5.49)	(7.32)	(6.40)	(8.32)	(6.49)	(8.17)	(3.28)	(4.32)
β_1^H	−0.19	0.28	0.74	0.38	0.08	0.69*	−0.08	0.47
	(0.57)	(0.56)	(1.44)	(0.41)	(0.49)	(0.34)	(0.34)	(0.23)
β_1^N	0.05	0.18	−0.16	−0.88	−0.69	1.12	−0.42	0.09
	(0.92)	(1.23)	(1.71)	(0.80)	(1.17)	(0.99)	(0.60)	(0.53)
β_1^F	0.94	0.50	0.28	1.28*	0.48	0.56	0.80*	0.82*
	(0.57)	(0.58)	(1.44)	(0.41)	(0.51)	(0.34)	(0.35)	(0.24)
R^2	0.29	0.21	0.27	0.45	0.29	0.42	0.30	0.38
F-statistic	0.30	0.67	0.81	1.31	0.63	1.30	0.60	1.08
n	80	80	80	78	80	80	240	238

Notes:
This table reports the results of estimating equation (2). The regression is estimated separately on intra-conference games within the Atlantic Coast Conference (ACC), which is considered the high information market, and the Southern Conference, which is considered the low information market. Standard errors are reported in parentheses. The F-statistic tests the null hypothesis that $\beta_0^F = \beta_0^P = \beta_0^H = \beta_0^N = \beta_1^H = \beta_1^N = 0$ and $\beta_1^F = 1$. Failure to reject the null hypothesis implies market rationality in these markets. Coefficients statistically different from zero at less than the 0.05 level are denoted with *.

(iii) Tests of Forecast Accuracy

While we find that differences in information availability across these conference betting markets do not result in differences in efficiencies, we expect that information differences will result in differences in forecast accuracy across conferences. We examine this expectation by calculating the absolute forecast error (AFE) for each game and comparing the average errors across conferences. The absolute forecast error is calculated as follows:

$$\text{AFE} = |\text{SCORE} - \text{CLINE}|, \tag{3}$$

where SCORE and CLINE are defined as above. If increased information results in better forecast accuracy, then we should expect to find smaller absolute forecast errors in the ACC games than in the Southern Conference games.

Table 4 contains the yearly and three-year absolute forecast errors for both conferences. The forecast errors for the ACC are consistently smaller than the errors for the Southern Conference, with the three-year error significantly smaller at conventional levels. These differences suggest that in terms of pricing the game outcomes, market participants were more accurate in pricing the ACC games than in pricing the Southern Conference games.[12]

While the above comparisons of forecast errors are appealing because the errors can be cast in terms of points and therefore easily visualized, a statistical test of the error variances from the original regression estimations reported in Table 3 is possible. The error variance is a measure of the degree to which the closing line and other explanatory variables in our model cannot explain the actual game outcome. Consistent with the differences in forecast errors, we expect that if information differs across conferences and information availability affects price accuracy, the error variances will be different across conferences. More specifically, the error variance in the low information conference (i.e., the Southern Conference) should be greater than the error variance of the high information conference (i.e., the ACC). To determine whether the differences in error variances are significant, we calculate an F-statistic by dividing the mean square error for the Southern Conference by the mean square error for the ACC. In each year, the F-statistic exceeds the critical value for conventional levels of significance, confirming that market participants were more accurate in pricing the ACC game outcomes than in pricing the Southern Conference game outcomes. The relevant error variances and *F*-statistics are reported in Table 4.

As stated earlier, we assume that the ACC and the Southern Conference are relatively homogeneous in nature. One area in which they differ is the total number of points scored per game. For our three-year sample, Southern Conference teams scored a total of eight more points per game than ACC teams. This heteroskedasticity, which might arise from differences in player ability, officiating, or some other factor(s), may account for the increased error variance in the Southern Conference.

To test whether the error variance of the conference games increases with the number of points scored, we employed the Goldfeld-Quandt test. The Goldfeld-Quandt test requires that the data first be ranked on the variable suspected to be causing the heteroskedasticity. The data is then divided into thirds, the middle third is eliminated, and the regression is estimated on each of the two remaining groups. An *F*-statistic is then calculated with the two regression error variances to test for equality between the variances. An *F*-statistic that is insignificantly different from one implies that error variances are not different across the two groups, which indicates that the variances are not a function of the identified variable. We applied the Goldfeld-Quandt test to both conferences over the three-year period, and the resulting *F*-statistics were not significantly different from one at conventional levels. Thus, differences in points scored cannot explain the differences in error variances.

(iv) Robustness Tests

A natural question concerning our conclusions is whether they are robust to the inclusion of other conferences or simply a product of the ACC and the Southern Conference. We address this question by conducting similar tests across two groups of conferences. The first group is comprised of the three conferences that have the highest RPI ratings in a given year (Top 3) while the second group is comprised of the three conferences that have the lowest RPI ratings in each year (Bottom 3).[13] Conferences included in this comparison for at least one year include the ACC, the Big 12 Conference, the Big

Table 4

Comparison of Forecast Accuracy Across the Atlantic Coast Conference and the Southern Conference

	1994/95 Season		*1995/96 Season*		*1996/97 Season*		*Three Seasons*	
	ACC	*Southern*	*ACC*	*Southern*	*ACC*	*Southern*	*ACC*	*Southern*
Games Played	80	80	80	78	80	80	240	238
Absolute Forecast Error	7.43**	10.03	7.95***	11.54	7.88*	9.73	7.75***	10.42
Error Variance	105.19	158.95	97.27	204.52	95.68	147.67	96.80	171.26
F-statistic	1.51*		2.10***		1.54*		1.77***	

Notes:
Absolute forecast errors (AFE) on intra-conference games within the Atlantic Coast Conference (ACC) and the Southern Conference are calculated as follows: AFE = |SCORE − CLINE|. SCORE is the points scored by the home team less the points scored by the visiting team. CLINE is the closing line from Stardust Race and Sports Book stated on a home team basis. Error variances are the residual sum of squares from the regressions estimated in Table 3. The *F*-statistic is calculated by dividing the error variance of the Southern Conference by the error variance of the ACC. Absolute forecast errors that are statistically different across conferences at less than the 0.05 (0.01) [0.001] level and *F*-statistics that are statistically different from one at less than the 0.05 (0.01) [0.001] level are denoted with * (**) [***].

East Conference, and the Big 10 Conference in the high information group and the Southern Conference, the Ivy League, the Sun Belt Conference, and the Big Sky Conference in the low information group. Thus, almost half of all 17 conferences are represented in the comparisons to some degree.

Table 5 reports the results of the estimation of equation (2) for the Top 3 and Bottom 3 conferences. Although the null hypothesis that $\beta_0^F = \beta_0^P = \beta_0^H = \beta_0^N = \beta_1^H = \beta_1^N = 0$ and $\beta_1^F = 1$ can be rejected at the 0.05 level for the three conferences at the bottom of the RPI rating in the 1995/96 season, it cannot be rejected at conventional levels for either group of conferences over the three seasons.

Table 6 reports the absolute forecast errors, the error variances, and the *F*-statistics for each group of conferences. Over the three year window, the three conferences at the top of the RPI rankings exhibit significantly lower absolute forecast errors and significantly lower error variances than the three conferences at the bottom of the RPI rankings. Thus, our conclusions appear to be robust to the inclusion of additional conferences.

5. SUMMARY

This study examines whether differences in the availability of information across markets result in different efficiencies in price formation across those markets. Several studies of the relative efficiencies of the US stock markets have found evidence consistent with the hypothesis that differing markets exhibit different relative efficiencies. However, conclusions in such studies are limited by the inability to establish fundamental stock values.

We show that for markets within the NCAA basketball betting market, where fundamental values are known with certainty, efficiency in price formation differs across those markets. More specifically, participants in the betting markets of conferences with greater (lesser) information availability mis-price the fundamental values of the conference games to a lesser (greater) degree. Such evidence supports the conclusions reached in studies of stock markets suggesting that differences in fundamental information result in different relative pricing efficiencies across those markets.

Table 5

Tests of Market Rationality in the Conferences with the Highest and Lowest RPI Ratings

	1994/95 Season		*1995/96 Season*		*1996/97 Season*		*Three Seasons*	
	Top 3	*Bottom 3*	*Top 3*	*Bottom 3*	*Top 3*	*Bottom 3*	*Top 3*	*Bottom 3*
β_0^F	−1.26	0.69	−1.26	0.84	0.63	−1.97	−0.39	−0.08
	(1.12)	(1.35)	(1.57)	(1.78)	(1.20)	(1.69)	(0.81)	(0.91)
β_0^P	1.06	−7.45	−5.77	−7.99	−0.68	7.48	−2.04	−2.92
	(4.43)	(6.47)	(4.19)	(7.46)	(4.03)	(6.94)	(2.40)	(4.03)
β_0^H	−0.77	−0.55	0.40	−1.70	0.96	−2.15	0.26	−1.20
	(1.55)	(1.32)	(1.49)	(1.74)	(1.17)	(1.64)	(0.78)	(0.89)
β_0^N	3.00	−7.67	4.16	2.10	−1.03	8.68	2.08	2.13
	(2.92)	(4.37)	(3.33)	(3.39)	(3.82)	(4.71)	(1.85)	(2.21)
β_1^H	0.08	−0.05	0.01	0.06	−0.01	0.41	0.03	0.10
	(0.28)	(0.14)	(0.21)	(0.23)	(0.17)	(0.22)	(0.11)	(0.11)
β_1^N	0.20	0.26	−0.04	−0.81*	0.05	−0.45	0.10	−0.50
	(0.42)	(0.61)	(0.41)	(0.39)	(0.51)	(0.62)	(0.24)	(0.27)
β_1^F	1.06*	1.00*	0.98*	1.20*	0.89*	1.12*	0.95*	1.10*
	(0.28)	(0.15)	(0.22)	(0.22)	(0.17)	(0.23)	(0.12)	(0.11)
R^2	0.36	0.44	0.35	0.46	0.41	0.43	0.38	0.43
F-statistic	0.56	1.05	0.93	2.22*	0.29	1.63	0.89	1.70
n	225	222	239	196	286	220	750	638

Notes:
This table reports the results of estimating equation (2). The regression is estimated separately on intra-conference games within the three conferences with the highest RPI ratings each year, which are considered the high information markets, and the three conferences with the lowest RPI ratings each year, which are considered the low information markets. Standard errors are reported in parentheses. The *F*-statistic tests the null hypothesis that $\beta_0^F = \beta_0^P = \beta_0^H = \beta_0^N = \beta_1^H = \beta_1^N = 0$ and $\beta_1^F = 1$. Failure to reject the null hypothesis implies market rationality in these markets. *F*-statistics and regression coefficients significantly different from zero at the 0.05 level are denoted with *.

Table 6

Comparison of Forecast Accuracy Across Conferences with the Highest and Lowest RPI Ratings

	1994/95 Season		*1995/96 Season*		*1996/97 Season*		*Three Seasons*	
	Top 3	*Bottom 3*	*Top 3*	*Bottom 3*	*Top 3*	*Bottom 3*	*Top 3*	*Bottom 3*
Games Played	225	222	239	196	286	220	750	638
Absolute Forecast Error	8.49	8.65	8.96*	10.32	8.11*	9.43	8.49**	9.43
Error Variance	120.41	120.49	122.46	155.49	104.08	136.35	110.18	138.74
F-statistic	1.00		1.27*		1.31*		1.22**	

Notes:
Absolute forecast errors (AFE) on intra-conference games within the three conferences with the highest RPI ratings each year and the three conferences with the lowest RPI ratings each year are calculated as follows: AFE = |SCORE − CLINE|. SCORE is the points scored by the home team less the points scored by the visiting team. CLINE is the closing line from Stardust Race and Sports Book stated on a home team basis. Error variances are the residual sum of squares from the regressions estimated in Table 5. The *F*-statistic is calculated by dividing the error variance of the low RPI conferences by the error variance of the high RPI conferences. Absolute forecast errors that are statistically different across conferences at less than the 0.05 (0.01) [0.001] level and *F*-statistics that are statistically different from one at less than the 0.05 (0.01) [0.001] level are denoted with * (**) [***].

NOTES

1 Racetrack and baseball betting markets have also received attention from researchers. However, these markets are based on the odds of winning rather than on the point spread estimates of the game being played.

2 In addition to the studies comparing markets within the US, there have also been studies conducted that analyze the relative efficiency of markets around the world (see Barnes, 1986; and Antoniou, Ergul, Holmes and Priestly, 1997).

3 The 'eleven for ten' rule dictates a payoff of $21 for each $11 bet on the team beating the spread. Suppose that the point spread resulted in one bettor of $11 for each team. The bookmaker receives $22 and pays $21 to the winning bettor. Therefore, regardless of the outcome of the game, the bookmaker earns a riskless profit of $1.

4 Results from Gandar et al. (1998) are consistent with closing lines reflecting information from both the bookmaker and market participants.

5 We limit our analysis to intra-conference games to avoid the inclusion of games involving teams from other conferences that may have differential information availability.

6 Some conferences, such as the Central Collegiate Hockey Association, are formed specifically for non-basketball sports.

7 Bookmakers often do not post lines for games between smaller schools and for games in which significant uncertainty exists (e.g., whether or not a star player will participate).

8 Such an assumption is consistent with the assumption made by stock market researchers that differing degrees of information are available on the stocks that are traded in the three major US stock markets (i.e. the NYSE, the AMX and the OTC market).

9 The basic formula of the RPI consists of the following: 25% is made up of the team's winning percentage; 50% is the opponents' average winning percentage; and 25% is made up of the opponents' opponents' average winning percentage. There is an undisclosed adjustment that the NCAA makes to the basic formula of the RPI to compute the official RPI. It is not expected that this adjustment is significant enough to cause our use of the basic formula of the RPI to be problematic. Incidentally, the official RPI is used as a factor in selecting the teams that will participate in the NCAA tournament and the seeding of the teams that make the tournament (Palm, 1998).

10 Note that the Southern Conference is ranked last in each of the three years and the ACC is ranked first in two years and second in the other.

11 See Dare and MacDonald (1998) for a detailed discussion of the merits of equation (2) and the conditions for market efficiency.

12 Because the purpose of testing forecast errors was to determine the effect on price formation of differential information across markets, we based the forecast errors on closing lines, which reflect information from both the bookmaker and market participants. In light of Gandar et al.'s (1998) results on line changes, a natural question is whether the differences in price formation that we found were a product of the bookmaker's opening line, line changes resulting from participant betting, or both. Basing forecast errors on opening lines (that is, bookmaker price formation only), we find similar differences in price formation across the ACC and Southern Conference. Additionally, we find no evidence that line changes move the

lines towards game outcomes more for one conference than another.

13 The three conferences with the highest average RPI ratings for the sample period are the ACC, the Big 12 Conference, and the Big East Conference. However, the Big East Conference has the third highest average RPI rating due primarily to its strength in only one of the three sample years, 1994/95. The Big East Conference finishes sixth and fifth during the years 1995/96 and 1996/97, respectively. The fourth and fifth strongest conferences, as measured by the three-year RPI rating, had similar variability with regard to the RPI rating for each of the sample years. As a result, the intra-conference games from the top three teams during each separate sample year comprise the high information group. Similar variation in rankings occurs at the bottom of the RPI list and, therefore, the intra-conference games from the bottom three teams during each separate sample year comprise the low information group.

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